Leaf Area and Dry Matter Production in Adult Coconut Palms*

Leaf area and dry matter production are two plant characters that determine the total biological productivity, but partitioning of the total biological yield is the most important inherent character that determine the economic yield. While in annual crops such growth analytical studies have been conducted (Cooper, 1972; Donald and Hamblin, 1976; Dyson and Watson, 1971; Pandey, Saxena and Singh, 1978) in cultivated perennial tree crops, such attempts are rare. Rees (1963) was the first to attempt the growth analysis in oil palm *(Elaeis guineensis)* Jacq. followed by a few such reports in coconut (Rees and Tinker, 1963; Hardon, Williams and Watson 1969; Corley, Hardon and Wood 1976). In the adult coconut palm, Pillai and Davis (1963) made the first attempt in determining the dry matter yield after destructive analysis of one adult West Coast Tall (WCT) coconut palm. In the present paper the results of a study on the estimation of leaf area and dry matter production in adult WCT coconut palms, with special reference to development of non–destructive methods are discussed.

Five adult WCT palms of 35-45 years old growing in the CPCRI Farm at a spacing of 7.0 m apart and receiving scientific management, were used for destructive analysis. The root portion was excluded from the studies. The dry weights of nuts including husk, shell and kernal, spadices, spathes, petiole with leaf sheath, the leaflets and the rachis were estimated by determining the dry to fresh weight ratio. The area of all leaflets of individual leaves representing all positions in the crown of each palm were determined using L–1 Cor. Electronic leaf area meter model L–1.3000. The dry weights of different parts of the palm were determined after drying the samples in hot air oven at 80°C. In the trunk of the palm, cylindrical segments were cut from the portion immediately below the crown, each to include 3 leaf scars. Four to six such trunk segments were cut from each palm and their circumference and linear growth to grow 3 leaves, were recorded, before determining the dry weights. The apical portion of the trunk, below the crown, was selected as it is this portion that produces the leaves in succession which contributes to growth.

The mean area of individual leaves ranged from 4.55m^2 to 6.01m^2 between the 5 palms studied. It is also noted that the differences in area between the leaves of different positions of the individual palms was low, the C.V ranging from 5.14% to 10.24%. Similarly the variability in the number of leaflets of different leaves of the crown ranging from 206 to 231, also is low, the C.V. being less than 3% in all the 5 palms studied.

The correlation coefficient values between the area of 6 leaflets collected from both sides of the rachis from the

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base, middle and apical region of the leaf as well as between the area of 18 leaflets of all these positions and the total leaf area of individual leaf were estimated (Table I). The area of 6 leaflets of the middle position and that of the 18 leaflets of all positions showed significant highest positive correlation with the total leaf area of individual leaves, followed by the area of 6 leaflets of the apical region of the leaf.

The mean dry weight of individual leaves ranged from 1.219 kg to 2.931 kg and the differences between the dry weights of leaves of different positions of the individual palm were also small,

Table I. *Relationship for the area and dry weight of leaflets in different positions with the total area and dry weight of the leaves*

	Coefficient of total leaf area	Correlation with total dry weight
Area of base 6 leaflets	0.3553	0.0839
" middle 6 leaflets	0.8652	0.7183
" apical 6 leaflets	0.5927	0.0982
" total 18 leaflets	0.8246	0.4310
Dry weight of base 6 leaflets	0.0165	0.0881
" middle 6 leaflets	0.4945	0.5526
" apical 6 leaflets	0.3423	0.6364
" total 18 leaflets	0.3148	0.2199
Total number of leaflets	0.6847	0.7674

the C. V. ranging from 6.22% to 10.88%. As in the case of leaf area, the correlation coefficient values between the dry weights of 6 leaflets of base, middle and apical region, and the total dry weight of the 18 leaflets together, and the total dry weight of the individual leaves, were estimated.

Besides, the correlation coefficient values were estimated between the area of 6 leaflets and 18 leaflets of all the positions with the total dry weights of individual leaves; and between the dry weights of 6 leaflets of all position and that of 18 leaflets with the total leaf area of individual leaves (Table I). As may be noted, in general, the correlation between the area of middle 6 leaflets and the total leaf area and total leaf dry weights is the highest, followed by the correlation coefficient values between the dry weight of 6 leaflets of middle portion and the total leaf area and total leaf dry weight.

In the case of the trunk, the correlation coefficient values between the linear growth of the segments to include 3 leaf scars and the circumferance of the segment, with the dry weight of the segment were estimated. The 'r' values obtained are 0.8307 for linear growth and 0.5248 for the circumferance. These correlation values were then used to develop the regression equations to estimate the leaf area and dry weight of individual leaves (Table II).

In developing these regression equations, the leaf area and leaf dry weights of 6 leaflets of middle portion were preferred, as the correlation coefficient values of leaflets of this position were better than for the leaflets of other positions. Since the correlation of the number of leaflets of the leaf with the total leaf area

Table II. *Regression equations for estimating the total area and dry weight of coconut leaves*

Equation No.	Constant term	Regression coefficients for			
		Area of middle 6 leaflets cm^2	Dry weight of middle 6 leaflets	No. of leaflets	R^2
A. to estimate the total dry weight of the leaf (in kg)					
1	–2.8755	0·00068 (0.00011)	—	0.0146 (0.0040)	0.77
2	–3.4380	—	0.0197 (0.0038)	0.0202 (0.0037)	0.74
3	–2.9000	0.00053 (0.00021)	0.0056 (0.0067)	0.0152 (0.0040)	0.77
B. to estimate the total area of the leaf (m^2)					
4	–0.2225	0.00160 (0.00017)	—	0.0075 (0.0059)	0.82
5	–1.3274	—	0.0494 (0.0055)	0.0192 (0.0054)	0.81
6	–0.3234	0.00098 (0.00030)	0.0230 (0.0095)	0.0098 (0.0057)	0.84

Figures given in parenthesis are the standard errors for the regression coefficients.

and leaf dry weights were very high (Table I) the number of leaflets of single leaf also was considered for developing the regression equations.

As may be observed (Table II) the difference between the R^2 values of all the equations are low and hence all equations are found equally good. However, equation No. 2 and No. 5 may be preferred as the characters to be recorded *viz;* the dry weight of 6 leaflets of middle portion and the number of leaflets of the leaf, can be done with ease. Equation Nos. 1, 3, 4, and 6 may also be used to obtain relatively more reliable values, where facilities to determine the area of leaflets are available.

To estimate the dry weight of trunk segments, each to include 3 leaf scars from the base of the crown downwards upto the 5th segment, the equation: $y = 113.44 + 93.67 \times$ ($R^2 = 0.69$) (SE of b = 13.69) where $\times$ is the length of the segment in cm can be used. As the palm produces 10–14 leaves annually the data on these segments may be sufficient to obtain the quantity of dry matter produced by way of stem growth annually. Besides, any differences in the rate of growth of stem as influenced by variation of soil fertility or environmental variables will be reflected in this portion of stem. On verification of the reliability of these regression equations (Table II) it was found that the difference between the observed values and the estimated values is less than 5.0% for leaf area although this was seen to go upto 15.0% for the mean leaf dry weight.

The regression equations presented in this paper help to estimate the leaf area and the annual dry matter production in adult coconut palms. Together with the data on (1) dry weights of samples of nuts, spadices, leaf sheath etc. collected from the different harvests of a year (2) the dry weight of a single leaf of the crown and (3) the dry weight of trunk growth by marking the annual growth, the annual dry matter production in adult coconut palms can be estimated adopting least destruction. As the CV(%) between the individual leaves of the different positions in the crown is low it could be sufficient to determine the leaf area and dry weights of any single fully opened leaf for estimating the total values for the trees. The results show that once the leaf unfolds fully, there is very little increase in the area and dry weight of the leaves of the coconut crown. The estimated leaf area of a few WCT adult coconut palms with 30 leaves on the crown and with an annual yield of nuts ranging from 50–75 nuts, is 135 m^2 to 165 m^2. The annual dry matter production studied in a few palms by adopting this method ranged from 65 kg to 85 kg per palm in adult 30–40 year old WCT palms.

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