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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.

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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 circumference 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 circumference. 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 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 R² 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

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

Equation No.	Constant term	Regression coefficients for			R ²
		Area of middle 6 leaflets cm ²	Dry weight of middle 6 leaflets	No. of leaflets	
1. 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
2. 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.

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: $y = 113.44 + 93.67 \times x$ ($R^2 = 0.69$) (SE of $b = 13.69$) where x 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 m² to 165 m². 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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Estimation of Leaf Area in Large Cardamom (*Amomum subulatum* Roxb.)

The large cardamom leaves are simple, arranged alternatively on a long leafy stem, which is formed by long sheath-like stalks, encircling one another. The length of leafy stem ranges from 1.0 to 2.4 metres, with 10-13 leaves. The leaves are linear and lanceolate with prominent midrib, entire margin with parallel venation. The leaf has got only a short petiole and long leaf-sheath. The leaves are major sources of photosynthates, thus a rapid, accurate and non-destructive estimates of leaf area is necessary to study the relationship with other morphological characters. Several methods have been devised to determine leaf areas of various crops, and the most suitable method was the use of mathematical regression; on leaf parameters like

length and breadth. Korikanthimath and Subba Rao (1983) and George et al. (1984) in *Elettaria cardamomum* and Sritharan, Perera and Jacob (1983) in cinnamon, have estimated the leaf area based on the above.

Forty five leaves of different maturity stages were collected in each variety viz., Sawaney and Golsey grown at the experimental farm of I C A R Research Complex for NEH Region, Sikkim. The length was measured from the base to its tip and breadth at the widest portion. The actual leaf area in cm² was obtained by using the leaf-area meter (model AAM-7, Hayashi Denkoh Co-Limited, Japan with a precision range upto 99.98%). The coefficient of determination (R²)