

NOTE ON LEAF AREA MEASUREMENT IN OIL PALMS

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As part of a study of the growth of eight *tenera* oil palm progenies in Papua New Guinea (Mendham 1971a), it was necessary to devise a method for estimating leaf area. Fuller details are given elsewhere (Mendham 1971b).

The method developed was similar to that subsequently published by Hardon, Williams and Watson (1969), and was influenced by discussions with the first two of these authors in 1965. Studies in the Keravat nursery indicated that the area of individual leaflets was linearly related to a rectangular length x maximum width measurement. The area of the whole frond could be accurately estimated by summing the individual leaflet rectangular measurements. This is too tedious for field use, and of the approximations tried, the best relationship to the above was given by measuring the length x width of a leaflet in the region where they are largest (about two thirds of the distance from the base to the tip of the rachis), and multiplying this by the total number of leaflets on the frond. Measuring two or more leaflets did not appear to increase precision greatly. What appeared to be nearly as good a linear relation as this was if the length of the rachis was measured, and multiplied by the same leaflet measurement. This last measurement is much quicker than counting leaflets and was thus used as the standard field measurement on the present trials. As the palms grew, several series of calibration measurements were done on some of the Mosa palms, both of leaflet and whole leaf area.

Leaflet area. — The linear regression of $(l \times b)$ of leaflets on "actual" area was calculated. The method of Hardon *et al* (1969) was used for this of summing the length x midwidths of the leaflet cut into about 10 sections. For the Keravat nursery measure-

ments, the weight of paper outlines of the leaflets had been used to estimate actual area from the known weight per unit area of the paper. Regressions were calculated for each progeny of the form $Y = bX$, with values of b as follows, for the Mosa measurements. b is a "leaflet shape factor". About 40 leaflets per progeny were used.

Progeny	Regression coefficient(b)	Determination coefficient(r^2)
C1	0.774	0.997
C2	0.755	0.982
C3	0.787	0.987
C4	0.772	0.986
C mean	0.772	
H5	0.755	0.978
H6	0.752	0.993
H7	0.758	0.989
H8	0.754	0.980
H mean	0.755	

A highly significant difference was shown to exist between the C slopes, but a negligible difference between H slopes. Thus, the individual coefficients were used for the C progenies, and the mean for the H ones. Hardon *et al* found a coefficient of 0.838, but they used the midwidth of the leaflets instead of the maximum width as used here. Differences between progenies were apparently not tested.

Whole leaf area. — The first estimate of area mentioned above, number of leaflets x $(l \times b)$ of the largest leaflet, subsequently referred to as "leaf($l \times b$)", was found to have the best relationship with area measured by summing the $(l \times b)$ of the individual leaflets, subsequently referred to as " $\Sigma(l \times b)$ ". The relationship was linear, of the form $Y = bX$, where $Y = \frac{\Sigma(l \times b)}{100}$, $X = \frac{\text{leaf}(l \times b)}{100}$

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and b is a regression coefficient. The regression coefficient for all progenies combined was 0.55, but the progenies differed significantly at the 5 per cent level. Individual coefficients were thus used to convert field data and these are as follows:

Progeny	b	r^2	Progeny	b	r^2
C1	0.58	0.998	H5	0.57	0.996
C2	0.54	0.997	H6	0.54	0.991
C3	0.54	0.998	H7	0.54	0.998
C4	0.55	0.995	H8	0.59	0.999
C mean	0.55		H mean	0.56	

The second estimate, rachis length x ($l \times b$) of the largest leaflet, subsequently referred to as " $L(l \times b)$ ", gave not such a simple and precise relationship. The differences between progenies were significant at the 1 per cent level, with quadratic equations giving the best relationship, of the form $Y = b_0 + b_1X + b_2X^2$, where $Y = \frac{\Sigma(l \times b)}{100}$ and $X = \frac{L(l \times b)}{100}$.

The coefficient for the eight progenies were:

Progeny	b_0	b_1	$b_2(x10^{-4})$	r^2
C1	-0.533	0.448	-0.892	0.981
C2	5.692	0.428	-0.652	0.997
C3	29.081	0.394	-0.997	0.996
C4	41.500	0.307	-0.134	0.995
H5	-10.611	0.516	-0.972	0.986
H6	-16.662	0.470	-0.751	0.991
H7	22.426	0.417	-0.618	0.982
H8	57.703	0.288	+0.088	0.979

C3 is the only curve to diverge markedly from the rest at higher levels. All have a downward curve (b_2 negative), C3 being the most pronounced, except for H8 which has a slight upward trend (b_2 positive). The value of these curves is limited, as they are derived from a small number of points (seven)

per progeny. They are not accurate for measurements of individual progenies on the trials before July, 1968 and after about January, 1970, as there were no points for leaf sizes on some progenies outside this period.

The "C4" used in the above calibration is in fact the substitute progeny used at Mosa, Siki and Keravat, but the curve for it was used for C4 at all sites. This should cause small or negligible errors.

The shapes of the calibration curves and the larger difference between the progenies mean that the $L(l \times b)$ estimate is less precise and more difficult to use than $leaf(l \times b)$. However, it was used for most of the measurements in Mendham (1971a) before these regression analyses were available. The $leaf(l \times b)$ estimate corresponds closely to the method of Hardon *et al*, and it or a modification of it should be used for future work. To convert a field measurement (plot mean) of $L(l \times b)$ to "actual area", the $\Sigma(l \times b)$ value was taken off curves drawn from the above equations, and multiplied by the appropriate leaflet regression coefficient for the progeny.

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