Environment & Ecology 30 (2) : 415—417, April—June 2012

Non-Destructive Leaf Area Estimation of Jackfruit (*Artocarpus heterophyllus* Lam.)

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Abstract

The investigations were carried out during the period 2011-12. Study employed randomly selected of jackfruit 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 product of length and breadth have high coefficient of determination; this suggests that the result have shown a good fit of observed and predicted value for the leaf area estimation in the future.

Key words : Jackfruit, Leaf area estimation, Non-destructive method.

Jackfruit (*Artocarpus heterophyllus* Lam.) is one of the most important minor fruit trees in tropical home gardens and perhaps the most widespread and useful tree in the important genus *Artocarpus* under the family Moraceae. It is a medium to big sized evergreen tree typically reaching 8 to 25 m in height that is recognized by its fruit, the largest among cultivated plants. Although, jackfruit lack systematic cultivation of plantation it is preferred in homestead and in roadside plantation in Manipur. However, these jackfruits are still neglected in research including the leaf area estimation with non-destructive method. Meitei and Devi (1) reported about the importance of leaf area estimation for economically important crops of Manipur in the growth study of crops. Measurement of leaf area is often necessary for agronomic and physiological studies and many methods of estimation leaf area have been developed (2).Generally, estimation procedure involves measurement of leaf length or width and the correlation of these characteristics, via regression with actual leaf area. Accurate, non-destructive method of estimating leaf area is useful in studying the relationship between leaf area development and plant growth. These method permit repeated sampling of the same plant over time, thus facilitating the study of dynamic not possible with destructive sampling procedures (3). However, non-destructive method of leaf area assessment with leaf area meter is limited due to financial constraint. Various workers reported about the accurate non-destructive method of estimating leaf area on various crops like citrus (4), mango (5), dwarf mango syn moreh (1) and grape (6). Therefore, the objective of this investigation was to test whether a leaf area estimate model could be derived for jackfruit cultivar from the measurements of length and width with the non-destructive method.

Methods

The estimation of leaf area of jackfruit (*Artocarpus heterophyllus* Lam.) was done during 2011-12 at the Horticultural Research Farm, College of Agriculture, Central Agricultural University, Imphal, Manipur. To obtain a single equation to determine leaf area, about 40 leaf samples of different sizes were randomly collected from various trees to estimation of leaf area. The collected leaf samples from jackfruit 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 to get constant weight and the individual dry weights were recorded. The regression equations of actual leaf area on without petiole were obtained along with their correlation coefficient (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

Table 1. Relationship between actual leaf area and various parameters of jackfruit (*Atrocarpus heterophyllus* Lam.)

Parameter	Regression equation	Correlation co-efficient (γ)	Co-efficient of determination (r^2)	Calculated value of *t*
1. Leaf length (X_1)	Y=8.09+1.11 X_1	0.97	0.95	27.15
2. Leaf breadth (X_2)	Y=3.66+7.65 X_2	0.96	0.93	23.55
3. Leaf length × leaf breadth (X_4)	Y=3.66+7.65 X_4	0.97	0.96	28.80
4. Dry weight of leaf (X_4)	Y=-46.59 + 9.84 X_4	-0.64	0.41	-5.16

calculating the regression parameters a and b. Y in the above expression represented 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 coefficient 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.

Results and Discussion

The results obtained in the 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 jackfruit are presented in Table 1 and its relationship between the predicted and observed leaf area in Figure 1. The correlation coefficient (γ) and coefficient of determination (r^2) were calculated for finding out the components of leaf area. The coefficient of determination (r^2) varied from 0.41 to 0.962 in jackfruit. The coefficient of determination, closer to 1.0 observed with the method based on product of length and breadth

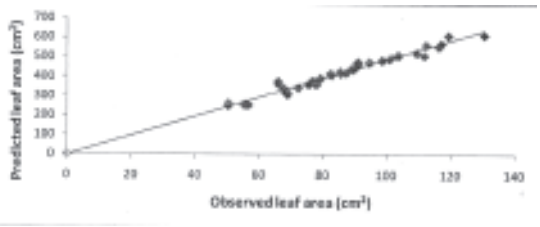

Figure 1. Relationship between the observed and predicted leaf area estimation of jackfruit.

(r^2=0.96) and followed by methods based on leaf breadth (r^2 = 0.95) and leaf length having the coefficient of determination (r^2 = 0.95), indicted the equation based on the product of length and breadth are good fit for the estimation of leaf area in jackfruit. Similarly, the estimation of leaf area using simplest non-destructive methologies based on the leaf blade length and maximum width and on the basis of leaf weight (7) reported. As regards the estimation of leaf area based on the model of dry weight, the coefficient of determination (r^2 = 0.41), 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 estimation leaf area on various horticultural crops like citrus (4), mango (5), grape (6). Besides, the result from the graph between the predicted and observed value suggests that 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 jackfruit, unless other cultivar differ greatly in leaf morphology from those used in this experiment. The r^2 value between the predicted and the observed leaf area is 0.96, with standard of error of 4.00 cm^2. Since the predicted value is less than 1.0, there is a significantly relationship between the variables at the 99% confidence level. Therefore, for most accurate estimation of the leaf area, the regression equation based on product of leaf length

and breadth for jackfruit can be used in the future as non-destructive method of leaf area estimating 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 favorable leaf area regression equation will depend on the jackfruit cultivars, as cultivars vary in leaf shape and characteristics.

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Received : 20/12/2011
Accepted : 10/02/2012
Published : 15/06/2012