Short Communications

Indian Journal of Agricultural Sciences 56 (8) : 619-21, August 1986

A non-destructive method of estimating leaf area in pepper seedlings

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Received : 23 May 1985

Several workers have developed mathematical regression equations to estimate leaf area non-destructively, using length and width of leaves (McKee, 1964; Sepaskhah, 1977). Use of such linear measurements is often less time-consuming and does not require expensive instrumentation. However, an important prerequisite is that the suitability of the regression equations to precisely estimate leaf area at the different stages of crop growth must be known.

Mohan Kumar and Prabhakaran (1980) reported regression equation to estimate leaf area in pepper using leaf length and leaf width. But they did not consider the variations in leaf size and shape occurring at various stages of crop growth. In this paper, a non-destructive method for the estimation of leaf area in seedlings of different age groups of pepper (*Capsicum annuum* Linn.) is reported.

The study was conducted with seedlings of 'Panniyur I' pepper raised from single-node cuttings in polythene bags. Plants varied in age from 1 to 6 months and had 8 to 20 functional leaves. Ten plants of different age groups were destructively sampled. Only uninjured and well-developed leaves were selected for the measurement of leaf area. Leaf length was measured to the nearest millimeter from the leaf tip to the place where the leaf lamina is attached to the petiole. Leaf width was measured at the widest region across the lamina at right angles to the length. Leaf area of individual leaves was measured using an electronic leaf-area meter LI-3000 (Licor, USA).

Correlation coefficients of leaf area with leaf length, leaf width and the product of leaf length and leaf width were worked out. Prediction equations of the form $Y = bx$, where 'b' is the regression coefficient and 'Y' is the predicted leaf area for the variate value 'x' were developed for each of the component characters.

The measured leaf area at all stages of growth significantly correlated with the leaf length, leaf width and length × width. The product of length and width gave the highest correlation with the leaf area in all the cases. The coefficient of regression and the percentage variation explained by each regression equation are presented in Table 1. In all cases, regression coefficients were highly significant. Leaf width explained more variation than the leaf length, thus showing that while using single measurements to estimate leaf area, the leaf width is preferable to length. This is in contrast

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Table 1. Linear regression coefficients (b) and coefficients of determination (r^2) for leaf-area estimation at different growth stages of seedlings of 'Panniyur I' pepper

Stages of growth (months)	Regression coefficient of leaf area on					
	(1) Length		(2) Width		(3) Length × Width	
	b	r^2 (%)	b	r^2 (%)	b	r^2 (%)
1	4.9014 (0.1166)	76.48	6.5140 (0.0787)	93.80	0.6835 (0.0049)	97.76
2	5.5317 (0.1010)	85.27	7.0740 (0.0674)	95.89	0.6908 (0.0046)	97.93
3	4.9962 (0.1057)	81.27	6.8277 (0.0634)	96.25	0.6996 (0.0049)	97.85
4	5.1895 (0.1742)	87.36	6.8017 (0.1617)	93.42	0.7146 (0.0080)	98.43
5	4.5005 (0.0994)	78.80	6.2750 (0.1362)	79.47	0.6940 (0.0110)	88.84
6	4.0932 (0.0925)	74.13	5.6406 (0.1010)	83.49	0.6896 (0.0081)	92.74
Combined 'b'	4.8736	Heterogeneous	6.5577	Heterogeneous	0.6946	Homogeneous

Figures in parentheses are the standard errors of the regression coefficients.
All values are significant at 1% level of probability.

to the earlier findings (Mohan Kumar and Prabhakaran, 1980), where length was better correlated with leaf area. The length × width explained the maximum variation as compared with length or width taken separately. Further the predictive ability (r^2), taking leaf width alone, was not considerably reduced in comparison with the equations using both length and width. Similar successful attempts were also made to estimate the leaf area from single leaf measurements by other workers (Chowdhary and Patra, 1972; Gopalakrishnan and Sasmal, 1974).

Regression equations were developed for different sizes and shapes of leaves at various stages of maturity (Table 1). The regression coefficients were tested for homogeneity over different age groups to find out whether a common equation could be used irrespective of the plant age. The study showed that the regression coefficients were homogeneous for length × width, while being heterogeneous for length and width independently. Thus knowing both length and width it is possible to use a single equation to estimate leaf area at different age groups (area = 0.6946 × length × width). A comparison between the measured and predicted leaf area on a different sample

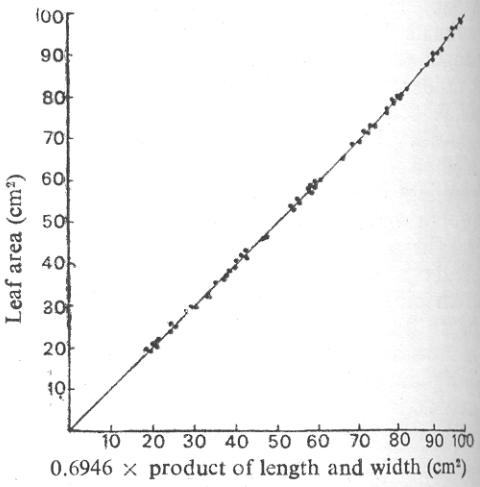

Fig. 1. Actual leaf area measured by leaf-area meter (dots) and the predicted leaf area (straight line) in pepper.

of leaves showed excellent agreement (Fig. 1) with slope being 0.9980.

ACKNOWLEDGEMENTS

We are grateful to Dr K. V. A. Bavappa for providing facilities and to Mrs K. V. Kasturi Bai for the help in leaf-area determinations.

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