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PREDICTION EQUATION FOR ESTIMATING LEAFLET AREA OF KUDZU VINES (*Pueraria lobata* Ohwi)

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Abstract

One hundred expanding and fully expanded trifoliolates belonging to the − or ± types were used to derive prediction equations for estimating leaflet areas of kudzu vines. The prediction equations were presented as regression formulae calculated between the products of lengths (Lcm) and widths (Wcm) of leaflets and the leaflet areas (cm^2)

Left leaflet area = $[(L\times W)\times 0.6959]-1.97$ ($r^2=0.995$)

Terminal leaflet area = $[(L\times W)\times 0.5721]-2.16$ ($r^2=0.991$)

Right leaflet area = $[(L\times W)\times 0.7066]-2.64$ ($r^2=0.993$)

These regression formulae can be used to estimate leaflet areas since there was no significant difference between leaflet areas measured with an automatic leaf area meter and calculated using the formulae.

Introduction

In recent years, the improvement of a leaf area meter has facilitated the leaf area determination of crops and has advanced rapidly the studies on leaf area production. However, presently there is no development of an apparatus to determine leaf area without detaching the leaves from the plants. A non-destructive, accurate and rapid method for leaf area determination, therefore, is needed to run a follow-up survey of leaf area expansion.

The most common method for non-destructively determining leaf area is the estimation from prediction equations using easily measured leaf parameters. The usual procedure for making prediction equations involves measuring lengths (L), widths (W) and areas (A) of leaves and then calculating either regression coefficients[3,7,8] or a leaf factor ($K=LW/A$ or $K=A/LW$)[2,5,6]. Several prediction equations have been devised to estimate leaf areas of various crops, however, there has been no information available so far for estimating leaflet area of kudzu vines. In this study, the prediction equations were derived from independent variables involving measurements of lengths and widths for left, terminal and right leaflets of kudzu vines.

Materials and Methods

On July 30, 1979, uninjured 100 trifoliolates were collected randomly as to size and trifoliolate position on the stem from the wild plants in Kitabata, Motoyama-cho, Higasinada-ku, Kobe, located on the southern slope of the Rokko mountains. Each leaflet's orientation (left, terminal or right) on a trifoliolate was recorded and each leaflet was cut off at the junction of the blade with petiolule, and then lengths, widths and areas of these leaflets were measured. As shown in Fig. 1, leaflet length was measured as a straight line from the apex to the base of the leaflet blade, and leaflet width was measured across the widest portion of the blade at a right angle to the measurement for length. The leaflet area was measured with an automatic leaf area meter of Hayashi Denko Inc. (model AAC-100).

An important consideration in formulating prediction equations is the choice of the independent variable. SCHNEITER[7), working with sunf-

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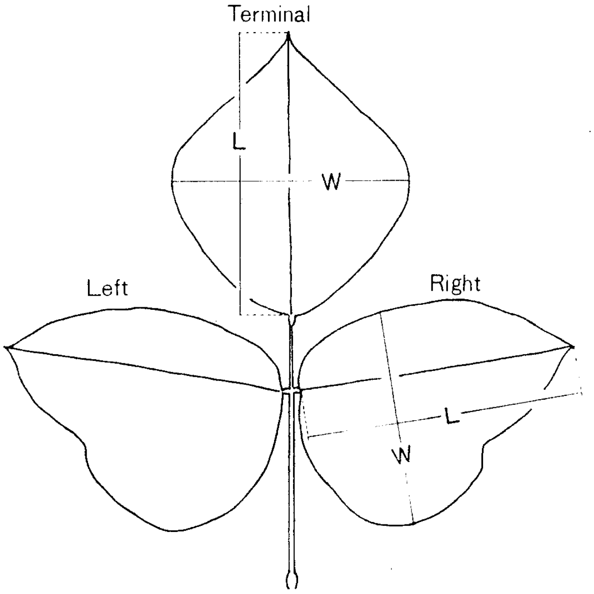

Fig. 1. Portions for measurement of length (L) and width(W) in leaflets of a trifoliolate.
Note : This trifoliolate is classified as ± type because there is no lobe in the terminal leaflet and light lobes in the laterals.

lowers (*Helianthus annuus* L.), noted that the regression formula incorporating both lengths and widths of leaves could be used to estimate the leaf areas and were superior to those involving only lengths or widths. WIERSMA and BAILEY[8] also obtained the same results in leaflet area estimation of soybeans [*Glycine max*(L.) Merr]. Accordingly, in this study we calculated the regression formulae between the products of the lengths and widths and the areas for the estimations of left, terminal and right leaflet areas.

Results and Discussion

On the basis of the shape of the leaflets, ADACHI et al.[1] divided trifoliolates of kudzu vines into the following three types, namely, −type : All three leaflets were round, lacking lobes, ±type: The terminal leaflet lacked lobes or had light lobes and two lateral leaflets had light lobes, and + type : All three leaflets had deep lobes. The trifoliolates used in this study involved the expanding and fully expanded leaflets, classifying into − or ± types according to ADACHI et al.'s classification.

Means, standard deviations and ranges of the products of the lengths and the widths, and the areas for different three leaflets were given in Table 1. The leaflets varied in size, with large leaflets fully expanded and small ones generally expanding.

WIRSMA and BAILEY[8] reported that in soybeans the mean lengths, widths and areas of the two lateralleaflets of a trifoliolate were approximately equal, but that the same measurements for the terminal leaflet were always greater than those of either lateral. LIM and NARAYANAN[4] observed similar relationships among the leaflets of trifoliolates of rubber plants (*Hevea Brasiliensis* Muell. Arg.). Forty two percent of the trifoliolates of kudzu vines used in this study had a larger area in the terminal leaflet than in two lateral teaflets, and 25% and 33% of the trifoliolates had the largest area in the left and right leaflets, respectively. However, the three leaflet areas of a trifoliolate do not seem to be very different.

The regression formulae calculated between the products of the leaflet lengths and widths and the measured leaflet areas for two lateral leaflets and a terminal leaflet were shown in Table 2.

Table 1. Means, Standard deviations and ranges of lengths × widths, and areas of left, terminal and right leaflets on the trifoliolates.

Leaflet orientation on the trifoliolate	Length × Width (cm)			Area (cm^2)		
	Range	Mean	Standard deviation	Range	Mean	Standard deviation
Left	2.09～356.40	120.01	88.63	0.92～253.97	81.54	61.82
Terminal	2.20～399.28	147.25	105.83	0.86～233.58	82.08	60.82
Right	2.09～368.08	118.88	87.96	1.01～285.31	81.35	62.38

Note : Each mean is the result of 100 observations.

Estimates of leaflet areas obtained from the regression formulae were very reliable, as indicated by respective r^2 values of 0.995, 0.991 and 0.993 for the left, terminal and right leaflets. Differences between measured and calculated leaflet areas using these formulae were -0.54, 0.31 and -0.41 cm^2 for the left, termimal and right leaflets, and the differences between measured and calculated values for three respective leaflets were not significant at the 5% level of the critical rate. These facts would indicate that the regression fomulae incorporating both lengths and widths could be used with precision to non-destructively estimate individual leaflet expansion.

These regression formulae can be used to estimate leaflet areas of the trifoliolates belonging to the − or ± types. However, the applicability of these formulae to the ± type of trifoliolates is not known because we didn't deal with this type of trifololates. The question remains to be further studied in the future.

Table 2. Regression formulae developed to estimate leaflet areas(A) of Kudzu vines using leaflet lengths(L) and widths(W).

Leaflet orientation on the trifoliolate	Regression formula	r^2
Left	$A = [(L \times W) \times 0.6959] - 1.97$	0.995
Terminal	$A = [(L \times W) \times 0.5721] - 2.16$	0.991
Right	$A = [(L \times W) \times 0.7066] - 2.64$	0.993

Note : The units associated with regression formulae are centimeters for lengths and widths and square centimeters for areas.

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クズの小葉面積を推定するための予測式

津川兵衛・丹下宗俊

要　約

ーあるいは土型に属する展開途中および展開しきったクズの複葉 100枚を供試し，小葉面積を推定する予測式を導き出した。予測式は小葉の長さ(L)と幅(W)の積と小葉面積(A)との間の1次回帰式で表わされる。

左小葉；$A=[(L\times W)\times 0.6959]-1.95$　　$(r^2=0.995)$

頂小葉；$A=[(L\times W)\times 0.5721]-2.16$　　$(r^2=0.991)$

右小葉；$A=[(L\times W)\times 0.7066]-2.64$　　$(r^2=0.993)$

実測値とこれらの式から計算した値には有意差は認められないので，これらの式は小葉面積推定に使用できる。