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Estimation of leaf area model in hooker chives (*Allium hookeri*) and chollng (*Allium chinense*) using non-destructive method

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ABSTRACT : A field trial was conducted from 2011-12 on hooker chives (*Allium hookeri*) and chollang (*Allium chinense*), to find out the best method of estimation of leaf, at Horticultural Research Farm, Andro, Central Agricultural University, Manipur. In this study, a leaf area estimation model was developed using linear measurement such as laminar length and breadth individually and together with the product of length and breadth by step wise regression analysis. *Allium* species are commercially used by the people of Manipur as spice crops however; their cultivation is not commercialized for large scale production. Leaf area estimation *in situ* of these crops is important for studying the relationship between leaf area development and plant growth. The proposed leaf area (LA) estimation model of regression equation based on leaf length, $Y=6.426 + 2.051X_1$ having correlation of co-efficient of determination ($r^2=0.91$) were suited for the estimation of leaf area of hooker chives, while for chollang the proposed leaf area (LA) estimation model of regression equation based on dry weight of leaf, $Y=3.636+4.605X_3$ having the co-efficient of determination ($r^2 = 0.94$) were most suited for the estimation of leaf area for chollang. However, dry weight of leaf method being destructive, the non-destructive method of the regression equation in chollang based on leaf breadth, $Y= 0.214 + 3.772X_2$ having the co-efficient of determination ($r^2=0.93$) will be better suited for the estimation of leaf area estimation in chollang.

KEY WORDS : Hooker chives, Chollang, Leaf area, Estimation

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Hooker chives (*Allium hookeri*) and chollang (*Allium chinense*) are traditional herbal medicine with thick and fleshy leaves belonging to the Alliaceae family. These grassy, perennial, bulbous plants are popularly grown in Manipur as spice crop and are available through the year. Hooker chives leaves are linear to broadly with 0.5 to 1.0 cm wide and midvein distinct and blossoms in July to October month whereas chollang leaves are fistular, 2 - 4 in number and flowering in June/July month. People are depending more and more on these bulbous herbs for cooking as spices by using their leaves and bulb. Although no specific mention of medicinal uses has been seen for these species, members of this genus are in general very healthy additions to the diet and also used as medicinal herbs in Manipur. Besides, they contain sulphur compounds and help in reducing blood cholesterol levels and act as a tonic to the digestive system and also notify the circulatory system. John (2010) also reported the medicinal properties of chollang (*Allium chinense*) for preventing cardiac problems. Moreover, among the *Allium* species particularly hooker chives (*Allium hookeri*) are resistant to powdery mildew which can be used in the crop improvement programme (Brezhnev and Korovina, 1981). Besides, Yumnam and Tripathi (2012) also reported that *Allium hookeri* is used as medicine for aphrodisiac purpose. However, these perennial bulbous herbs are still being neglected in research. Meitei and Devi (2005b) also reported about the importance of leaf area estimation for economically important crops in Manipur in the growth study of crops. Measurement of leaf area is often necessary for horticultural, agronomic and physiological studies. Non-destructive methods of estimation

of leaf area are useful in studying the relationship between leaf area development and plant growth. These methods provide repeated sampling of the same plants over times, thus, facilitating the study of leaf dynamic not possible with destructive sampling procedure. Measurement of leaf area by Digital Planimeter is very costly and availability of the equipment is limited due to financial constraints. But various workers reported about the accurate non-destructive methods of estimation of leaf area by these device on various horticultural crops like onion (Glenn, 1971), pungent chillies (Meitei *et al*., 2005), Chinese chives (Meitei and Devi, 2005), faba bean (Peksen, 2007) and clary sage (Kumar and Sharma, 2010). There is not much systematic research work done on estimation of leaf area related to hooker chives and chollang in India or elsewhere**.** So, inorder to overcome these problem investigations were carried out to test whether a leaf area estimation model can be derived for hooker chives (*Allium hookeri*) and chollang (*Allium chinense*) from the linear measurement of leaf length and breadth alone or from the product of length and breadth.

RESEARCH METHODS

The estimation of leaf area of hooker chives (*Allium hookeri*) and chollang (*Allium chinense*), both belonging to Alliaceae family were done during 2011-12 at Horticulture Research Farm, Andro, Central Agricultural University, Imphal, Manipur, India. About 40 leaf samples of different sizes were used for the estimation of leaf area. The collected leaf samples from each hooker chives (*Allium hookeri*) and chollang (*Allium chinense*) 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 60^0 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. The leaf area obtained with these models was 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 relationship obtained between actual leaf area, product of length and width and leaf dry weight of hooker chives (*Allium hookeri*) and chollang (*Allium chinense*) are presented in Table 1 and 2 along with the relationship of graphic form of predicted and observed value of leaf area in Fig. 1 and 2, respectively. Correlation co-efficient (γ) and co-efficient of determination (r^2) were calculated for finding out the components of leaf area of each crop. The co-efficient of determination (r^2) varied from 0.10 to 0.91 in chollang and 0.87 to 0.94 in case of hooker chives, respectively. The co-efficient of determination, closer to 1.0 was observed with the dry weight of leaf (r^2=0.94) method and followed by leaf breadth (r^2= 0.93), indicating that these equations are good fit for the estimation of leaf area in hooker chives (*Allium hookeri*). The r^2 value between the predicted and observed value (Fig. 1) is 0.93, with standard of error of 7.33 cm^2. Since the predicted value is less than 1.0, there is statistically significant relationship between the variables 99% confidence level. In case of chollang, leaf length (r^2= 0.91) followed by the product of leaf length and breadth (r^2=0.90), indicted these equation are good fit for the estimation of leaf area in Chollang (*Allium chinense*). Further, the r^2 value between the predicted and observed value (Fig. 2) is 0.91, with standard of error of 1.69 cm^2 having the predicted value of less than 1.0, there is statistically significant relationship between the variables 99% confidence level. There was no significant difference between actual leaf area and the area estimated using different models based on parameters like plant length, breadth and dry weight. The co-

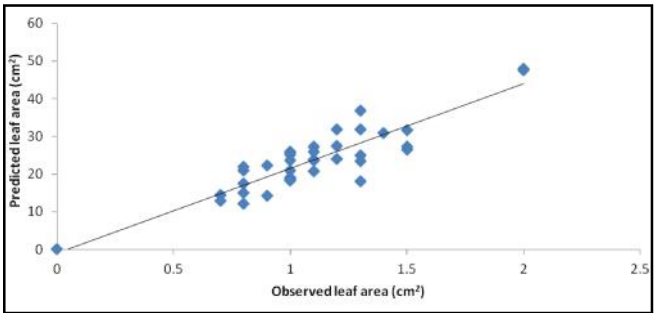

Fig. 1 : Relationship between the observed area and predicted area of leaf hooker chives (*Allium hookeri*)

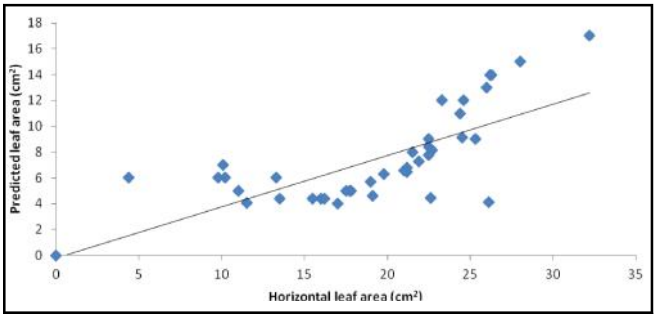

Fig. 2 : Relationship between the observed area and predicted area of leaf chollang (*Allium chinense*)

Table 1 : Relationship between actual leaf area and various parameters of hooker chives (*Allium hookeri*)

Sr. No.	Parameters	Regression equation	Correlation co-efficient (γ)	Co-efficient of determination (r^2)	Calculated value of 't'
1.	Leaf length (X_1)	$Y=16.084 + 0577X_1$	0.93	0.87	15.61
2.	Leaf breadth (X_2)	$Y=0.14 + 3.772X_2$	0.96	0.93	23.55
3.	Dry wt. of leaf (X_3)	$Y=3.636 + 4.605X_3$	0.97	0.94	24.87
4.	Leaf length x leaf breadth (X_4)	$Y=-1.623+ 1.495X_4$	0.94	0.89	17.80

Table 2 : Relationship between actual leaf area and various parameters of chollang (*Allium chinense*)

Sr. No.	Parameters	Regression equation	Correlation co-efficient (γ)	Co-efficient of determination (r^2)	Calculated value of 't'
1.	Leaf length (X_1)	$Y=6.426 + 2.051X_1$	0.95	0.91	19.92
2.	Leaf breadth (X_2)	$Y=4.666+1.882X_2$	0.88	0.77	11.47
3.	Dry wt. of leaf (X_3)	$Y=-1.635 + 9.471X_3$	0.35	0.10	2.30
4.	Leaf length X leaf breadth (X_4)	$Y= -1.187+0.738 X_4$	0.95	0.90	18.81

efficient of determination more closer to 1.0 were observed in larger t-values based on the dry weight of leaf in hooker chives (*Allium hookeri*) indicated good suited for estimating the leaf area but the model based on dry weight of leaf being a destructive method, the non-destructive estimation of leaf area based on leaf breadth having the co-efficient of determination (r^2=0.93) will be better suited for the estimation of that area of hooker chives. Similarly, leaf length based on the model of non-destructive method having the co-efficient of determination (r^2=0.91) indicated good fit for estimating the leaf area of chollang (*Allium chinense*). However, there was no significance between actual leaf area and the area estimated by using the respective models based on the data parameters. These findings are in conformity with the findings of on various horticultural crops like onion (Glenn, 1971), pungent chillies (Meitei *et al*., 2005), Chinese chives (Meitei and Devi, 2005), faba bean (Peksen, 2007) and clary sage (Kumar and Sharma, 2010) which use the co-efficient of determination more closer to 1.0 as the best suited for estimating the leaf area. Therefore, for most accurate estimation of the leaf area, the regression equation based on leaf breadth for hooker chives and the product of length and breadth for chollang can be used in the future as non-destructive method of leaf area estimation for studying the relationship between the leaf area growth and development .

Conclusion:

The result from this investigation indicates that the estimation of leaf area in hooker chives and chollang can be performed relatively quickly and with precision under field conditions using a non-destructive methology. To estimate the leaf areas of them precisely, the variables that are required are the sufficient number of leaves with smallest and largest leaf on each type to predict the leaf area of hooker chives and chollang.

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