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Relationships between leaf surface area and linear dimensions in *Citrus macroptera* (heiribob) using non-destructive method

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ABSTRACT : Leaf area is a commonly used measurement in many horticulture research experiments, but is generally destructive, requiring leaves to be removed for measurement which disturbs carbohydrates assimilation and translocation. The investigations on relationships between leaf surface area and linear dimensions in *Citrus macroptera* (heiribob) using non-destructive method were carried out at the experimental field of the Department of Horticulture, College of Agriculture, Central Agricultural University, Imphal, Manipur, during the period 2011-12. Study employed random selection of *Citrus macroptera* (heiribob) leaves from the exposed part of the trees and estimation of leaf area was carried out. Out of the non-destructive method of leaf area estimation, the area based on the breadth had high co-efficient of determination ($r^2 = 0.903$), suggesting that the result has shown a good fit of observed and predicted value for the leaf area estimation in the future. The produced model in this study can be reliably used for estimating area of leaf samples from the plants of *Citrus macroptera*.

KEY WORDS : *Citrus macroptera*, Leaf area estimation, Non-destructive method

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Citrus macroptera is a fruit tree in the family Rutaceae which is a semi-wild species of citrus native to Malaysia and is very popular in India particularly throughout North East India, especially in Mizoram and Manipur, where it is most commonly used as a flavouring and aromatic agent. The rind is peeled and added fresh or dried for further use by the people of Manipur and is locally known as heiribob. The tree, which has thrown, can reach 5 m in height. Its fruit is about 6–7 cm in diameter, has a fairly smooth, moderately thick rind, and is yellow when ripe. The pulp of the fruit is greenish yellow and dry (does not produce much juice). The juice is very sour, and somewhat bitter. Mild antioxidant activity with the n-hexane compound of lupeol and stigmasterol can be extracted from the stem bark of *Citrus macroptera* (Chowdhury *et al.*, 2008). Several methods for measuring leaf area have been widely used, including tracing, matching, punching and photoelectric devices. Most of the methods described involve injury to the leaves. Estimates also can be obtained at successive stages of plant development by measuring leaf dimensions using non-destructive method of estimation. Accurate, nondestructive method of estimating leaf area is useful in studying the relationship between leaf area development and plant growth. These method permits repeated sampling of the same plant over time, thus facilitating the study of dynamic not possible with destructive sampling procedures. However, nondestructive method of leaf area assessment with leaf area meter is limited due to financial constraints. Various workers reported about the accurate non-destructive method of estimating leaf area on various crops like citrus (Ascenso and Soost, 1976), mango (Rao *et al.*, 1978), banana (Potdar and Pawar, 1991), dwarf mango syn Moreh (Meitei and Devi, 2005) and grape (Beslic *et al.*, 2009). There is not much systematic research work done on estimation of leaf area related to heiribob (*Citrus macroptera*) in India or elsewhere. Therefore, the objective of this investigation was to test whether a leaf area estimate model could be derived for heiribob (*Citrus macroptera*) from the linear measurement of leaf length and breadth alone or from the product of length

and breadth or from the dry weight basis.

RESEARCH METHODS

The estimation of leaf area of heiribob (*Citrus macroptera*) was done during 2011-12 at the Horticultural Research Farm, College of Agriculture, Central Agricultural University, Imphal, Manipur. Inorder to obtain a single equation to determine leaf area, about 50 leaf samples of different sizes were randomly collected from various trees to estimated leaf area. The collected leaf samples from heiribob (*Citrus macroptera*) were then traced on a transparent sheet for the determination of leaf area by Placom Digital Planimeter. Leaf length and width were also determined subsequently for each type. The respective leaves were then dried in an electric oven at 60 °C for 24 hours in order to get constant weight and the individual dry weights were recorded. The regression equations of actual leaf area without petiole were obtained along with their correlation co-efficient (γ). From the above relationship, the following type of regression equation $Y= a + bX_1$, $Y= a + bX_2$, $Y= a + bX_3$ and $Y= a + bX_4$ were developed by calculating the regression parameters a and b. Y in the above expression represents leaf area and X_1, X_2 X_3 and X_4 represent the linear parameters like length, breadth, product of length and breadth and dry weight of leaf respectively. The regression models having a co-efficient of determination more close to 1.0 were suitable and good fit for the application in estimating leaf area. All the data were analyzed using the regression analysis and analysis of variance (ANOVA). Simple regression was conducted to determine the relationship between the dependent and independent variables. The means of leaf area obtained with these models were compared with actual leaf area and the significance of difference between them was determined by the help of paired t-test.

RESEARCH FINDINGS AND DISCUSSION

The results obtained by application of linear regression to estimate the leaf area, the relationship obtained between actual leaf area, product of length and width and leaf dry weights of heiribob (*Citrus macroptera*) are presented in Table 1 and its relationship between the predicted and observed leaf area in Fig. 1. The correlation co-efficient (γ) and co-efficient of determination (r^2) were calculated for finding out the components of leaf area. The co-efficient of determination (r^2) varied from 0.367 to 0.903 in heiribob (*Citrus macroptera*).

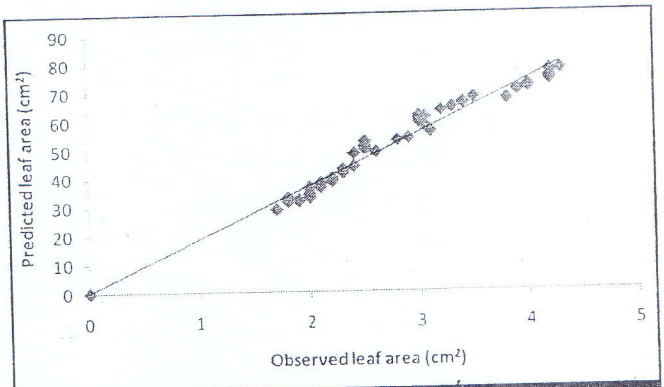

Fig. 1 : Relationship between the observed and predicted leaf area estimation of heiribob (*Citrus macroptera*)

The co-efficient of determination, closer to 1.0 observed with the method based on breadth (r^2=0.903) and followed by methods based on product of leaf length x breadth (r^2= 0.793) and closely followed by leaf length having the co-efficient of determination (r^2 =0.777), indicated the equation based on the breadth are good fit for the estimation of leaf area in heiribob (*Citrus macroptera*). Similarly, the estimation of leaf area using simplest non-destructive methodology based on the leaf blade length and or maximum width and on the basis of leaf weight (Sepulveda and Kliewer, 1983) are observed. As regards the estimation of leaf area based on the model of dry weight, the co-efficient of determination (r^2=0.367), less close to 1.0 was observed as compared with other parameters of leaf length, breadth and product of length and breadth. Further leaf area estimation based on dry weight of leaf being destructive and its r^2 was also minimum, the non-destructive methods was better as compared to destructive methods based on dry weight of leaf. Similar finding of non-destructive method better than destructive was noticed by various workers about the accurate non-destructive methods of estimating leaf area of various horticultural crops like citrus (Ascenso and Soost, 1976), mango (Rao *et al.*, 1978), grape (Beslic *et al.*, 2009). Besides, the result from the graph between the predicted and observed value suggests that there is no significance difference between them since a straight line passing through the origin is obtained indicated that the model worked reasonably and it would likely be useful under a wide range of environmental conditions for heiribob unless other cultivar differ greatly in leaf morphology from those used in this experiment. The r^2 value between the predicted and the

Table 1 : Relationship between actual leaf area and various parameters of heiribob (*Citrus macroptera*)

Sr. No.	Parameters	Regression equation	Correlation co-efficient(γ)	Co-efficient of determination (r^2)	Calculated value of 't'
1.	Leaf length (X_1)	$Y=1.003 + 0.161\ X_1$	0.882	0.777	12.951
2.	Leaf breadth (X_2)	$Y=0.034 + 0.054X_2$	0.950	0.903	21.160
3.	Leaf length x leaf breadth (X_4)	$Y = -25.027+10022\ X_4$	0.891	0.793	13.593
4.	Dry weight of leaf (X_4)	$Y= -46.59+9.84X_4$	0.606	0.367	5.279

observed leaf area is 0.903 with standard of error of 0.250cm^2. Since the predicted value is less than 1.0, there is a significant relationship between the variables at 99% confidence level. Therefore, for most accurate estimation of leaf area, the regression equation based on breadth of heirbob (*Citrus macroptera*) can be used in the future as non-destructive method of leaf area estimation for studying the relationship between the leaf area development and plant growth since leaf area is an important element in the study of plant physiology, particularly when exposing the photosynthetic activity, canopy, light condition and water balance of the plant. However, the determination of the most favourable leaf area, regression equation will depend on the heiribob (*Citrus macroptera*) cultivars, as cultivars vary in leaf shape and characteristics. The result of this study indicated that the estimation of leaf area in heirbob (*Citrus macroptera*) can be performed relatively quickly and with precision under field conditions using a non-destructive methodology.

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REFERENCES

Ascenso, J.C. and Soost, R.K. (1976). Relationship between leaf surface area and linear dimensions in seedling citrus populations. *J. Amer. Soc. Hort. Sci.*, **101** : 697-698.

Beslic, Z., Todic, S. and Tesic, D. (2009). Validation of non-destructive methology of grapevine leaf area estimation cv. BLAUFRANKISCH (*Vitis vinifera* L.). *S. Afr. J. Vitic.*, **31**(1):22-25.

Chowdhury, S.A., Sohrab, M.H., Datta, B.K. and Hasan, Ch. (2008). Chemical and antioxidant studies of *Citrus macroptera*. *Bangladesh J. Sci. Ind. Res.*, **43** (4) : 449-454.

Meitei, W.I. and Devi, H.J. (2005). Leaf area estimation of important crops of Manipur. *Hort. J.*, **18** (3): 51-55.

Potdar, M.V. and Pawar, R.K. (1991). Non-destructive leaf area estimation in banana. *Scientia Hort.*, **45** (3-4): 251-254.

Rao, G.S., Khan, B.H. and Chahda, K.L. (1978). Comparison of methods of estimating leaf-surfaces area through leaf characteristics in some cultivars of *Mangifera Indica*. *Scientia Hort.*, **8** (4): 341-348.

Sepulveda, G. and Kliewer, W.M. (1983). Estimation of leaf area of two grapevine cultivars (*Vitis vinifera* L.) using laminae linear measurements and fresh weight. *Am. J. Enol. Vitic.*, **34** : 221-226.

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