Ceylon Cocon. Q. (1972) **23**, 92-99
Printed in Ceylon.

THE PERFORMANCE OF DWARFS (*Cocos nucifera* L. variety *nana*) AS A PLANTATION CROP IN CEYLON

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Data are presented on growth, flowering and yield of dwarf green, dwarf yellow and dwarf red palms. The short leaf span of this variety makes it possible to grow about 227 palms per hectare (92 palms per acre). All three colour forms bear early when compared with the commercially grown *typica* palms. However, the dwarfs are a failure as a plantation crop for they yield not more than 1.25-2.50 tonnes of copra per hectare (half to one ton of copra per acre). As dwarf nuts are small, overall production costs per unit of copra would be high. The dwarfs yield 85-113 g. (3-4 ozs.) copra per nut, which is low in comparison with the Ceylon *typica* (226 g. or 8 oz. copra per nut).Nevertheless, the dwarf variety constitutes a valuable source of breeding material on account of its early bearing character.

INTRODUCTION

A number of varieties and forms of the coconut palm *Cocos nucifera* L. have been identified in the different coconut growing areas of the world, of which the variety *typica* form *typica* is by far the commonest and accounts for most of the acreage under coconut cultivation. Much confusion still prevails regarding the classification of the varieties and forms, due no doubt to the different criteria used for this purpose, (Menon & Pandalai 1958, Liyanage 1958, Whitehead, 1966). However, the dwarf coconut palm has been recognized as a distinct variety from very early times (Handover 1919, Jack and Sands 1922). According to Handover (1919), the dwarf strains of coconut may have originated as a mutant of the 'tall-type' in Java. On the other hand, Swaminathan and Nambiar (1961), from a study of the cytology of this variety suggest that the dwarfs occurring in nature in different countries may be the products of inbreeding in the 'tall' variety. Some of the features of botanical interest of this variety have been described by Menon & Pandalai (1958), and Liyanage, (1958).

There are no large plantations of dwarf coconut palms in Ceylon. A few are grown mainly as ornamental palms and for the water of the tender nut used as a drink. In the absence of data on growth and yield relating to this variety an experimental block of dwarf palms was established at Ratmalagara Research Station in 1940 to study these aspects, and interim reports have been published. This paper reports on the bearing age and productivity of the three colour forms of the variety *nana*, *viz.* form *pumila* (dwarf green); form *eburnea* (dwarf ivory yellow) and form *regia* (dwarf red), and aims to assess the performance of the dwarfs as a plantation crop in Ceylon.

PLANTING MATERIAL

Source of Seed

Seednuts were taken from dwarf palms at Bandirippuwa Estate, Lunuwila, and Johanawatta Estate, Rajakadaluwa. These palms are suspected to be of "Malayan" origin. 941 open-pollinated progeny

of seed palms of the three colour forms were planted at a spacing of 6.7 × 6.7 m (22′ × 22′) on the square system at the Ratmalagara Research Station in 1939/40. This gave a planting density of 227 palms per hectare (92 palms per acre).

Routine cultural operations have been carried out during the last 30 years and the following records were maintained: Date of first flowering, yield of nuts and total weight of husked nuts per palm. The palms were re-classified in the field in 1970 into dwarf green (form *pumila*), dwarf yellow (form *eburnea*), dwarf red (form *regia*) and natural hybrids, largely on the basis of colour of petiole, inflorescence and epicarp of the nuts, as well as growth habit. As there were only a few typical dwarf red (form *regia*) palms, interest is focussed mainly on the performance of the forms *pumila* and *eburnea*.

RESULTS AND DISCUSSION

(*a*) Growth habit

The short habit and early flowering tendency are two useful attributes of the dwarf variety, and a preliminary report on these characters has been submitted earlier, (Liyanage, 1955). Differences in the growth habit among the three colour forms are evident even on a visual examination and some measurements made when the palms were 17 years old are given in table 1.

It would appear from these figures that all three colour forms are 2.6—3 m. (8-10 feet) tall, and have a smaller leaf spread 3.7 m (12 feet) compared with *typica* palms of the same age. The forms *pumila* and *regia* have a fewer number of leaves on the crown compared with the form *eburnea*, whose leaf production is of the same order as that of the variety *typica*. As each leaf axil produces an inflorescence, this would mean that the form *eburnea* bears more inflorescences and bunches per year compared with the other two colour forms. Girth of the stem also reveals an interesting feature. The Ceylon *typica* often shows massive 'bole' formation above ground level, and this may perhaps be a reflection of the degree of surface planting that is practised in Ceylon. 'Bole' formation above ground is practically absent in the three colour forms of dwarfs for their trunks are of uniform girth at the soil surface and about a metre above ground level.

(*b*) Period for flowering

The period taken for flowering from the date of transplantation is indicated in the frequency distribution for this character (table 2). The mean period for flowering is given in table 3. It will be observed from table 2 that over 60 percent of green dwarfs (form *pumila*) and red dwarfs (form *regia*) have flowered in under 60 months, compared with only 33 percent of yellow dwarfs (form *eburnea*).

Thus, the forms *pumila* and *regia* produce earlier than the form *eburnea*. The variety *nana* is known to flower much earlier than the mean flowering periods in table 3 would indicate, and the delayed flowering in this field trial may perhaps be a reflection of soil-type as well as climatic conditions during the first few years of growth. This is reflected in the period for flowering of second generation progenies of form *pumila* seed parents planted at the Coconut Seed Garden, Ambakelle in 1959 where the mean period for flowering is 36.5 months (table 4).

(*c*) Yield of nuts, copra and oil

The dwarf variety of coconuts is reported to be a heavy yielder, although the nuts tend to be small when compared with the *typica* variety.

Tables 5 and 6 give the yield of the progeny of 11 dwarf green (form *pumila*) and 10 dwarf yellow (form *eburnea*) seed parents for an eight year period. The mean yield per palm per year has varied between 53-100 nuts. As regards nut size, the form *eburnea* has an appreciably heavier husked nut than the form *pumila*. (The yield data relating to the form *regia* palms are not presented as they are few and cannot be grouped into a sufficient number of families as the other two forms). No *typica* palms were grown

in this experimental block, and therefore the yield of the dwarfs may be compared with that of *pumila* × *typica* natural cross F_1 hybrids of similar age and grown with the dwarfs (table 7). This field experiment was planted at a spacing of 6.7 × 6.7 m (22 ft. × 22 ft) on the square system giving a density of 227 palms per hectare (92 palms per acre). The yield (calculated) of nuts and copra per unit area of land is given in table 8.

During 1968/1969 nuts from the three colour forms as well as the natural hybrids were cured separately and table 9 gives the weight of copra per nut as well as copra out-turns. The forms *pumila* and *eburnea* appear to out-yield the natural hybrids (table 8). However, it needs to be emphasised, that in calculating these figures, a planting density of 227 palms per hectare (92 palms per acre) has been used for the forms *pumila* and *eburnea* compared with 158 palms per hectare (64 palms per acre) for the natural hybrids, the latter being the normal planting density in Ceylon for *typica* as well as hybrid palms. Furthermore, in a crop where the kernel weight is economically important the number of nuts alone is no criterion of productivity. Weight of copra and copra out-turn constitute a better index of production. It will be observed from table 9 that 8,600-12,250 nuts of dwarf varieties are required for a ton of copra compared with 6,500 nuts of the natural hybrids. The out-turn of Ceylon *typica* is about 4,000-5,200 nuts per ton of copra, (Liyanage, 1958). Thus, when overall production costs are taken into account all forms of dwarfs appear to be a failure as a plantation crop compared with the commercially grown *typica* variety. In this regard it is reported that in Jamaica the Malayan dwarf out-yields the tall variety (Harries 1970, Smith 1970, Romney 1971). According to Smith *loc. cit.* "the use of dwarf varieties among several crop plants has resulted in more plants per acre and thereby an increase in yield. The Jamaican farmer has been virtually forced to accept Malayan dwarf palms in the absence of any alternative disease-resistant, coconut". Thus, the production of Jamaican "Talls" has been discontinued since 1967, and the issue of dwarf seedlings has risen to 488,000 in 1968 and about 500,000 seedlings in 1969, (Shaw 1971).

The form *pumila* (which has the smallest nut) has a slightly higher oil content when compared with the forms *eburnea* and *regia*, (table 10). However, when the size difference in the nuts of the three colour forms is taken into account, the production of oil per unit area of land may be the same in all three colour forms of dwarf although this aspect was not studied.

The dwarf coconut palm constitutes a source of valuable breeding material, largely on account of its early-bearing character. Increasing use is now being made of all colour forms of dwarfs for the large scale production of *typica* × *nana* hybrids in Ceylon and elsewhere.

ACKNOWLEDGEMENTS

This field trial was initiated by Mr. W. V. D. Pieris former Geneticist. Dr. D. V. Liyanage, former Botanist and presently F.A.O. Coconut Replanting Officer, Tonga, was also associated with this over a number of years. Grateful acknowledgement is made to both of them as well as to the Staff, Division of Botany and Plant Breeding, who participated in continuous recording of these palms and processing of data.

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Table 1—Growth Measurements

	Height of palms to base of crown		*Girth of stem* 6″ (15cm) *above ground*		3 *ft.* (90 *cm*) *above ground*		*Spread of leaves*		*No. of leaves*
	(*ft.*)	(*metres*)	*inches*	*cm*	*inches*	*cm*	*ft.*	*metres*	
Form *pumila* (green)	8.5	2.6	26.6	66	24.3	61	12.0	3.7	27.8
Form *eburnea* (yellow)	10.4	3.2	32.9	83	26.3	66	12.4	3.8	32.6
Form *regia* (red)	9.7	2.9	27.4	68	24.5	61	12.2	3.7	29.7
Typica	22.2	6.7	55.3	139	35.1	89	16.2	4.9	32.1

Table 2—Frequency distribution of period for flowering

Period for flowering Months	*form pumila*	*form eburnea*	*form regia*	*natural hybrids*
≤ 30	—	—	—	—
31 — 36	1	—	1	—
37 — 42	4	1	—	—
43 — 48	81	11	6	4
% in flower at 48 months	**26.1**	**5.6**	**22.5**	**3·7**
49 — 54	71	23	13	6
55 — 60	60	36	4	7
% in flower at 60 months	**66.0**	**33.3**	**60.0**	**15.9**
61 — 66	75	45	4	24
67 — 72	19	28	3	13
73 — 78	9	21	6	22
79 — 84	1	27	1	7
≥ 85	8	21	2	24

Table 3—Mean period for flowering

Variety	*No. of palms*	*Mean period for flowering (months)*
Nana form *pumila* (dwarf green)	327	56.6
Nana form *eburnea* (dwarf yellow)	214	67.2
Nana form *regia* (dwarf red)	40	60.0
Natural hybrids (from cross pollination of dwarfs)	107	72.6

Table 4—Period for flowering of form *pumila* (second generation) progenies planted at the Coconut Seed Garden, Ambakelle

Original Seed parent	*No. of progenies*	*Mean period for flowering months*
344 (dwarf green)	21	36.6
1712 ,,	17	37.7
1731 ,,	47	36.3
1482 ,,	18	36.4
1822 ,,	46	36.5
2646 ,,	29	34.7
2647 ,,	56	35·7
2649 ,,	67	36.5
2662 ,,	40	38.0
2663 ,,	106	37.3
2706 ,,	64	35.5

Mean flowering period (511 progenies) 36.5 months

Table 5—Yield of dwarf green (form *pumila*) progenies for an eight-year period

		1955		1956		1957		1958		1959		1960		1961		1962	
Mother Palm	*No. of Progenies*	*No. of nuts*	*Wt. of husked nuts (lb.)*	*No. of nuts*	*Wt. of husked nuts (lb.)*	*No. of nuts*	*Wt. of husked nuts (lb.)*	*No. of nuts*	*Wt. of husked nuts (lb.)*	*No. of nuts*	*Wt. of husked nuts (lb.)*	*No. of nuts*	*Wt. of husked nuts (lb.)*	*No. of nuts*	*Wt. of husked nuts (lb.)*	*No. of nuts*	*Wt. of husked nuts (lb.)*
2647DG	25	1387	1038	2303	1577	1509	952	2176	1180	1938	966	1911	1296	1936	974	2615	1980
2649	34	2022	1487	2407	1684	1714	1115	2526	1545	2159	1131	2756	1826	2123	1138	3610	2489
2646	9	495	433	810	527	625	423	666	417	825	678	866	625	699	382	885	882
2662	28	1446	1157	2354	1647	1766	1140	2005	1198	2216	1168	2688	1796	1843	983	2814	1908
2663	37	1880	1715	3045	2095	2452	1649	2843	1693	2901	1490	3406	2443	2680	1413	3880	2909
2706	23	1090	777	1747	1166	1116	652	1656	993	1527	710	1910	1241	1340	675	2020	1411
1731	11	553	456	705	505	553	331	766	466	698	364	791	550	798	422	890	645
1822	16	886	708	1327	897	1039	683	1229	706	1380	691	1481	1011	1141	660	1823	1281
1712	11	496	411	617	424	584	370	638	376	608	291	807	527	755	418	946	656
1713	7	411	344	478	347	479	341	475	282	457	231	637	460	471	235	677	514
1482	9	510	392	796	535	603	380	831	454	752	371	917	651	756	408	975	751
Total	210	11176	8918	16589	11404	12440	8036	15811	9310	15461	8091	18170	12426	14542	7708	21135	15426
Nuts/palm		53		79		59		75		74		86		69		100	
Wt./nut (lb.)			0.80		0.69		0.65		0.59		0.52		0.69		0.53		0.73
Wt./nut (g)			362		312		294		267		235		312		240		330

Table 6—Yield of dwarf yellow (form *eburnea*) progenies for an eight-year period

		1955		1956		1957		1958		1959		1960		1961		1962	
Mother Palm	*No. of Progenies*	*No. of nuts*	*Wt. of husked nuts (lb.)*	*No. of nuts*	*Wt. of husked nuts (lb.)*	*No. of nuts*	*Wt. of husked nuts (lb.)*	*No. of nuts*	*Wt. of husked nuts (lb.)*	*No. of nuts*	*Wt. of husked nuts (lb.)*	*No. of nuts*	*Wt. of husked nuts (lb.)*	*No. of nuts*	*Wt. of husked nuts (lb.)*	*No. of nuts*	*Wt. of husked nuts (lb.)*
60DY	9	465	508	545	633	433	357	500	597	524	444	609	821	508	494	787	892
88	10	460	530	842	985	475	468	646	802	627	555	759	940	691	639	944	1189
61	15	1392	964	1582	1122	1765	947	1222	957	2350	1074	1503	1138	2598	1416	1925	1470
82	13	619	838	1046	1624	748	847	694	889	960	915	1212	1504	842	908	1222	1510
55	15	682	793	933	968	617	590	878	889	655	636	892	1073	892	862	1346	1555
47	7	457	699	405	557	493	644	455	656	495	610	564	885	518	843	746	1050
26	11	680	833	796	866	659	649	895	612	689	620	1002	1196	838	815	1245	1526
3	5	236	271	306	319	215	173	301	323	274	204	363	390	286	239	371	410
79	10	484	607	802	886	633	639	660	773	602	466	1020	1173	612	524	1038	1173
80	14	617	750	795	861	699	728	683	788	709	652	958	1279	676	760	1207	1363
Total	109	6092	6793	8052	8821	6737	6042	6934	7286	7885	6176	8882	10399	8461	7500	10830	12138
Nuts/palm		56		74		62		64		72		81		78		99	
Wt./nut (lb.)			1.11		1.09		0.89		1.04		0.79		1.18		0.88		1.12
Wt./nut (g)			502		493		403		471		357		534		398		507

Table 7—Yield of *pumila* × *typica* natural hybrids

	1955	1956	1957	1958	1959	1960	1961	1962
Mean yield/palm/year ..	78	74	77	81	90	99	105	122
Weight/nut (lb.) ..	1.31	1.38	1.16	1.36	1.12	1.48	1.36	1.50
Weight/nut (g) ..	593	625	525	616	507	670	616	679

Table 8—Yield of nuts

	1955	1956	1957	1958	1959	1960	1961	1962
Yield per Hectare	12043	17952	13407	17043	16815	19542	15679	22724
Form *pumila** Yield per Acre	4876	7268	5428	6900	6808	7912	6348	9200
Yield per Hectare	12725	16815	14088	14543	16361	18406	17724	22496
Form *eburnea** Yield per Acre	5152	6808	5704	5888	6624	7452	7176	9108
Yield per Hectare	12330	11697	12172	12804	14227	15649	16598	19270
Natural hybrids† Yield per Acre	4992	4736	4928	5184	5760	6336	6720	7802

* Planting density 92 palms/acre — 227 palms/hectare
† Planting density 64 palms/acre — 158 palms/hectare

Table 9—Copra out-turn of the variety *nana* and natural hybrids

Type	*No. of nuts cured*	*Weight of copra* (*lb.*)	(*kg*)	*weight of copra per nut* (*oz.*)	(*gm*)	*Nuts/ton of copra* (*approx.*)
form *pumila*	15002	2740	1243	3.00	85	12,250
form *eburnea*	17841	4626	2103	4.00	113	8,650
form *regia*	2677	673	305	4.00	113	8,900
natural hybrids	17354	5920	2685	5.50	156	6,550

Table 10—Oil content (percent—dry basis)

	Date of pick/percent oil					
Type	7.9.68	5.11.68	21.1.69	1.3.69	30.5.69	6.10.69
form *pumila*	70.02	66.12	71.23	70.83	72.23	69.89
form *eburnea*	67.01	66.12	69.62	68.29	68.24	66.05
form *regia*	69.04	—	69.23	66.79	67.90	66.02
Natural hybrids	67.79	66.87	71.18	69.62	70.12	69.90

Source: *Ceylon Cocon. Q.* **20**:41 and **21**:19