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Raising Ornamental Palms

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There is no "how to" book to provide detailed information for the amateur horticulturist attempting to raise ornamental palms. Until such time as a manual of this sort is written, one must be guided by fragmentary information published on a limited number of palm species. Extensive studies have been directed toward defining the optimum conditions necessary for the germination and culture of only a few species of economically significant palms. Some data are available for many of the extensively cultivated ornamental palms as well as a lesser number of rarer species. These must be applied by analogy to species of unknown horticultural requirements. I report herein the results of my efforts to germinate and grow a number of species both common and rare hoping that some of the information presented will promote a more successful propagation of these palms.

All of the horticultural work was done in a greenhouse in the southwest section of the San Fernando Valley, Los Angeles, California. The climate in this area at an elevation of about 950 feet is insulated by the Santa Monica Mountains (approx. 1,500 ft. high) from the moderating effect of the Pacific Ocean some nine miles distant. The climate is Mediterranean—mild, moderately rainy winters and hot, dry summers. Table 1 gives the monthly average maximum and minimum temperatures observed over the past several years. Maximum temperature in the greenhouse is usually 5–10° F above the outdoor maximum, but occasionally it is a few degrees below when hot dry winds blow from the desert. The minimum temperature is maintained at 55° F by an electric space heater (5 kw) and thermostat controlled bench cables distributing 12 watts/ft^2.

The greenhouse consists of a 9′ × 12′ × 10′ high redwood and glass structure plus an attached 9′ × 7′ × 10′ high redwood and acrylic structure lined with polyethylene film but without space heat. Air circulation (other than from heater) is by natural convection through vents operated by a "heat motor" (a thermally operated hydraulic cylinder). Summer shading of the glass is provided in part by overhanging tree limbs and the remainder by 50% Saran shade cloth. The acrylic structure is not shaded. No provision exists for automatic humidity control.

Plant and Seed Acquisition

I have found it advantageous to remove as much of the potting medium as possible from newly acquired palm seedlings or plants without seriously disturbing the roots and to replace it with a potting mix of my own. The rationale for this procedure is first that the old mix will most probably have a different capacity for retaining moisture or absorbing nutrients and second that it is more convenient to provide all my plants with a common potting medium rather than to change my

Table 1. Average Monthly Temperature Maxima and Minima (Superscript is the number of days minimum temperature fell to 32° F or below. Subscript is the lowest minimum recorded during the month.)

	1974		1975		1976		1977		1978		1979		1980		7-year average	
Month	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
JAN	57	39_{25}^{4}	65	38_{24}^{7}	68	37_{24}^{7}	59	37_{28}^{7}	58	40_{30}^{3}	53	34_{22}^{11}	60	42_{32}^{1}	60	38^{6}
FEB	67	37_{30}^{3}	63	37_{29}^{5}	63	40	71	40_{31}^{1}	61	40_{31}^{1}	60	35_{30}^{10}	64	42_{30}^{3}	64	39^{3}
MAR	66	42_{31}^{1}	64	38_{30}^{3}	68	38_{26}^{4}	62	35_{28}^{8}	66	44	64	39_{28}^{2}	62	38	65	39^{3}
APR	78	42	63	38_{29}^{3}	67	39_{31}^{1}	75	41	65	41	70	41	70	42	70	41^{1}
MAY	76	48	78	45	78	47	68	42	79	46	74	46	67	44	74	45
JUNE	90	51	78	48	88	50	83	51	86	50	85	51	81	47	84	50
JULY	93	57	99	53	88	56	94	53	91	53	89	53	92	55	92	54
AUG	90	54	89	52	86	52	90	57	86	53	84	55	85	55	87	54
SEP	92	54	89	55	78	57	82	51	86	54	93	55	83	51	86	54
OCT	76	49	74	45	81	50	79	48	81	50	75	47	80	46	78	48
NOV	71	41	68	39_{27}^{5}	73	46	73	43_{32}^{1}	61	38_{28}^{6}	65	39_{27}^{2}	68	40_{32}^{1}	68	41^{2}
DEC	60	38_{27}^{5}	64	39_{30}^{4}	64	37	62	43_{32}^{1}	55	32_{22}^{17}	63	38_{27}^{6}	66	39_{29}^{3}	62	38^{5}

watering and fertilizing regimen to suit a diversity of other media. Since adopting this practice, loss of plants has been reduced due particularly to decreased fungal attack (damping off). If the root structure has been unduly disturbed, I treat with a vitamin B_1 solution in addition to the usual fungicidal treatment.

By far the most common means of propagating palms is from seed. Division of plants (limited to those which produce suckers) is also much practiced while air layering or ground layering is used only infrequently on a few species which can develop roots along the stem. Virtually all articles on palm horticulture stress the importance of promptness in planting seeds since those of many if not most species lose viability rather quickly (De Leon 1958). All soft fruit tissue should be removed and the seed should then be washed, dried, and treated with a fungicide as soon after collection as possible. The seed is then either planted or packaged in polyethylene bags together with a small amount of damp peat moss for transport to the planting site for prompt planting.

Germination

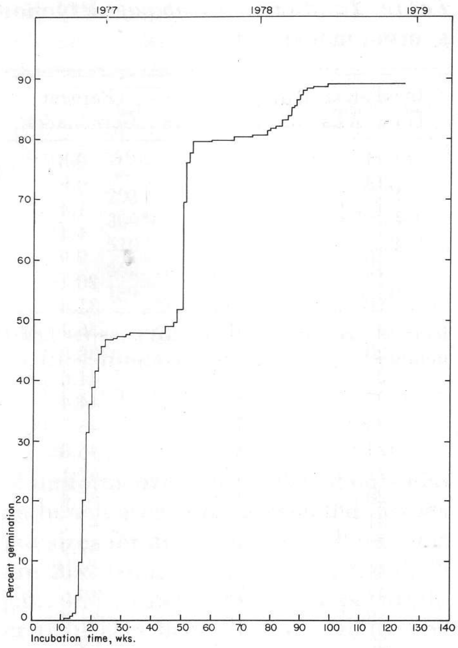
My seed bed is a 2′ × 10′ area, enclosed on the back and sides with polyethylene film and located under a bench in the glasshouse. It is equipped with a thermostatically controlled cable at 12 watts/ft² of bottom heat set to maintain a minimum temperature of 70–72° F at the seed depth during the winter months. The cable is buried in a 2″ bed of vermiculite which supports the seed containers. For seed that might be more readily germinated at a higher temperature, I have a second seed bed maintained at 80° F at the seed depth. This bed is located indoors and consists of a hot pad on which is placed a 12″ × 15″ aluminum roasting pan enclosed by Styrofoam sides and polyethylene film top, back and front. The seed containers are supported by 2″ of crushed lava rock. A Gro-lux fluorescent lamp 8″ above the seed bed operates for 15 hours per day on an automatic timer. With this arrangement the more tender seedlings can be grown until they are large enough to be transplanted and placed in the glasshouse. All seeds in either seedbed are planted individually rather than in community pots for the following reasons: 1) root damage on transplanting from seed bed to bench pot is nearly eliminated, 2) other seed and seedlings are undisturbed when an individual seedling reaches size for transplanting, 3) germination time, speed (to be discussed later), and percentage are easily observed. With this system a larger seedbed is required but the decreased loss of many rare species on transplanting justifies it.

Two sizes of seed containers are used for all but a relatively few species that either have very large seed or exceptional germinating requirements. Seed up to 0.5″ dimensions are planted in 1″ × 1″ × 2¾″ deep containers which I make by cutting a vacuum formed polystyrene 196 unit cavity tray into individual units with an electrically heated Nichrome wire (caution: wire must not be more than dull red or plastic will catch fire). The individual containers are unable to stand unaided and are placed in an uncut cavity tray for support in the seedbed. For larger seed (up to 1.5″ dimensions) the standard 2¼″ × 2¼″ × 3¼″ plastic liners are used.

There are probably as many formulas for germinating media as there are horticulturists using them. The general requirements for a medium are well known: 1) retention of moisture, 2) porosity and good drainage, and 3) sterility. The components of the germination mixture that I use were selected on the basis of availability and economy rather than by comparative testing. Equal parts by volume of peat moss, vermiculite, and well washed silicious beach sand are used. The first two components have good moisture retention and all three are porous and sterile. The mixture packs firmly holding the seed in place without restricting penetration of the emerging roots and it is easily tapped out of the container without crumbling. The heavier sand inhibits washing away of the other lighter components during watering. In the absence of information to the contrary all seed are covered to a depth of ⅛″–¼″ depending on their size.

Since the seedbed is open on one side to the glasshouse environment it is watered daily with a fine spray. At this time an inspection is made for seed germination which I shall define as the appearance of the plumule or ligule above the planting medium and not the initial (and usually unobserved) extension of the cotyledon out of the seed.

Several methods of reporting germination time are in common practice. The most prevalent method records the time from planting of the seed batch until the first seedling emerges (Loomis 1958). A second method is to report the time to emergence of the first seedling, the speed or time to 50% of the final germination, and the final percent germination (Rees 1963). The germination is considered complete if after a given (albeit arbitrary) interval no further seedlings emerge (e.g., 10 consecutive days with no germination for *Elaeis guineensis*). A third method is to measure percent of germination as a function of time. I use the last method because it gives more information than the first two, particularly



1. Germination of *Ptychosperma macarthuri*.

on the length of time the seed remains viable under incubation. An illustration of the three methods and the information each conveys is provided by a planting of seeds from an entire infructescence of *Ptychosperma macarthuri* (363 seed) on 24 July 1976.

Method 1: Germination time, 74 days.
Method 2: First germination, 74 days. Half of total seedlings up, 157 days (22 weeks, 3 days). Percent germination, 89.3%.
Method 3: See Tables 2 and 3 and Figure 1 (wherein incubation time is given in weekly increments rather than daily for brevity). The last viable seed germinated after 862 days incubation.

I do not terminate the incubation period arbitrarily but continue it until all

Table 2. Germination of Ptychosperma macarthuri

Incubation Time, Wks	No. Seedlings	Percent Germination
11	1	0.3
13	3	0.8
14	5	1.4
15	16	4.4
16	36	9.9
17	73	20.1
18	114	31.4
19	131	36.1
20	141	38.8
21	151	41.6
22	161	44.4
23	166	45.7
24	170	46.8
27	171	47.1
28	172	47.4
31	173	47.7
32	174	47.9
44	178	49.0
47	180	49.6
48	188	51.8
50	253	69.7
51	276	76.0
52	283	77.7
53	289	79.6
59	290	79.9
67	292	80.4
73	293	80.7
78	296	81.5
79	297	81.8
81	298	82.1
83	302	83.2
85	304	83.7
86	309	85.1
87	310	85.4
88	314	86.5
89	317	87.3
90	320	88.2
91	321	88.4
93	322	88.7
98	323	89.0
124	324	89.3

seed have either germinated or are no longer viable, i.e., show evidence of rotting or a missing embryo on a semiannual inspection. Note that if the second method had been used (with termination of incubation after 10 consecutive days without germination) incubation would have been stopped on the 176th day and the periodicity of the germination would not have been observed (cf. Braun 1968, p. 54). Interestingly the periods of maximum germination rate are at about eight month intervals and thus do not correlate with seasonal influences. I have noted that the seedlings which emerge near the end of the incubation period are often less vigorous and succumb to diseases more easily than those having a shorter incubation. In many cases the primary root of the dead seedling is found to be stunted or absent altogether.

In addition to the planting of *Ptychosperma macarthuri* discussed above, data on four other seed batches and two literature reports are presented in Table 3 to emphasize the variability of germination among different plantings. Note that two of these batches were planted at the same time and under the same conditions.

It is obvious from even a casual perusal of horticultural articles that many widely differing results in germination of a given palm species are attributed to "old seed." While viability is surely affected by prolonged storage time, numerous other factors such as 1) incubation temperature, 2) moisture and oxygen content of the seed bed, 3) presence of naturally occurring or inadvertently introduced germination inhibitors, 4) presence of fungi and molds, or 5) the differing environmental conditions under which the seed matured, are not often considered by the average palm horticulturist. Almost never considered by other than botanists is the possibility that the seed may be a hybrid and not that of a pure species. Since a large part (if not the major part) of the seed distributed by the Seed Bank is obtained from cultivated sources without controlled pollination rather than from the

Table 3. Variability of Germination in Ptychosperma macarthuri

Total No. Seed	Seed Source	Date Planted	Germination, Days			Percent Germination
			First	Last	½ of total	
ca. 100	a	—	58	—	—	—
14	b	2/12/62	78–108	—	—	57.1
27	c	9/ 3/72	91	293	233	85.2
16	d	10/14/73	258	309	273	93.8
27	c	7/24/76	205	510	369	77.8
363	e	7/24/76	74	862	157	89.3
10	f	12/18/77	90	189	147	60.0

a, Indian Botanic Garden, Calcutta, India (Basu and Mukherjee, 1972); b, The Palm Society Seed Bank (School, 1962); c, Foster Botanical Garden, Honolulu, HI; d, Hirose Nursery, Hilo, HI; e, Sheraton Kauai Hotel, Kauai, HI; f, Pauleen Sullivan, Ventura, CA.

wild, the potential for obtaining hybrid seed is high. Thus, one or more hybrids and/or the true species could be produced on the same infructescence and each seed type could exhibit different qualities, e.g., germination time or viability, under comparable incubation conditions.

Germination data for a number of species are presented in Table 4 in the same form as was done for *Ptychosperma macarthuri* (Table 3), i.e., method 2. This method rather than the more informative method 3 is used because the rather small seed batch sizes, lack of repetitive plantings, and usually undocumented species purity do not justify the space required to publish more complete data. However, the incubation time for the last viable seed is also included. For those seed batches the incubation of which was incomplete at the time this manuscript was submitted, the data are given parenthetically and are subject to revision. All seeds were planted individually with the exception of the 1980 planting of *Chrysaliocarpus lutescens.*

Culture

Because of the limited growing area available and the fact that more pots of uniform size can be placed on a given bench area, I have selected just six pot sizes for my collection. These sizes are 2¼″ (square), 4″, 1 gal., 2 gal., 5 gal., and 15 gal. I use plastic pots rather than clay because they reduce the watering requirements. No problems normally associated with soggy overwatered soil have been encountered with the growing medium that I use since it drains very well.

The growing medium is the same as that used for seed germination (1 volume each of peat moss, vermiculite, and beach sand) plus up to an additional volume of sandy loam. If any information is available on the optimum pH for growth of a particular species, I add additional peat moss to increase acidity or crushed egg shells (limestone) to increase alkalinity.

Except for the sandy loam the constituents of the growing medium are almost devoid of nutrients. I supply the three basic nutrients (nitrogen, phosphorus and potassium) in the form of medium granular MagAmp (7-40-6) manufactured by W. R. Grace Chemical Company and available at nursery supply dealers. The nutrients are derived from magnesium ammonium phosphate and magnesium potassium phosphate, both of which have very low

Table 4. Germination of Various Palm Species

Species Name	Seed Source[a]	Date Planted[b]	Total No. Seed[c]	Germination, Days First	Last	½ of total	Percent Germination
Acoelorraphe wrightii	PG	5/ 8/74	27	358	(1,142)	(416)	(70.4)
	PG	5/23/78	10	78	1,096	430	80
Acrocomia antioquiensis	81-PS-122 (W-1)	6/15/81	4	(–)	(–)	(–)	(0)
Aiphanes acanthophylla	FTG	7/ 7/74	2	—	—	—	0
	RBG	10/16/79*	2	62	121	62	100
A. caryotaefolia	PG	6/30/80	12	42	(44)	(42)	(16.7)
A. lindeniana	FG	7/24/76	1	—	—	—	0
Archontophoenix alexandrae	PG	6/29/80	11	13	193	24	81.8
A. cunninghamiana	HBG	9/21/74	8	154	262	230	100
	PG	9/21/74	18	77	288	169	66.7
A. sp. (Purple Crownshaft)	W-2	5/25/80	24 (8 GOA)	32	67	33	25
	PG	6/29/80	8	(–)	(–)	(–)	(0)
A. sp.	PG	6/29/80	18	23	32	26	61.1
Areca hutchinsoniana	PS(W-3)	5/20/79	12	37	189	57	58.3
A. ipot	PS	5/17/79	8	—	—	—	0
A. triandra	F-1233	7/24/76	12	297	649	309	66.7
	PS	2/25/79	10	119	133	121	100
A. vestiaria	F-80	9/ 3/77	11	132	177	137	100
	PG	12/18/77	10	127	168	155	70
	PS	11/23/78	10	78	189	83	90
A. sp. "concinna"	L66.539	6/30/80	6	186	323	258	100
A. sp.	F-1768	9/ 2/72	17	111	268	245	70.6
	F-1768	7/24/76	6	282	336	309	83.3
A. sp.	80-PS-177 (W-4)	9/30/80	12	(–)	(–)	(–)	(0)
A. sp.	81-PS-11	1/17/81*	15	20	27[d]	20	33.3
Arenga caudata	PG	12/18/77	10	226	451	286	80
A. engleri	HBG	7/12/81	17	56	(79)	(62)	(17.6)
A. pinnata	80-PS-170	9/30/80	12	280	(354)	(284)	(66.7)
A. porphyrocarpa	PS(W-5)	5/16/74	15	148	792	461	80
	PG	6/29/80	17	185	(410)	(247)	(64.7)
A. tremula	80-PS-220	11/ 7/80	55	247	(324)	(292)	(41.8)
A. sp.	FG71.466	7/24/76	9	374	752	488	77.8
A. sp.	F-3	6/29/80	20	70	(388)	(326)	(35)
Asterogyne martiana	PS	7/28/79	15	—	—	—	0
	81-PS-155	8/ 3/81	23	(–)	(–)	(–)	(0)
Bactris jamaicana	W-6	11/14/76	7	—	—	—	0
Basselinia eriostachys	80-PS-258 (W-7)	1/ 7/81*	16	79	79[d]	79	6.3
	80-PS-258	1/ 7/81	22	172	(185)	(190)	(40.1)
B. pancheri	80-PS-142 (W-8)	8/16/80	10	(–)	(–)	(–)	(0)
B. sp.	80-PS-143 (W-9)	8/16/80	24	—	—	—	0
B. sp.	81-PS-49	2/21/81	20	(–)	(–)	(–)	(0)
Brahea armata	PG	7/16/78	67	47	(639)	(102)	(92.5)
B. brandegeei	PG	1/12/76	12	365	(812)	(566)	(66.7)
	PG	2/ 4/79	14	162	(556)	(464)	(78.6)
B. edulis	LACA	3/18/75	7	151	598	272	100

Table 4. Continued

Species Name	Seed Source[a]	Date Planted[b]	Total No. Seed[c]	Germination, Days First	Last	½ of total	Percent Germination
Burretiokentia vieillardii	80-PS-259	1/ 6/81	13	170	(242)	(180)	(30.8)
	80-PS-259 (W-10)	1/ 6/81*	12	86	168[d]	86	33.3
Butia capitata	PG	10/15/72	1	278	~643 (twin)	278	100
	HBG	11/18/75	7	968	(1,789)	(968)	(28.6)
	PG	9/20/76	17	636	(–)	(636)	(5.9)
B. capitata × *Jubea chilensis*	PS	8/ 4/77	9	284	704	306	44.4
F-2 hybrid (mesocarp removed)	PS	9/ 6/78	6	313	313	313	16.7
Calamus ornatus	PS	11/17/78*	8	76	88	76	25
C. reysianus	79-PS-180	11/22/79	16	93	126	120	37.5
	79-PS-180	11/22/79*	16	46	97[d]	54	50
C. siphonocanthus	81-PS-50	2/21/81	16	133	(167)	(137)	(37.5)
C. vitiensis	PS	8/ 8/78	5	—	—	—	0
Calyptrocalyx spicatus	PG	6/29/80	4	22	42	31	100
Calyptronoma rivalis	PS	5/25/79	51	43	183	43	88.2
Carpentaria acuminata	PS	3/30/74	19	—	—	—	0
	FG	7/24/76	17	212	350	320	64.7
	PG	12/18/77	10	157	225	186	70
Caryota cumingii	FG	9/10/71	4	178	322	214	75
C. griffithii	FG64.290	6/29/80	5	—	—	—	0
C. mitis	PG	10/14/73	50	216	346	260	92
	PG	7/24/76	111	114	482	177	90.1
C. urens	FTG	7/ 7/74	6	100	100	100	16.7
C. sp. "plumosa"	F-1815	7/24/76	10	142	180	142	20
	FG	6/29/80	10	60	351	81	100
	LA	6/29/80	7	62	(98)	(80)	(71.4)
C. sp.	PG	7/24/76	6	200	350	200	33.3
Ceroxylon quindiuense	80-PS-12	2/17/80	15	(–)	(–)	(–)	(0)
Chamaedorea cataractarum	PS	2/25/78	55	44	47	44	3.6
	PS	1/13/79	20	34	34	34	5
	PS	1/14/79*	15	11	27	15	20
C. costaricana	79-PS-71	8/ 1/79	32 (4 GOA)	15	(436)	(31)	(14.3)
C. elegans	PG	8/16/80	3	347	(347)	(347)	(33.3)
C. erumpens	PG	3/20/74	6	84	125	111	100
	PG	8/ 9/80	18	27	(57)	(34)	(77.8)
C. glaucifolia	PG	6/ 1/78	36	43	(409)	(52)	(50)
C. graminifolia	PS	3/24/74	12	—	—	—	0
C. microspadix	PG	1/12/76	36	196	271	217	100
C. oblongata	PS	5/24/79	15	86	(846)	(443)	(53.3)
C. radicalis	PS	4/25/74	16	124	687	132	93.8
C. seifrizii	PS	4/20/74	19	107	(1,941)	(141)	(94.7)
C. seifrizii hybrid	80-PS-236	12/11/80	18	234	(234)	(234)	(5.5)
C. tepejilote	PS	2/25/78	14	31	98	33	85.7
C. sp.	W-11	3/24/74	2	—	—	—	0
C. sp.	PS	5/11/74	15	—	—	—	0
Chamaerops humilis	PG	9/ 5/73	1	282	282	282	100
	PG	1/19/75	13	75	276	261	30.8
	PG	10/19/75	5	55	91	60	80

Table 4. Continued

Species Name	Seed Source[a]	Date Planted[b]	Total No. Seed[c]	Germination, Days First	Last	½ of total	Percent Germination
Chrysalidocarpus lutescens	PG	9/ 2/72	7	43	259	156	100
	PG	9/ 3/72	9	66	140	101	100
	PG	7/ 3/75	16	110	110	110	6.3
	PG	7/ 2/80	531	54	(218)	(96)	(97.7)
Clinosperma bracteale	80-PS-144 (W-8)	8/16/80	10	(–)	(–)	(–)	(0)
Clinostigma onchorhynchum	81-PS-78	4/ 8/81	23	87	(153)	(99)	(39.1)
		4/ 8/81*	23	47	69	66	21.7
C. samoense	80-PS-30	3/31/80	20	157	(–)	(157)	(5)
	(W-12)	3/31/80*	10	170	(–)	(170)	(10)
Coccothrinax fragrans	PS	2/ 3/79	25	205	(345)	(205)	(8)
C. sp.	PG	6/29/80	10	61	87	71	80
Cocos nucifera	PG	9/21/72	7	303	303	303	28.6
Copernicia prunifera	FG	9/ 1/72	8	300	319	319	25
Cryosophila nana	PG	3/11/73	11	58	90	70	72.7
C. warscewiczii	81-PS-56	2/21/81	20	—	—	—	0
C. sp.	MSP	6/29/80	3	36	57	47	100
Cyphokentia macrostachya	80-PS-190	10/11/80	14	(–)	(–)	(–)	(0)
Cyphophoenix nucele	PS(W-13)	8/22/74	13	39	78	60	46.2
Cyrtostachys lakka	PS	4/30/78	21 (2 GOA)	15	45	15	31.6
	PS	6/ 1/78	50 (29 GOA)	8	33	18	14.3
Daemonorops loheriana	79-PS-194	12/15/79	20	20	74	43	35
	79-PS-194	12/15/79*	26	14	84	26	61.5
D. mollis	79-PS-154	10/21/79	15 (2 GOA)	159	(267)	(252)	(23.1)
	81-PS-7	1/14/81*	15	28	159[d]	53	73.3
D. sparsiflora	79-PS-207	12/29/79*	12	52	85	70	100
Desmoncus orthacanthos	PS	2/ 1/79*	7	143	190	164	85.7
Dictyosperma album var. *album*	PG	9/21/76	62	144	363	293	71
D. album var. *aureum*	PS	3/24/74	15	—	—	—	0
Drymophloeus beguinii	PG	7/ 7/74	4	49	57	52	75
D. pachycladus	80-PS-140	8/12/80	10	—	—	—	0
Elaeis guineensis	PG	6/27/80	6	(–)	(–)	(–)	(0)
E. oleifera	PG	6/29/80	7	(–)	(–)	(–)	(0)
Euterpe purpurea	80-PS-189 (W-14)	10/11/80	12	65	111	71	91.7
E. sp.	PS	10/27/77	16	46	120	62	50
E. sp.	PS	2/ 3/79	13 (4 GOA)	5	66	49	100
E. sp.	PG	6/30/80	12	33	56	43	91.7
E. sp.	81-PS-104 (W-15)	5/15/81	18	122	(122)	(122)	(5.5)
Gastrococos crispa	80-PS-147	8/16/80	10	(–)	(–)	(–)	(0)
Geonoma interrupta	PS	2/25/79	80	37	(74)	(47)	(63.6)
G. pinnatifrons	PS	8/1/77	30	770	770	770	3.3
G. schottiana	79-PS-160	10/21/79	12	500	(613)	(613)	(41.7)
	80-PS-59	5/ 9/80*	19	49	242[d]	110	78.9
G. sp.	PS	9/19/77	20	117	201	157	20

Table 4. Continued

Species Name	Seed Source[a]	Date Planted[b]	Total No. Seed[c]	Germination, Days: First	Germination, Days: Last	Germination, Days: ½ of total	Percent Germination
G. sp.	W-16	3/24/74	7	—	—	—	0
Gulubia costata	81-PS-96	5/16/81	22	—	—	—	0
	81-PS-96	5/16/81*	18	—	—[d]	—	0
G. macrospadix	79-PS-150	10/20/79	26	129	163	151	15.4
Heterospathe negrosensis	80-PS-65	5/20/80	33	37	(209)	(80)	(60.6)
	80-PS-65 (W-17)	5/20/80*	12	69	111	85	66.7
H. philippinensis	80-PS-76	6/ 2/80	22	24	45	28	18.2
	80-PS-76 (W-18)	6/ 2/80*	12	49	49	49	8.3
H. sibuyanensis	80-PS-36	4/25/80	23	—	—	—	0
	80-PS-36	4/25/80*	12	—	—	—	0
H. woodfordiana	PG	6/29/80	5	(–)	(–)	(–)	(0)
H. sp.	80-PS-194	10/11/80	13	25	57	29	30.8
H. sp.	80-PS-195	10/11/80	26	92	92	92	3.8
Howea belmoreana	PG	8/ 5/73	5	—	—	—	0
	PG	9/18/73	4	—	—	—	0
H. forsteriana	PG	8/ 5/73	4	(–)	(–)	(–)	(0)
	PG	9/18/73	15	1,694	(–)	(1,694)	(6.7)
	PG	4/20/75	10	811	811	811	10
	PG	7/15/78	14	396	(611)	(396)	(14.3)
	PG	7/15/78	12	(–)	(–)	(–)	(0)
Hydriastele wendlandiana	PS	1/ 8/78	8	185	232	189	62.5
H. sp.	PS	2/ 3/79	10	—	—	—	0
Hyophorbe lagenicaulis	FG	7/24/76	4	348	357	349	75
	PS	10/12/78	15	255	(1,021)	(261)	(86.7)
H. verschaffeltii	PG	12/18/77	10	181	609	195	70
	LA	6/29/80	14	374	(374)	(374)	(7.1)
Hyphaene crinita	PG	9/26/76	1	—	—	—	0
H. thebaica	FG	8/ 1/76	1	—	—	—	0
Iriartea ventricosa	81-PS-171 (W-19)	8/21/81	6	21	38	29	83.3
I. sp.	81-PS-164 (W-20)	8/21/81	10	(–)	(–)	(–)	(0)
Jessenia sp.	PSSB-28	6/25/77	6	13	20	13	100
Jubaea chilensis	HBG	9/21/74	3	(–)	(–)	(–)	(0)
	PG	7/15/78	1	—	—	—	0
Korthalsia laciniosa	81-PS-34	2/ 9/81*	15	45	81[d]	61	60
Laccospadix australasica	PS	2/ 3/79	10	45	167	52	40
Latania loddigesii	PG	6/27/80	8	47	47	47	12.5
Licuala grandis	PS	11/23/78	20	70	(165)	(106)	(45)
	PS	5/20/79*	39	87	308[d]	168	33.3
	PS	5/20/79	11	124	(299)	(202)	(54.5)
	PG	7/ 9/79	14	108	227	145	71.4
L. lauterbachii var. *bougainvillensis*	PS	2/ 3/79	15	(–)	(–)	(–)	(0)
L. ramsayi	PS	11/17/78	10	197	381	207	90
L. spinosa	FG	9/10/71	10	238	273	246	40
	FG	7/24/76	22	321	(399)	(321)	(9.1)
L. sp. "elegans"	PS	5/31/74	10	849	1,149	860	90

Table 4. Continued

Species Name	Seed Source[a]	Date Planted[b]	Total No. Seed[c]	Germination, Days First	Last	½ of total	Percent Germination
Linospadix monostachya	PS	3/26/74	22	130	499	203	81.8
	PS	3/ 9/78	19	—	—	—	0
	PS	11/22/79	61	228	(244)	(228)	(9.8)
Livistona chinensis	PG	6/29/80	9	35	53	48	44.4
L. eastoni	79-PS-104	8/30/79	11	379	(740)	(740)	(27.3)
L. loriphylla	PS	3/29/74	22	64	131	94	36.4
L. merrillii	80-PS-169	9/30/80	20	170	(321)	(296)	(85)
L. muelleri	PS	1/ 8/78	14	20	44	30	85.7
L. rigida	W-21	5/25/80	20	55	(424)	(412)	(30)
L. robinsoniana	PG	6/29/80	10	—	—	—	0
L. rotundifolia var. *luzonensis*	PS	1/29/79	15	171	259	199	66.7
	PG	7/15/79	31	35	(237)	(42)	(80.6)
L. sp. "blackdownsii"	PS	7/ 1/78	14	41	99	56	78.6
L. sp.	FG71.519	7/24/76	1	—	—	—	0
Mauritia sp.	PS	1/16/78	6	201	(–)	(201)	(16.7)
Microcoelum weddellianum	PS	5/11/74	13	70	77	70	15.4
Nengella sp.	81-PS-88	4/30/81*	12	—	—[d]	—	0
Neodypsis decaryi	PS	9/ 6/78	10	9	37	21	50
Neoveitchia storckii	PS	5/19/79	8	64	87	68	75
Normanbya normanbyi	PS	12/23/77*	8	14	21	14	75
	PG	7/ 1/80*	6	—	—	—	0
Oncosperma tigillarium	FG	7/24/76	4	74	297	74	50
Opsiandra maya	PS	3/26/74	12	117	129	117	16.7
	80-PS-212	10/29/80	11	23	(268)	(237)	(63.6)
	80-PS-212	10/29/80*	11	20	34	26	90.9
Orania sp.	PS	1/28/78*	3	59	62	59	66.7
Orbignya sp.	PG	6/27/80	3	179	179	179	33.3
Phoenix canariensis	PG	1/16/77	29	43	275	55	89.7
P. dactylifera	PG	11/ 6/75	6	53	80	59	100
P. humilis hybrid	LACA	3/18/75	3	88	106	88	66.7
P. roebelenii	PG	10/13/73	13	174	258	209	76.9
	PG	1/19/75	11	—	—	—	0
P. rupicola	PS	7/ 6/78	12	—	—	—	0
Physokentia insolita	81-PS-132	7/18/81	12	(–)	(–)	(–)	(0)
Pigafetta filaris	PS	2/ 4/79	45	90	178	105	84.4
	PS	2/ 4/79*	6	23	101	23	33.3
Pinanga barnesii	80-PS-254	6/ 1/81*	15	20	47[d,e]	29	86.7
P. copelandii	79-PS-65	8/ 3/79	12	52	145	53	100
P. coronata	PG	7/ 7/74	10	49	89	67	90
	PG	11/14/76	12	126	237	134	50
	PG	12/18/77	10	85	170	93	50
	LA	6/29/80	10	35	(58)	(42)	(80)
P. dallasensis	79-PS-156	10/21/79	12	(–)	(–)	(–)	(0)
P. elmeri	79-PS-184	11/22/79	38	30	138	58	63.2
P. geonomaeformis	PS	2/10/79	24	142	142	142	4.2
	79-PS-21	4/13/79	25	36	77	46	44
P. insignis	PS	1/14/79*	2	—	—	—	0
	PS	2/ 3/79	23	124	432	124	8.7
P. isabelensis	79-PS-155	10/21/79	36	129	—	129	2.8

Table 4. Continued

Species Name	Seed Source[a]	Date Planted[b]	Total No. Seed[c]	Germination, Days First	Last	½ of total	Percent Germination
P. maculata	PS	4/13/79	9 (1 GOA)	—	—	—	0
P. merrillii	79-PS-181	11/22/79	38	16	129	73	65.8
P. mooreana	PS(W-22)	1/ 8/78	5	—	—	—	0
P. patula	FG	9/10/71	12	110	227	149	50
P. philippinensis	80-PS-22	3/18/80	20	85	(315)	(112)	(75)
P. polymorpha	81-PS-161 (W-23)	8/21/81	10	(–)	(–)	(–)	(0)
P. sp. (black crownshaft)	79-PS-68	8/ 4/79	20	51	114	75	45
P. sp. (orange crownshaft)	79-PS-67	7/28/79	16	47	238	71	93.8
P. sp. (purple crownshaft)	79-PS-66	8/ 3/79	15	52	84	74	73.3
P. sp. (white crownshaft)	PS	2/16/79	25	100	392	118	24
P. sp.	PG	10/14/73	32	98	293	140	84.4
P. sp.	79-PS-31	5/12/79	65	49	(396)	(76)	(35.4)
P. sp.	79-PS-32	5/12/79	15	68	157	86	80
Prestoea montana	79-PS-171	11/ 8/79	15	32	64	38	80
	PG	6/29/80	25	(–)	(–)	(–)	(0)
Pritchardia affinis	W-24	7/ 1/80	10	58	(89)	(75)	(30)
P. beccariana	PG	7/ 1/80	3	308	(308)	(308)	(33.3)
P. pacifica	PG	9/10/72	42	44	260	73	33.3
	PG	7/24/76	14	51	110	84	35.7
P. thurstonii	PS	11/ 9/77	22	51	124	63	50
	PG	6/29/80	35	28	(41)	(33)	(80)
P. sp.	PG	7/24/76	26	73	132	90	84.6
P. sp.	FG	9/ 3/77	6	—	—	—	0
P. sp.	MSP	7/ 1/80	2	—	—	—	0
Ptychosperma angustifolium	FG	9/ 2/72	3	112	345	226	100
P. elegans	PS	5/28/74	21	67	100	70	14.3
	PG	5/23/78	17	55	254	91	23.5
	PG	6/29/80	16	21	82	32	93.8
P. hospitum	LA	6/27/80	10	71	(319)	(71)	(40)
P. microcarpum	PS	6/27/74	7	46	48	46	28.6
	80-PS-100	7/11/80	15	17	(47)	(35)	(46.7)
P. propinquum	L66.312	6/29/80	19	53	(–)	(53)	(5.3)
P. sanderianum	PG	7/ 7/74	9	64	325	72	77.8
P. sp. (prob. hybrid "*P. nicolai*")	PG	6/27/80	22	82	(412)	(350)	(63.6)
P. salomonense	FTG	7/ 7/74	6	33	40	36	100
	79-PS-59	7/ 5/79	15	51	(64)	(51)	(26.7)
P. sp.	WBG72.636	6/27/80	6	29	214	29	100
P. sp.	80-PS-98	7/11/80	14	53	(350)	(76)	(71.4)
P. sp.	FG	6/27/80	8	73	(381)	(341)	(75)
Reinhardtia gracilis	PS	2/ 1/79*	10	52	122	52	20
R. gracilis var. *rostrata*	PS	6/28/79	12	47	109	71	58.3
R. simplex	FG	9/ 2/72	9	119	234	134	100
	FG	7/24/76	8	—	—	—	0
	PS	7/28/79	12	(–)	(–)	(–)	(0)
Rhapidophyllum hystrix	PS	2/ 4/79	15	195	(–)	(195)	(6.7)
Rhapis humilis	PG	7/24/76	22	—	—	—	0
Rhopaloblaste sp.	PS	4/25/74	10	46	63	50	70

Table 4. Continued

Species Name	Seed Source[a]	Date Planted[b]	Total No. Seed[c]	Germination, Days First	Last	½ of total	Percent Germination
Rhopalostylis baueri	PG	11/16/80	32	73	(202)	(91)	(90.6)
R. cheesemanii	81-PS-98	5/15/81	14	(–)	(–)	(–)	(0)
R. sapida	PG	9/21/76	18	(–)	(–)	(–)	(0)
	PG	11/14/76	18	94	195	114	100
	PG	2/13/77	21	—	—	—	0
	PG	7/15/78	7	72	(–)	(72)	(14.3)
	PG	1/27/80	44	62	(601)	(151)	(72.7)
Rhyticocos sp.	MSP	6/29/80	8	(–)	(–)	(–)	(0)
Roystonea sp. (*regia*?)	PG	5/23/78	38	54	(717)	(140)	(68.4)
Sabal causiarum	PG	5/ 1/75	10	60	114	74	90
S. mauritiaeformis	FG	7/24/76	17	108	616	176	82.4
S. mexicana	LACA	3/18/75	57	92	917	180	98.2
S. minor	LACA	3/18/75	19	133	548	495	57.9
S. palmetto	NBG	10/ 8/75	13	349	349	349	7.7
	PG	1/21/77*	32	37	99	55	62.5
S. uresana	PS	1/28/78*	12	25	903[d]	25	83.3
S. sp.	PG	7/ 7/74	4	39	40	39	75
S. sp.	PG	7/ 5/75	13	34	68	36	92.3
Serenoa repens (green)	PS	2/ 4/79	10	—	—	—	0
(blue)	PS	2/ 4/79	25	—	—	—	0
Syagrus comosa	80-PS-148	8/16/80	10	40	(55)	(47)	(50)
S. coronata	FG	6/29/80	10	40	(44)	(40)	(40)
Synechanthus warscewiczianus	PS	7/28/79	10	25	41	25	20
Trithrinax acanthocoma	PG	5/20/79	34	105	(448)	(217)	(38.2)
Veillonia alba	81-PS-108	5/16/81*	12	—	—[d]	—	0
Veitchia arecina	L64. 2794	6/27/80	6	55	105	75	83.3
V. joannis	FG	7/24/76	3	93	93	93	33.3
	PG	6/27/80	4	48	120	59	100
V. macdanielsii	LA	6/27/80	6	32	(100)	39	(83.3)
V. merrillii	PG	9/ 1/72	17	24	35	28	94.1
	PG	7/ 3/75	2	31	(–)	(31)	(50)
	PG	4/30/78	3	42	45	45	100
	PG	7/ 9/79	7	23	28	24	100
V. montgomeryana	LA	6/27/80	6	32	(71)	40	83.3
V. sessilifolia	LA	6/27/80	6	41	(54)	(41)	(33.3)
Washingtonia filifera	W-25	11/11/79	50	25	145	40	100
Wettinia fascicularis	80-PS-202 (W-26)	10/20/80	12	(–)	(–)	(–)	(0)

[a] Abbreviations used refer to the following sources:

The Palm Society Seed Bank
- PS
- PSSB-number
- year-PS-number

Botanical Gardens
- FG / F-number—Foster Botanical Garden, Honolulu, HI
- FTG—Fairchild Tropical Garden, Miami, FL
- HBG—Huntington Botanical Garden, San Marino, CA
- RBG—Royal Botanic Garden, Kew, Surrey, England
- LACA—Los Angeles County Arboretum, Acadia, CA
- LA / L-number—Lyon Arboretum, Honolulu, HI

Table 4. Continued

MSP—Manuka State Park, HI
NBG—National Botanic Garden, Washington, D.C.
WBG—Wahiawa Botanic Garden, Wahiawa, HI
Private Gardens—PG
Wild (W) (days between collection and planting if known)
1. San Joxónime Antioquia, Colombia (31 days)
2. Mt. Lewis, Queensland, Australia
3. Nabua, Sorsogon Province, Philippines
4. Island off Manado, Celebes (80 days)
5. John Dransfield #4180
6. Rat Trap, Jamaica
7. Near Pontrihoven, New Caledonia (24 days)
8. Mt. Do, New Caledonia (between 16–47 days)
9. Tchamba Valley, New Caledonia (between 16–47 days)
10. Mt. Aoupinit, New Caledonia (23 days)
11. Robert W. Read #74-98, Panama
12. Near Pago Pago, Tutuila Is., American Samoa (21 days)
13. Seed Bank Expedition, Lifou Is., Loyalty Islands
14. Depto. de Antioquia, Cocorná, Colombia (27 days)
15. San Carlos, Antioquia, Colombia (55 days)
16. Robert W. Read #74-59, Panama
17. Near Nabua, Philippines (44 days)
18. Near Real, Quezon, Philippines (59 days)
19. Tarapoto, Peru (28 days)
20. San Francisco de Ichó, Chocó, Colombia (37 days)
21. Northwest Queensland, Australia
22. John Dransfield #5313, Sq. Medalam, 4th Div., Sarawak
23. Cameron Highlands, Malaysia (39 days)
24. Punaluu, HI (14 days)
25. Palm Canyon, Anza-Borrego State Park, CA (1 day)
26. Santa Rita, Municipio de Guatapé, Antioquia, Colombia (59 days).

[b] Asterisk (*) indicates 80° F incubation temperature; others 70–72°F.

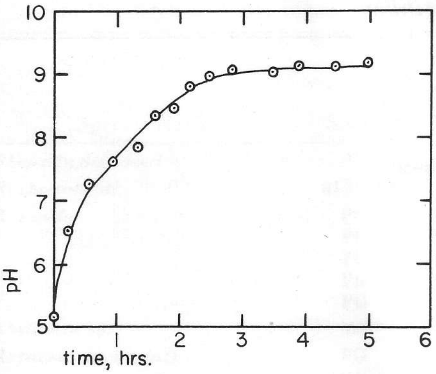
[c] A parenthetical number and the letters GOA indicate the number of seed in the planting which were germinated on arrival.

[d] Germination terminated on 24 June 1981 by a fire which destroyed seedbed.

[e] Of the 13 seedlings obtained 6 had mottled reddish leaves and 7 had uniformly dark green leaves.

solubility in water. Thus the nutrients are not leached out quickly by the daily watering, but are released in a controlled manner over a 6–12 month period. The pH of pure water in contact with granular MagAmp changes with successive leachings at 0.25–0.5 hr intervals from slightly acid to basic and stablizes at about pH 9 (Fig. 2). The MagAmp is incorporated in the planting mix at the volume rate of 1 oz/gal. of mix. Not only does the low solubility of this fertilizer diminish leaching losses but with inadequate watering the dissolved material returns to the solid state so that buildup of soluble nutrient salts and subsequent burning of the plant do not occur. Twice a year a top dressing of MagAmp is applied. For convenience of application of iron I moisten the MagAmp granules and coat them with an iron chelate powder.

The time for transplanting seedlings from the seed bed containers depends not only on the growth characteristics of the species (see Tomlinson 1960 for types of seedling development) but on the vigor of the individual plant. Species in which seed germination is



2. pH of successive leachings of MagAmp.

characterized by a downward extension of the cotyledon often have a thick primary root protruding from the container at the time the plumule is first observed. Such plants are transferred to larger pots immediately. Palms which have a fine root structure or slow growth rate can often remain in the germination container (with subsequent fertilization) for periods up to a year or more. Usually I transplant seedlings to the next larger pot size when the second juvenile leaf emerges. For those species that develop the seedling adjacent to the seed (as opposed to those with extended cotyledons), I repot the seedling at a shallower depth than in the seedbed such that the seed is almost completely exposed. I have found that this procedure decreases loss of seedlings from damping off.

Ideally young palms should be moved up to larger pots before excessive crowding of the roots limits the growth because of restricted availability of water and nutrients. Often the growth rate of palms is slowed and their stature diminished when they are raised in containers. Thus, if the growing space available is limited the desire to encourage rapid growth can sometimes be subordinated to increasing the variety and size of the collection.

The environment provided by the greenhouse not only benefits the plants growing therein, but pests as well. Probably the most damaging in my experience is the red spider mite. This tiny arachnid, barely visible to the unaided eye, feeds by sucking the plant juices and in so doing injures a small spot on the leaf. With a life cycle of only three to four days, large numbers of these spiders develop rapidly so that the more susceptible palm species can be severely stunted or even killed by a heavy infestation. A periodic spraying of the foliage with either Malathion or Diazinon (according to the label directions) serves to keep the population in check. Between sprayings an application of a systemic insecticide to the soil around the more susceptible species serves to keep them alive. Mealy bugs and occasional aphids are also controlled by these sprays. Snails and slugs do not appear to cause much damage to the palms (as long as there is a supply of other foliage plants present) but periodic distribution of an arsenic free metaldehyde-containing bait keeps them in check. Other pests frequently seen but doing little harm are earwigs, sow bugs, millipedes, and ants. The last, however, are active spreaders of both mealy bugs and aphids. Perhaps more annoying is the ants' preference for nesting in the greenhouse during the winter months. Whenever nests are found in the gravel benches or in a potted specimen they are sprayed with Ortho Ant and Roach Killer (manufactured by Chevron Chemical Company), containing 1% 2-(1-methylethoxy)phenylethylcarbamate and 82.3% petroleum distillate as active ingredients. Although the label directions for this product specifically state not to use it on any vegetation, I have routinely given both an infested root ball and the inside of the pot a light spraying to eliminate the nest without any evident effect on the palm. Many plants (particularly broadleaf, fern, or bromeliad) but not all are defoliated or withered by misdirected spray so that care in application is advised.

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NEWS OF THE SOCIETY

News of the South Florida Chapter

On October 17, 1981, the South Florida Chapter of The Palm Society, under new Chairman Jim McLeod, approved a 12-member Board and incorporation under the laws of the State of Florida.

The meeting was held in the Activities Center of East Ridge Retirement Village near Cutler Ridge, new home of Ted and Teddie Buhler. Jonathan Foote, plant propagator at Fairchild Tropical Garden, presented an excellent program on how to plant and/or transplant palms. He brought a large bare rooted *Ptychosperma elegans* and graphically demonstrated how palm roots grow. New roots form from the base of the trunk only, never from the severed old roots. Root pruning before moving is not essential. However, a palm should be planted as soon after being dug as possible because roots should never be allowed to dry. Jon also demonstrated on his specimen how to cut off many of the old fronds, then halve the remaining ones to lessen the exposed leaf surface and to minimize wind resistance. The spear leaf is left intact and gradually the fronds will develop until the palm is again in its full glory. Frequent watering is essential during the early period. When planting the palm a sort of saucer should be shaped at the edge of the hole to retain water. Mulching helps to keep soil cool and moist and also adds to its enrichment.

After the business meeting and program the group walked to the new palmetum where, in June 1980, Teddie had had 100 holes drilled and about 80 palms planted so far. Some are large ones from her old property but most are smaller specimens; all are doing very well thanks to the hot and humid summer weather.

Before planting, a wheelbarrow load of good soil was mixed with the ground up rocky soil that had come out of each yard wide and yard deep hole. A good layer of mulch was spread over and starting last spring the palms were lightly fertilized every month. Watering is handled by a sprinkler system covering the 250 by 50 foot area of the palmetum. After a little over a year, some of the palms are already assuming their more mature characteristics. Eric Beers was instrumental not only in supervising the plantings, but in actually putting most of the plants into the ground. Without his help it would have been well nigh impossible.

After the palmetum walk, a delicious covered dish dinner was served. It was a good meeting.