OIL PALM YIELDS IN NEW BRITAIN

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ABSTRACT

Yield, bunch weight, male inflorescence and leaf analysis data are presented for the only mature plots of oil palms in New Britain. The palms are mainly 1959 plantings of dura x tenera *material from Malaysia, and all records are from plots in East New Britain. Very high yields of 35 tons of fresh fruit bunches per hectare per annum were recorded for three successive years on the Keravat block, which received a fertilizer application, but reduced yields on the other plots in the last year probably indicated nutrient stress.*

Leaf analysis data show low and declining nitrogen and magnesium levels. Sulphur is also declining, and there was apparently a response to all three nutrients in leaf levels, and probably yields, after fertilizing at Keravat. Other nutrients appear in adequate supply, although very low manganese levels of around 40 parts per million were recorded.

Excellent climatic conditions and the volcanic ash soil appear to be responsible for the high yields. Another plot in the same series in West New Britain, with similar soils but heavier rainfall in the wet season, was not yield-recorded but growth was good and the palms should be capable of similar yields.

INTRODUCTION

Commercial plantings of oil palms in Papua New Guinea only commenced in 1967 in West New Britain, and no yield data are available yet, but the favourable rainfall distribution and fertile volcanic soils should mean that high yields can be achieved. The purpose of this paper is to give yield and associated data from the few existing plots of mature oil palms in New Britain.

The oil palm, although grown in many parts of the tropics, produces its highest yields in south-east Asia. For example, Ng Siew Kee (1968) gives yield data for the range of soils used for oil palms in West Malaysia, which has the largest area of high-yielding palms. The coastal alluvial clays, represented by the Selangor series, are regarded as the best soils, and they can give 22 to 30 metric tons of fresh fruit bunches (f.f.b.) per hectare per annum under good management. The other major classification, referred to as the "inland" soils, can give 20 to 25 tons per hectare, quoted for the granite-derived Rengam series. The reasons for these high yields, as compared to Africa where yields are usually less than half these figures, are generally claimed to be the even rainfall distribution with no marked dry periods, and high temperatures and sunshine levels (Hartley 1967). This and general information about the oil palm and the industry in Malaysia were reviewed by Mendham (1967).

The climate at Keravat, in East New Britain, is similar to that of West Malaysia. Total annual rainfall is about 2800 mm, mean monthly rainfall varies between 170 mm and 280 mm, mean monthly sunshine between 5 and 6.5 hours per day, and daily temperatures are usually in the range 21 to 32 deg C. At Talasea in West New Britain, the climate is more seasonal. Total rainfall is about 3900 mm and the mean monthly rainfall varies between 110 mm and 700 mm, January to April being the wettest months. Sunshine varies from a mean of 3 hours per day in January to 6.5 hours per day in June. Temperatures are similar to those at Keravat.

The first observation block of oil palms in New Britain was planted at Keravat in 1934. About 12 hectares were planted with Deli *dura* seed introduced from Sumatra. The palms grew well and bore abundant fruit, although

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no records were taken. They were cut out in 1964.

In 1957 a local plantation company imported some *dura* x *tenera* seed from Malaysia, and planted some blocks on plantations in East New Britain and one in West New Britain. Some of the seed was also used to plant a block at the Lowlands Agricultural Experiment Station at Keravat, the Malaysian seed being surrounded by open-pollinated progeny from the older Keravat palms. Nursery and early field treatments for all these blocks were poor, planting being done in 1959. The spacing used was much too close, at about 7 metres triangular. All blocks contain a number of undesirable types that should have been culled in the nursery.

EXPERIMENTAL METHODS

In 1965 it was decided to clean up and commence yield-recording the Keravat block and a selection of the plantation blocks. To thin them out to something like a normal density, every second palm in every second line was removed. For the Keravat block, this left 212 palms on 1.24 hectares, or about 170 palms per hectare. Blocks were selected on two plantations, Gunanur and Taboona, in each case the plots for recording being chosen from larger blocks. Both plantations are in the drier Kokopo area, and receive about 2000 mm annual rainfall. The Gunanur plot is 1.54 hectares, and after thinning contained 253 palms, or 164 per hectare. These palms are uniformly well grown. The Taboona plot has 106 palms on 0.7 hectares, or 152 palms per hectare. These palms had grown more slowly than at Gunanur and were apparently on an area used as a food garden during the Japanese occupation.

Another plot in the same series had been planted on Numundo Plantation, about 22 km from Talasea, which is close to the present centre of oil palm development. It was not possible to yield-record this plot, which was only cleaned up in 1970, and observations only are recorded here.

The East New Britain soils are fairly uniform volcanic sands, and the soils of the trial sites are similar to those described by Graham and Baseden (1956), derived from recent volcanic ash and pumice. The soils at Numundo are also derived from recent volcanic depositions, but are of somewhat heavier texture.

Records. — Fortnightly harvesting rounds have been carried out since mid 1965. For the first year, yields were very low as the palms were still being pruned and fruit set was poor, so yields from mid 1966 to mid 1970 only are given here. Records were on a per palm basis, but only the block totals are used here. The number and weight of bunches, and the number of male inflorescences produced were recorded. Some errors were found in transcription of field notes into record books, and these may have slightly affected the 1968-69 and 1969-70 figures. However, taken over the whole year these differences would be small or negligible. Leaf samples were also taken for chemical analysis. All samples were taken from the 17th leaf, the standard one sampled on mature palms in other countries. Samples were usually taken monthly at Keravat, and at irregular intervals at Gunanur and Taboona.

Fertilizer was applied to the Keravat palms only on 3rd February, 1969, as follows, per palm:

2.3 kg ammonium sulphate

0.9 kg potassium chloride

0.9 kg magnesium sulphate

60 g manganese sulphate

Some of the earlier results in this paper have been given previously in Annual Reports (DASF 1969). A summary was also included as part of a study on oil palm growth and yield in New Britain by Mendham (1971a).

RESULTS

A summary of the yield, bunch weight and male inflorescence data is given in *Table* 1, on a yearly basis.

The most obvious feature is the very high yields being obtained. During the first year, 1966-67, the fortnightly yields were rising rapidly, and the figures given include quite low yields in the earlier part of the year. Since then the yield has remained steady at Keravat at about 35 tons per hectare, which is very high by any standards, and exceptional considering the poor treatment the palms had had previously. Yields on the plantation blocks were lower than at Keravat in the first two years, then in 1968-69 were higher, but dropped back again in 1969-70, to a level which was still high. Yields on all blocks have fluctuated, often greatly, between harvests, but no consistent seasonal pattern has emerged. This is in contrast to other countries, even Malaysia, where there is normally a high- and low-yielding part of the year.

Mean bunch weights generally increased throughout the recording period. This was partly the normal increase with age, but was also due to poorer fruit set in the first year, and possibly in the second also, mainly the result of low male inflorescence production. In Malaysia, at least 50 male inflorescences per hectare per month (600 per year) appear to be required for good fruit set (Gray 1969), and this was only exceeded on these blocks in the last two years. Some errors may have been made in the 1967-68 recordings of male inflorescences, as the system used was not fully efficient, and the actual numbers produced may have been higher. Fruit set was generally quite good in 1967-68, and a big improvement over the previous year, as can be seen from the bunch weights.

The low male inflorescence production in the first two years was almost certainly a result of the previous treatment. No fruit had been harvested from the blocks until mid 1965, so there had been little stress on the palms, from either pruning or fruit production, and the small amount of fruit produced fell to the ground and rotted. Thus the sex ratio (the ratio of female to total inflorescences) remained high. Approximately two years after heavy crops of fruit began to be taken from the palms, the sex ratio dropped greatly and a normal number of male inflorescences began to be produced. This two-year period corresponds approximately to the period between sex differentiation and flowering of an inflorescence (Hartley 1967).

Table 1. — Yield, bunch weight and male inflorescence production for three oil palm blocks in East New Britain, 1966-70

	Yield of Fresh Fruit Bunches (metric tons per hectare per annum)			
	1966-67	1967-68	1968-69	1969-70
Keravat	24.0	34.6	35.4	35.7
Gunanur	20.4	30.2	36.4	29.2
Taboona	20.4	31.5	38.8	27.9

	Mean Bunch Weight (kg)			
	1966-67	1967-68	1968-69	1969-70
Keravat	8.0	10.5	12.3	12.8
Gunanur	7.3	10.3	13.2	12.0
Taboona	7.8	9.9	11.7	11.7

	Male Inflorescence Production (per hectare per annum)			
	1966-67	1967-68	1968-69	1969-70
Keravat	425	263	890	941
Gunanur	277	219	769	729
Taboona	470	345	983	939

The main factor contributing to the high yields was the large number of bunches produced, as the mean weight per bunch was not high, and was lower than normal for palms of this age in Malaysia. The large number of bunches was due in part to higher palm density, but even the number of bunches produced per palm was higher than normal. Now that more male inflorescences are being produced, the number should drop. It may be, however, that more leaves, and hence more potential bunches, are produced under these favourable conditions of soil and climate.

The palms at Numundo in West New Britain have grown as well as the East New Britain ones, and appear healthy except for probable magnesium deficiency symptoms on some palms. The sex ratio was observed to be high after cleaning up in 1970, resulting in poor fruit set. However, the bunches that were set developed normally and there would seem to be no reason for the yielding ability there to be substantially different from the other plots, unless the more seasonal climate has a marked effect on the seasonal yield pattern or overall yields. This could come about through effects on sex ratio or fruit set — pollination could be poor in the wet season.

Nutrition. — A summary of the leaf analysis data obtained is given in *Table* 2. Tentative "critical levels" are given also. These are based on Ollagnier, Ochs and Martin (1970), with the minor elements as in Mendham (1971b). For the major elements at least, if levels drop substantially below these critical levels a response to fertilizer would be expected. However, the levels vary with different soil types and management conditions, and are only given here as a guide.

Table 2. — Leaf analysis data for three blocks in East New Britain, 1966-70
All samples 17th leaf. The figures given are means of the stated number of samples. "Critical levels" are also included for comparison (see text)

			per cent on Dry Basis					p.p.m. on Dry Basis					
		No. of Samples	N	P	K	Ca	Mg	S	Mn	Fe	Zn	Cu	B
Keravat	1966-67	9	2.40	0.159	1.37	0.61	0.39	175	39	62	35	8.9	11.9
	1967-68	16	2.23	0.170	1.23	0.67	0.20	143	44	64	20	6.1	14.8
	1968-69 a*	6	2.05	0.153	1.30	0.76	0.21	230	53	80	26	11.0	12.8
	b*	5	2.17	0.158	1.31	0.70	0.29	269	49	81	28	4.0	11.5
	1969-70	8	2.05	0.170	1.17	0.72	0.19	127	57	64	22	3.9	9.9
Gunanur	1966-67	5	2.28	0.165	1.64	0.59	0.37	190	27	62	38	7.7	13.9
	1967-68	9	2.45	0.192	1.36	0.76	0.26	115	28	59	30	6.5	13.5
	1969-70	2	2.16	0.169	1.24	0.69	0.15	104	44	49	25	5.4	10.1
Taboona	1966-67	6	2.43	0.170	1.46	0.66	0.39	175	51	64	31	6.6	13.9
	1967-68	9	2.50	0.197	1.30	0.66	0.24	137	69	62	23	6.8	13.7
	1969-70	2	2.12	0.165	1.27	0.70	0.13	121	47	71	28	5.4	9.4
"Critical levels"			2.5	0.15	1.00	0.60	0.24	150	50	60	15	5	10

* a = July, 1968 to January, 1969 (before fertilizing)

b = February, 1969 to June, 1969 (after fertilizing)

Low and declining nitrogen levels are the most important feature of these results. They would indicate a marked deficiency in Malaysia. Generally a reduction in yield is obtained if levels drop below 2.5 per cent, and visible foliar symptoms become apparent below about 2.2 per cent. However, the New Britain palms still appear quite healthy. There was apparently some response in leaf levels at Keravat to fertilizer, as they reached 2.5 and 2.4 per cent in May and June, 1969 (after fertilizer was applied in February), but then dropped again to around 2.0 per cent.

The other nutrient with clearly declining levels is magnesium. Levels were quite high initially, but dropped rapidly at Keravat. There appears to have been a response in leaf levels to this nutient also, as they increased to above the critical level after fertilizing, but have since dropped again. The most recent levels are low on all blocks, particularly Gunanur and Taboona. Symptoms resumbling magnesium deficiency, namely bronzing of the lower leaves, have been obvious on many palms in all plots since recording began, but have not become noticeably worse.

Phosphorous levels are generally adequate, and do not appear to be declining. The mean figures for potassium are well above the critical level given. However, there was apparently a response in leaf level to fertilizing. The levels were 1.1 per cent in February, March and April. 1969, 1.33 per cent in May, 1.86 per cent in June, and then there was a fall to 0.9 per cent in July and 0.8 per cent in September. These low levels did not persist subsequently.

No critical levels are available for sulphur in oil palms, as it has not been considered in overseas work. However, this nutrient has been shown to be important in most other Papua New Guinea crops, and will presumably also be with oil palms. A tentative level of 150 p.p.m. is suggested. Again there may have been a response after fertilizing at Keravat, as the levels appear to be declining on the other blocks, and for the last year at Keravat.

Manganese levels are all far lower than is normal in Malaysia, but similar to results from other Papua New Guinea samples on younger palms, so 50 p.p.m. may be a normal level here, as in Colombia (Ollagnier, Ochs and Martin 1970). On low-yielding acid sulphate soils in west Malaysia, manganese sulphate application raised leaf levels from 50 to 90 p.p.m. and gave a significant yield response (B. S. Gray, personal communication). However, a yield response in New Britain is not likely, and there is no marked response in leaf levels after fertilizing at Keravat. The other minor elements appear to have normal levels.

DISCUSSION

Very high yields have been obtained on these blocks in spite of early neglect and close spacing. About 35 tons of f.f.b. per hectare (14 tons per acre) have been obtained for the last three years of recording at Keravat. Deli *dura* material normally gives about 17 per cent oil in the bunch, and modern *tenera* about 23 per cent. The Keravat block, which is about 60 per cent *dura* x *tenera* (usually with an average of 20 per cent oil to bunch) and 40 per cent Deli *dura,* would give fruit with an average oil content of about 19 per cent. This would give about 6.5 tons of palm oil and 1.3 tons of palm kernels per hectare, which is a very high yield indeed. The more modern *tenera* material now being planted, with its higher extraction rate, will give correspondingly more oil, which at 35 tons f.f.b. per hectare would be about 8 tons of oil per hectare, or over 3 tons per acre.

However, it seems that nutrition will be important in maintaining these yields. High yields continued on the Keravat block, which was fertilized, but lower yields were recorded on the other unfertilized blocks for the last year of recording. It appears that nitrogen and magnesium particularly will be needed to maintain yields, considering the low leaf levels now being recorded on all blocks. The moderate single dressing of fertilizer applied at Keravat was apparently not enough to boost leaf levels for longer than a few months, and larger regular dressings may be needed to maintain leaf levels and yields. Sulphur levels also appear to be decreasing and there may have been a response in leaf levels at Keravat after fertilizing. Manganese levels are very low by Malaysian standards, but apparently normal for Papua New Guinea. The importance of all these factors can only be studied in a proper fertilizer trial, but these results give some clear indication as to the problems likely to be encountered.

Provided close attention is paid to nutrition, it seems that excellent yields could be obtained commercially in East New Britain, and probably West New Britain. However, the more seasonal climate in the latter, particularly the heavy wet season with reduced sunshine hours, may give greater seasonal yield fluctuation, and possibly lower overall yields. The effects on growth, sex ratio and fruit set can only be studied in further trials and by observation of commercial plantings in that district.

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