A Rapid Non-Destructive Method of Estimating Leaf Area in Cashew

K. N. MURTHY, K. VIJAYA KUMAR, S. BHAGAVAN, C. CHENCHU SUBBAIAH and P. M. KUMARAN
Central Plantation Crops Research Institute, Regional Station, Vittal 574 243, Karnataka, India.

Abstract

A rapid non-destructive method to estimate leaf area in cashew is proposed based on linear measurements of leaf. The exponential model involving maximum length and maximum breadth gave the best prediction equation $A=(0.8356)\ L^{0.848}\ B^{1.08}$ with R^2 as high as 98.92 per cent. Since this model involved cumbersome computation it is preferable to use a linear model $A=0.21 + 0.69\ P$ where P is the product of length and breadth of leaf. This model also has sufficiently high predictability ($R^2 = 96.81\%$). Rapidity of this method can be further expedited without loss of predictability ($R^2=89.62\%$) by taking the linear model $A=-44.28 + 14.32\ B$ where breadth alone is taken into consideration in estimating the leaf area.

Introduction

Leaf area measurements are very often required in botanical and chemical studies. Several methods for estimating the area of leaves have been developed in various crops (Asomaning and Lockhard, 1963; Bhan and Pande, 1966; Hoffman, 1971; Krishna Marar and Papachan, 1964; Marshal, 1968; Mckee, 1964; Reynolds, 1971; Sepaskhash, 1977; Wiersma and Bailey, 1975). No such attempts have been made in cashew. The present study was taken up for developing prediction equations for estimating the individual leaf area of a cashew plant.

Materials and Methods

Twenty healthy and bearing middle aged cashew trees were selected and twenty leaves from each tree were collected at random to cover all the sides of the plant. Actual leaf area of individual leaf was determined by using a Planimeter. For the non-destructive procedure of estimation of leaf areas, modelling prediction equations by regression analysis was attempted. The following three methematical models were tried:

(i) $Ai = a + b\ Li$ where Li is the maximum length of i^{th} leaf.
(ii) $Ai = a + b\ Bi$ where Bi is the maximum breadth of i^{th} leaf
(iii) $Ai = a + b\ Pi$ where Pi is the product of Li and Bi

Further to test the adoptability, another set of 25 trees were sampled during the same season in a different year. In all 99 leaves were randomly collected from all the directions of the canopy. This time the actual leaf area was measured using a LI-Cor Electronic Area Meter. In addition to the models worked in set I following two models were also included.

(iv) $Ai = a + bi\ Li + b2\ Bi$

(v) $Ai = a + Li^{bi}\ Bi^{b2}$

Results and Discussion

The leaves sampled were with the length ranging between 8–16 cm and breadth from 5–10 cm. The models along with their multiple correlation co-efficient R^2 (predictablility of the model) for both the sets are given in the following table.

*SET I**		*SET II***	
Model	R^2	*Model*	R^2
(i) $A = -37.75 + 8.24\ L$	89.32%	(i) $A = -36.51 + 7.61\ L$	88.84%
(ii) $A = -44.28 + 14.32\ B$	89.62%	(ii) $A = -37.86 + 15.17\ B$	89.30%
(iii) $A = 0.21 + 0.69\ P$	96.81%	(iii) $A = 2.85 + 0.686\ P$	96.45%
		(iv) $A = -52.98 + 3.72\ L + 10.16\ B$	97.35%
		(v) $A = (0.8356)\ L^{0.843}\ B^{1.08}$	98.92%

*With planimeter conducted during September, 1972
**With LI – Cor electronic area meter during September, 1978

The regression equations obtained by Planimeter (Set I) and Electronic Area Meter (Set II) were tested for their coincidence (Chakravarthy, Laha and Roy, 1967) and found identical as Fcal = 0.83. It was therefore concluded that the area of an intact leaf can be best estimated by the exponential model $A = (0.8356)\ L^{0.843}\ B^{1.08}$ possessing maximum predictability

($R^2 = 98.92\%$). However this may involve too much of cumbersome computations. A simple model with comparatively higher predictability ($R^2 = 95.81\%$) namely a linear model $A = 0.21 + 0.69$ P (where P is the product of length and maximum breadth) may be adopted.

Wiersma and Bailey, (1975) have reported that considerable time could be saved by measuring length or breadth alone of a intact leaf for estimating the area. By considering the linear model $A = -44.28 + 14.32$ B where B is the maximum breadth of the intact leaf of cashew plant, it is possible to estimate the leaf area with reasonable predictability ($R^2 = 89.62\%$).

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