VARIATION IN NUTRIENT CONTENTS BETWEEN UPPER AND LOWER RANK LEAFLETS OF OIL PALM (*ELAEIS GUINEENSIS*)

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ABSTRACT

Chemical analysis of upper and lower rank oil palm leaflets has shown that, while differences in composition are generally small, they could occasionally affect the interpretation of results. Samples should therefore contain equal numbers of upper and lower rank leaflets.

INTRODUCTION

The leaflets of an oil palm frond are inserted at varying angles to the plane of the rachis. Generally the leaflets conform to two distinct ranks, with consecutive leaflets alternating between upper and lower ranks. There is, however, no set regularity and often two or more consecutive leaflets occur in the same rank. As lower rank leaflets are shaded by upper rank leaflets to varying degrees their physiological responses may be somewhat different to those of the upper rank. For example, magnesium deficiency symptoms are observed first in upper rank leaflets (Bull 1954).

If leaflet nutrient contents were to vary significantly with rank, samples taken for chemical analysis would need to contain the same numbers of upper and lower rank leaflets. The literature records some differences between ranks in nutrient composition but the reports are somewhat contradictory and cover only the elements Mg, K, Ca and P. Thus Bull (1954) found that upper rank leaflets had a higher magnesium concentration than lower rank leaflets and attributed this to shading. Further work in West Africa (WAIFOR 1960) showed that lower rank leaflets contained more potassium than upper rank leaflets while the opposite held for calcium. There were no consistent differences for phosphorus. The magnesium contents were lower in upper rank leaflets in young fronds (Nos. 1 to 9) but higher in upper rank leaflets of older fronds (Nos. 17 to 33). These conclusions were based on the analysis of leaflets from only one palm and therefore can hardly be considered applicable to all situations.

Because of the paucity of published data and the importance of chemical analysis in assessing the nutrient requirements of the oil palm, a number of upper and lower rank leaflet samples were collected from pilot blocks and plantations in Papua New Guinea and analysed for all essential elements except molybdenum.

EXPERIMENTAL METHODS

Leaflets were sampled from 5-year-old palms from pilot blocks at Keravat, Dami, Mosa, Bubia, Saiho, Murua, Epo and Kapogere and from Mosa Plantation. As the 17th frond is internationally accepted as the reference frond for assessment of the nutrient status of oil palms (Ollagnier *et al.* 1970), only these fronds were sampled. Three upper and three lower rank leaflets were taken from each side of the rachis midway along its length. Only the "middle thirds" of each leaflet were retained for analysis. Ten palms were sampled in each block.

The leaflet segments were oven-dried at 70 degrees C as soon as possible after collection, usually on the same day. The midribs were discarded before the laminae were ground in a Wiley mill fitted with a 1 mm stainless steel sieve. Before analysis the ground samples were dried overnight at 100 degrees C. Nitrogen was determined by the Kjeldahl method, sulphate-sulphur by the method of Johnson and Nishita (1952) and boron colorimetrically with curcumin. All other elements were determined on a single nitric-perchloric acid digest, phosphorus

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colorimetrically after reaction with ammonium vanadate/molybdate, potassium by flame photometry and the remainder by atomic absorption spectrophotometry on a Varian-Techtron AA-5 spectrophotometer.

RESULTS AND DISCUSSION

A quick perusal of the analytical results (*Table* 1) shows that upper rank leaflets often had higher concentrations of most elements than those of the lower rank. In most cases the differences were small and would have made no difference to the interpretation of the data. An analysis of variance showed that differences between upper and lower rank leaflets were significant at the 1 per cent level for N and Ca.

In a normal random sample of oil palm leaflets it would be unlikely that they would be predominantly from one or other rank. There could be a bias one way or the other, but the magnitude of any effect on elemental composition of the composite sample would generally be much smaller than the maximum differences indicated in the present series of samples. Even in these samples the interpretation of the data would have been changed in only seven instances if all upper or all lower rank leaflets had been collected. However, these few instances suggest that personnel who collect oil palm leaflets should take some care during sampling.

There could be a considerable bias towards one rank or the other if only two or three leaflets are taken from each side of the rachis. Taking a larger number would probably give more nearly equal numbers from upper and lower ranks and would be quicker than asking collectors to actually count equal numbers from the two ranks. Further investigations are indicated to determine the optimum number of leaflets which should be taken.

ACKNOWLEDGEMENTS

My thanks are due to Mr N. Mendham, formerly Oil Palm Agronomist, Dami; Mr E. K. Best, Soil Chemist, and especially Mr J. Horne, Saiho, for their interest and help in collecting samples and to Mrs K. Hietbrink for statistical analysis.

Table 1.—Concentrations of nutrient elements in upper and lower rank leaflets from oil palm 17th fronds

Sample Source	Rank	% on Dry Basis					p.p.m. on Dry Basis					
		N	P	K	Ca	Mg	SO_4-S	Mn	Fe	Zn	Cu	B
Dami	U	2.39	0.15	0.82	0.95	0.16	85	14	39	13	5.6	12.3
	L	2.32	0.15	0.80	0.93	0.17	105	13	35	13	4.5	12.8
Mosa, pilot	U	2.42	0.16	0.90	1.01	0.15	103	23	42	14	4.3	16.5
	L	2.47	0.15	0.86	0.96	0.15	101	26	43	14	4.5	16.5
Mosa, block B	U	2.56	0.14	0.92	0.90	0.21	87	52	36	12	4.8	14.5
	L	2.34	0.13	0.85	0.83	0.20	100	57	43	10	5.4	12.5
Keravat	U	2.53	0.17	1.10	0.71	0.17	76	60	44	15	5.4	15.0
	L	2.35	0.16	1.15	0.65	0.17	72	47	35	15	4.4	13.0
Murua	U	2.47	0.17	0.80	1.10	0.26	130	300	56	13	5.0	12.0
	L	2.16	0.14	0.75	0.93	0.26	120	220	49	12	4.5	12.3
Epo	U	2.36	0.10	0.52	0.95	0.15	105	320	48	11	5.7	8.5
	L	2.19	0.09	0.50	0.73	0.14	120	140	40	9	4.9	9.5
Saiho, H palms	U	2.80	0.15	1.00	0.88	0.27	118	85	—	18	5.8	16.0
	L	2.42	0.13	0.98	0.73	0.25	110	66	—	15	5.3	12.0
Saiho, C palms	U	2.28	0.13	0.90	0.75	0.15	87	68	59	13	4.5	13.0
	L	2.19	0.13	0.98	0.73	0.15	72	64	45	11	4.3	12.5
Saiho, H palms	U	2.30	0.15	0.95	0.83	0.21	72	62	37	13	5.0	13.0
with white stripe	L	2.15	0.13	0.90	0.78	0.23	75	62	45	11	5.0	13.0
Saiho, C palms	U	2.40	0.15	0.98	0.85	0.16	86	77	40	11	4.4	16.0
with white stripe	L	2.47	0.14	0.98	0.90	0.18	83	72	44	11	4.4	13.5
Kapogere	U	2.69	0.18	0.85	1.00	0.28	114	16	78	17	6.7	16.0
	L	2.65	0.19	0.87	0.98	0.28	107	14	63	13	6.7	15.3
Bubia	U	2.08	0.13	0.75	0.77	0.14	100	30	145	13	5.2	16.5
	L	1.91	0.12	0.90	0.70	0.16	104	30	200	14	5.2	15.5
Mean	U	2.44	0.15	0.87	0.89	0.19	97	92	57	14	5.2	14.1
	L	2.30	0.14	0.88	0.82	0.20	97	76	59	12	4.9	13.2

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(Accepted for publication November, 1971.)