A Nondestructive Method for Estimation of Leaf Area in Pecan

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Nondestructive estimations of pecan leaf area [*Carya illinoensis* (Wangenh.) K. Koch.] have usually been obtained by computing a relationship between shoot length and leaf area, then measuring the length of the shoots in question (Sparks, 1966). However, in other crops, leaf length (Ackley et al., 1958) or number of leaves (Chacko et al., 1982) has been used to estimate leaf area. Measuring individual leaves is substantially more time consuming and requires more data storage than does measuring shoot length. Counting leaves would require even less time and data storage space than shoot length

measurement. Counting leaves would also have less measurement error than measuring shoots. We determined if the number of leaves per shoot or shoot length is a better estimator of leaf area in pecan.

Ten fruiting and 10 vegetative shoots were randomly selected and removed from each of five 17-year-old 'Mohawk' and five 34-year-old 'Western' pecan trees at the Pecan Research Station near Sparks, Okla., in Aug. 1985. The fruit and pedicel were then removed from fruiting shoots. All shoots were measured to the nearest 5 mm, and the leaves on each shoot were counted. Leaf areas were measured for each shoot using a LI-COR 3100 area meter (LI-COR, Lincoln, Neb.). Regression analyses were then used to determine the relationships of shoot length with leaf area and of the number of leaves with leaf area for each cultivar and shoot type.

The number of leaves per shoot was a more accurate estimator of leaf area than was shoot length for both cultivars (Table 1). Each shoot type and cultivar was different from the others in its relation to shoot length vs. leaf area and between number of leaves and leaf area (Table 1). Both relationships for fruiting shoots were linear, while relationships chosen for vegetative shoots were quadratic. All the quadratic relationships were concave except for 'Mohawk' shoot length, which was convex (Table 1). In general, fruiting shoots had relatively small leaves on short shoots and larger leaves on long shoots. Short fruiting shoots often had only relatively small leaves (data not shown). Quadratic relation-

ships for vegetative shoots are the result of the longest, most vigorous shoots producing the largest leaves. A similar relationship has been observed in apple (*Malus domestica* Borkh.) (Barlow, 1980). This relationship increases more quickly for 'Mohawk' than for 'Western'. For example, at 1000 cm² total shoot leaf area, 'Mohawk' leaves were ≈222 cm² each, whereas at 2000 cm² leaf area each leaf was 267 cm². 'Western' leaves were 118 cm² each at 1000 cm² total leaf area per shoot and 143 cm² at 2000 cm² total leaf area per shoot.

These results provide evidence that number of leaves is a better estimator of leaf area in pecan than is shoot length. The relationships among leaf area, number of leaves, and shoot length would be expected to vary with cultivar, tree age, and environment. Since the relationships for fruiting shoots are linear, it may be possible to sum all leaves of fruiting shoots within an experimental unit, thus decreasing the data storage required for leaf area estimates. This procedure does not seem feasible for vegetative shoots because of the quadratic relationships. Therefore, the leaves on each vegetative shoot would have to be counted separately. Leaf count is also a more convenient method for estimating leaf area than is shoot length because it has been observed to be quicker and less likely to introduce error than shoot length measurements taken in the field.

Literature Cited

- Ackley, W.B., P.C. Crandall, and T.S. Russell. 1958. The use of linear measurements in estimating leaf areas. *Proc. Amer. Soc. Hort. Sci.* 72:326-330.
- Barlow, H.W.B. 1980. The relationship between leaf size and shoot length in apple. *J. Hort. Sci.* 55:269-283.
- Chacko, E.K., Y.T.N. Reddy, and T.V. Ananthanarayanan. 1982. Studies on the relationship between leaf number and area and fruit development in mango (*Mangifera indica* L.). *J. Hort. Sci.* 57:483-492.
- Sparks, D. 1966. A rapid method for estimating the leaf area of the Stuart pecan, *Carya illinoensis* Koch. *HortScience* 1:93-94.

Table 1. Shoot lengths, R² values, and equations used to define relationships of leaf area with shoot length and with leaf count.^a

Cultivar	Shoot type	Shoot length (cm)				Leaves (no.)			
		Range	Mean	R ² ^b	Equation	Range	Mean	R ² ^b	Equation
Mohawk	Fruiting	3.0-17.5	8.5	0.538	y = 614.6 + 98.4x	4-10	6	0.733	y = -620.2 + 343.3x
	Vegetative	0.5-35.0	5.8	0.888	y = -25.4 + 210.6x - 2.5x ²	1-15	4	0.930	y = -365.3 + 264.4x + 6.7x ²
Western	Fruiting	4.5-25.0	10.8	0.388	y = 284.7 + 54.7x	3-11	7	0.501	y = -219.2 + 160.4x
	Vegetative	0.5-46.5	7.3	0.948	y = -21.7 + 67.6x + 0.3x ²	1-22	5	0.966	y = -169.6 + 106.2x + 3.5x ²

^aRelationships are linear for fruiting shoots and quadratic for vegetative shoots in all cases.

^bAll R² values are significant at the α = 0.001 level.