Research Note

*ESTIMATION OF LEAF AREA OF TARO [*COLOCASIA ESCULENTA *(L.) SCHOTT] FROM LINEAR MEASUREMENTS*[1]

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J. Agric. Univ. P.R. 80(3):183-185 (1996)

Plant leaf area has a crucial role in determining solar radiation interception and biomass accumulation. Physiological studies on crop growth and development often require the estimation of leaf area throughout the growth cycle of plants by nondestructive methods. The necessity for such estimation became critical in our crop growth simulation studies designed to generate a crop data base for taro cultivars used in the development of the SUBSTOR-aroid model (IBSNAT, 1988; Singh et al., 1992).

Leaf area of numerous crops is related to linear dimensions such as length and width of the leaf lamina (Ashley et al., 1963; Lyon, 1948; Payne et al., 1991). Chapman (1964) developed a simple and nondestructive technique to estimate leaf area of tanier (*Xanthosoma* spp.), an edible aroid also of interest in our crop simulation studies. His methodology consisted of measuring the distance between the leaf apex (A') and the point of conjunction between the petiole and lamina (A) as well as the distance between A and the tip of one of the basal lobes of the leaf (B'). Regression equations were then derived to calculate leaf area from leaf blade dimensions by using the product of $(AA')(AB')^2/1000$ as the independent variable. More recently, Goenaga et al. (1991) redefined the independent variable as the product of (AA') × (AB') to develop regression equations to estimate the leaf area of three tanier cultivars. Reddy et al. (1968) used values of AA' and AB' from taro leaves as the independent variables in regression equations to determine corm weight but not leaf area.

The objective of this study was to establish regression equations by which taro leaf area can be calculated from nondestructive, linear leaf-blade measurements.

Leaves of cultivars Blanca and Lila were obtained from a taro growth-analysis field experiment established 25 June 1992 (Goenaga and Chardon, 1995) and those of cultivars Lehua and Niue from a yield trial established 8 September 1993. Both experiments were conducted under upland conditions at the USDA-ARS, Tropical Agriculture Research Station Farm, Isabela, Puerto Rico. The soil is a well drained Oxisol (Typic Eutostrox) with a pH of 5.4, bulk density of 1.4, 2.0% organic carbon and 8.3 cmol(+) kg of soil of exchangeable bases.

The experimental design in the 1992 study was a split plot with cultivars as the main plots and biomass harvests as subplots. The 1993 study was arranged in a randomized complete block design. Treatments were replicated five times in each experiment. Cultivar Blanca produces white-fleshed corms; Lila and Lehua, purple-fleshed; and Niue, white-pink-fleshed. In both experiments, plants were spaced 0.91 × 0.46 m apart and were drip irrigated when the soil water tension, measured with tensiometers at a depth of 15 cm, exceeded 20 kPa. Fertilization through the drip system was supplied every two weeks at the rate of 5.6 and 7.6 kg/ha of N and K, respectively.

[1]Manuscript submitted to Editorial Board 27 March 1995.

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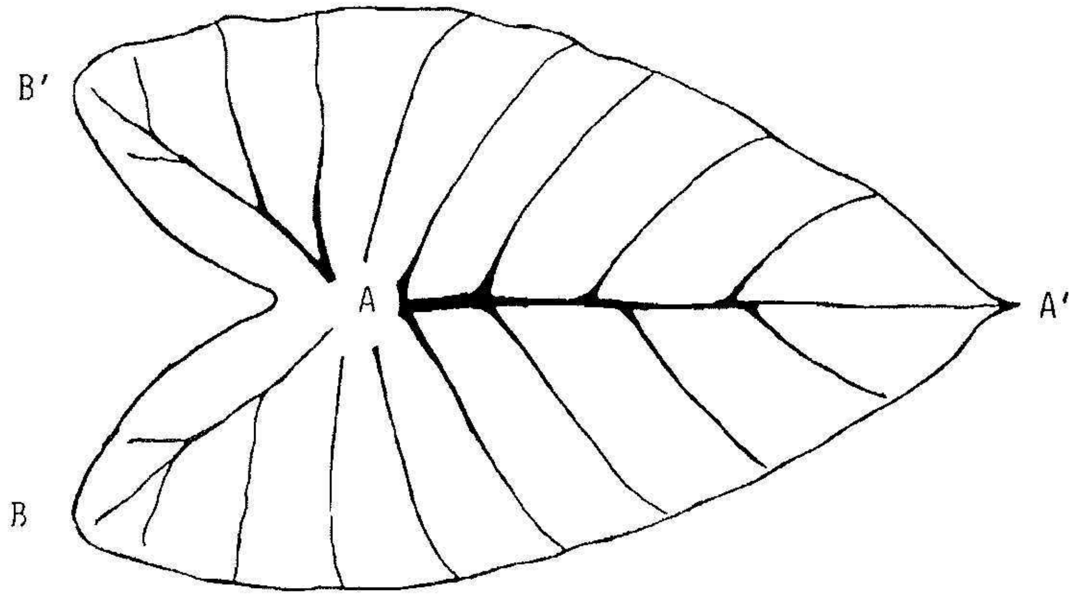

FIGURE 1. Linear measurements taken on taro leaves to determine leaf area.

Between 50 and 330 days after planting, leaves of each cultivar were cut at the midrib-petiole intersection and measurements of AA' and AB' recorded (Figure 1). Immediately after the measurements were recorded, leaf area was determined with an LI-3100 area meter (LI-COR[4], Inc., Lincoln, NE). The number of leaves taken for measurements from cultivars Blanca, Lila, Lehua, and Niue was 492, 647, 227, and 227, respectively.

Analysis of variance and best-fit curves were determined by using the GLM procedure of the SAS Program Package (SAS Institute, 1987). Only significance levels of 0.05 or lower were used in the analyses.

Leaf area was linearly related to the independent variable, AA' × AB', in all cultivars (Figure 2A-D). The coefficients of determination (r^2) show that the regression equations closely fit the observed data (Figure 2A-D). Consequently, the total sum of squares in the models can be mainly attributed to the independent variable. The analysis of variance (data not shown) indicated a significant difference among the four cultivar leaf areas and slopes. Therefore, it was not possible to obtain a single regression equation that would have accommodated all cultivars. The regression equations derived from this study, by obtaining linear measurements of AA' and AB' throughout the growth cycle of taro, provide the means for calculating leaf area in agronomical and physiological field studies with taro through nondestructive techniques.

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[4]Mention of a trade name or vendor does not constitute an endorsement or warranty by the USDA.

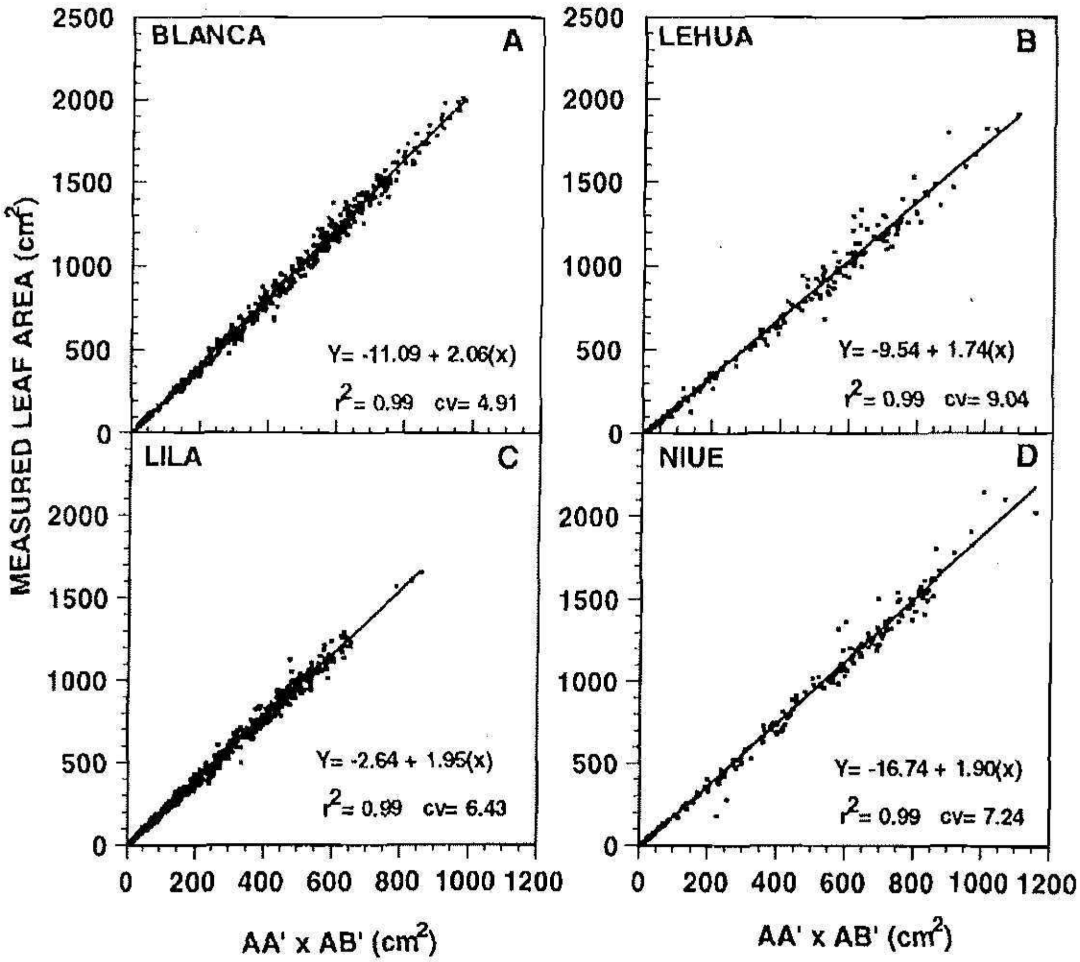

FIGURE 2. Relationship between measured leaf area in taro cultivars Blanca (A), Lehua (B), Lila (C), and Niue (D) and the independent variable AA' × AB'.

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