PREDICTION OF LEAF AREA IN RAMIE [*BOEHMERIA NIVEA* (L.) GAUD.] BY NON-DESTRUCTIVE METHOD

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SUMMARY

Rapid, non-destructive and accurate measurement of leaf area for agronomic and physiological studies is important. There is little information available in this regard for ramie [*Boehmeria nivea* (L.) Gaud.]. The purpose of this study was to develop prediction equations for estimating leaf area of Indian ramie cultivars. Prediction equations were derived from independent variables involving maximum leaf length squared (L^2), maximum leaf breadth squared (B^2) and product of length and breadth (L.B) for different ramie cultivars, viz. R 1411, R 1412, R 1449, R 1452, R 67-34 and RH - 1. In all the cases, independent variable L.B gave best-fitted prediction equations (coefficient of determination, R^2 = 0.9941 - 0.9754). But to save valuable time of researcher in the measurement of leaf parameters, only breadth (B) measurement gave sufficiently high predictability of leaf area (R^2 = 0.9824 - 0.9176) for all important Indian ramie cultivars.

Key words : **Leaf area, non-destructive, prediction equation, Ramie .**

INTRODUCTION

Ramie [*Boehmeria nivea* (L.) Gaud.], an important bast fibre crop which has tremendous scope for commercial utilization as a substitute for flax and thereby saving several crores of foreign exchange by restricting import of flax (Pandey 1998). To do so, Indian ramie germplasms and cultivars are to be assessed physiologically and utilized for hybridization programme.

Leaf area is an important input in physiological and agronomic studies such as various transpiration models, characterization of crop growth, leaf area index etc. (Sivakumar 1978). Sophisticated electronic instrument provides accurate and fast leaf area measurement but it is always expensive. Economically cheaper and technically easier but sound method is therefore, needed for leaf area measurements (Korva and Forbes 1997).

There are number of prediction equations for leaf area measurement of several crops such as jute (Chaudhuri and Patra 1972), cotton (Ashely *et al.* 1963), Blackgram (Balakrishnan *et al.* 1987), soybean (Wiersma and Bailey 1975), frenchbean (Rai *et al.* 1988) etc. However there is no prediction equation for ramie (especially for Indian cultivars) for estimation of leaf area through non-destructive method. Attempt was made in the present study to develop separate prediction equations for estimating leaf area (by non-destructive method) of different Indian ramie cultivars.

MATERIALS AND METHODS

The study was conducted in July 2000 at Ramie Research Station of CRIJAF (ICAR), Sorbhog, Assam. Leaf samples used in the present study were obtained from 6 important Indian ramie cultivars, viz. R 1411, R 1412, R 1449, R 1452, R 67-34 and RH-1. Eighteen leaves of different sizes and positions were removed from 3 randomly chosen plants (tall, medium and short) of each cultivar, so totalling 108 leaves were considered for the prediction model. The maximum length (L) and maximum breadth (B) of each leaf was measured to the nearest mm.

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Actual leaf area of each leaf was measured with minute care by graph paper (mm) method. The individual leaf area was predicted by a linear regression equation, Y=a+bX, where, Y is the predicted leaf area (dependent variable), 'a' and 'b' are constants and X is the independent variable [square of length (L^2)/square of breadth (B^2)/ product of L and B (L.B)]. As a measure of fit of the regression equation, the co-efficient of determination (R^2), defined as the ratio of the sum of squares due to regression and the total sum of squares, had been considered. Regression model with highest R^2 value was considered as best prediction equation (Abraham and Ledolter 1983).

RESULTS AND DISCUSSION

The high values of standard deviation (SD) and range of leaf length, breadth and area (Table 1) indicated a wide diversity in the experimental material, which is a must for prediction models having good predictive ability over a wide range of leaf size and shapes.

Three sets of methematical models (or regression equations) involving maximum leaf length squared (L^2), maximum leaf breadth squared (B^2) and product of L and B (L.B) as different independent variables (X) were formulated for estimating leaf areas (Y) for different cultivars by using linear regression equations (Table 2).

When building prediction models, we always look for independent variable (X) that explain most of the variations in the variable (here leaf area = Y) we want to predict. Thus to find models with high explanatory power, higher R^2 value should be considered (Abraham and Ledolter 1983).

It was observed (Table 3) that for each cultivars the product of leaf length and breadth (L.B) as an independent variable gave highest co-efficient of determination (R^2) values as compared to other independent variables (leaf length and breadth). The regression equation involving L.B as independent variable for all cultivars accounted for 99.41 to 97.54% of variance of the target quantity (leaf area). Such a high value of prediction (R^2 = 0.9941-0.9754, i.e., near to 1) proved the acceptability of the regression equation for estimation of leaf area (Lewis-Beck 1993).

Table 1. Means, standard deviations (SD) and ranges of length, breadth and actual area of leaves.

	Length (cm)	Breadth (cm)	Actual leaf area (cm²)
Mean*	15.26	13.80	155.13
SD	3.05	2.56	53.92
Range	22.2-10.1	20.5-8.9	308.6-67.5

* Each mean is the result of 108 observations.

Table 2. Regression equations for prediction of leaf area for different ramie cultivars.

	Regression equations		
Cultivars	X=(Length)²	X=(Breadth)²	X=L.B
R 1411	Y = 22.66 + 0.55 X	Y = 7.67 + 0.72 X	Y = 10.21 + 0.65 X
R 1412	Y = 15.22 + 0.58 X	Y = 12.37 + 0.72 X	Y = 8.87 + 0.68 X
R 1449	Y = -5.40 + 0.66 X	Y = 31.49 + 0.62 X	Y = 7.02 + 0.67 X
R 1452	Y = 2.11 + 0.67 X	Y = 10.38 + 0.72 X	Y = 5.46 + 0.70 X
R 67-34	Y = 52.60 + 0.44 X	Y = 0.05 + 0.81 X	Y = 22.91 + 0.62 X
RH 1	Y = 20.06 + 0.58 X	Y = 9.41 + 0.76 X	Y = 11.97 + 0.68 X

X = Independent variables, Y = Predicted leaf area (dependent variables)

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Table 3. Co-efficient of determinations (R^2) for each regression equation

	Co-efficient of determination (R^2)		
Cultivars	**Length (L)**	**Breadth (B)**	**L.B**
R 1411	0.9622	0.9743	0.9941
R 1412	0.9495	0.9206	0.9803
R 1449	0.9313	0.9176	0.9841
R 1452	0.9775	0.9824	0.9885
R 67-34	0.9215	0.9260	0.9754
RH 1	0.9617	0.9747	0.9901

Although L.B as the independent variable gave the best prediction model but it involves measurement of 2 leaf parameters (L and B), hence time consuming. Valuable time of a researcher can be saved without compromising the perfection of leaf area prediction by considering only the breadth (B) of the leaf. Wiersma and Bailey (1975) reported similar time saving by measurement of one parameter for leaf area estimation. It was observed (Table 3) that square of breadth (B^2) as the independent variable for prediction of leaf area (Y) had higher R^2 values ranging from 0.9824 to 0.9260 (except for R 1412 and R 1449) which are much higher than the R^2 values of leaf length (L) equations (0.9775-0.9215) and not much lower than the concerned values of L.B. equations (0.9941-0.9754).

Therefore, it may be concluded from this study that if time permits for both length and breadth measurement and highest precision needed then the prediction equations involving L.B could be used; otherwise, measurement of only maximum leaf breadth (B) could predict the leaf area with minimum deviation from the actual, through the use of regression equations involving breadth as independent variable. In general the exact values of constants 'a' and 'b' in prediction equations are not unique parameters. The applicability of the suggested prediction equations to other cultivars (of ramie) and other environmental and management conditions is not known, so more investigations are needed.

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