A new factor for estimating total leaf area in banana

N. Kumar, V. Krishnamoorthy, L. Nalina and K. Soorianathasundharam

Leaf area is one of the parameters used to determine a plant's photosynthesis potential. Watson (1947) applied the concept of leaf area to measure the productive potential of field crops. He defined a leaf area index as the area of green leaf per unit area of land.

Leaf area can be measured by destructive methods, but the non-destructive method of linear measurement was found to be simple, inexpensive and accurate (Yeboach *et al.* 1984). For bananas, Murray (1960) suggested a 'K' factor of 0.80 to be multiplied by the length and breadth of the leaf. This method gives the area of the leaf in question but not the total leaf area of the plant, which is of more interest to researchers. One way to obtain the latter is to estimate the area of each leaf, using Murray's method, and to

Table 1. Total leaf area.

	Column number							
	1	2	3	4	5	6	7	8
Plant No.	Number of leaves per plant	Estimated area of third leaf (m^2)	Estimated total leaf area (m^2) (1 x 2)	Actual total leaf area (m^2)	Individual K_2 factors (4/3)	Predicted total leaf area (m^2) (2 x 1 x K_2)	Difference between predicted and actual (6-4)	Difference (%)
1	15	1.689	25.3320	16.663	0.658	16.775	0.112	0.667
2	15	1.715	25.718	16.155	0.628	17.030	0.875	5.139
3	18	1.593	28.674	18.581	0.648	18.988	0.407	2.144
4	16	1.741	27.854	18.469	0.663	18.445	-0.024	-0.128
5	15	1.766	26.496	16.824	0.635	17.546	0.722	4.115
6	16	1.705	27.286	17.031	0.624	18.069	1.039	5.747
7	14	1.389	19.449	13.41	0.690	12.880	-0.538	-4.176
8	14	1.777	24.878	16.699	0.671	16.474	-0.225	-1.365
9	15	1.669	25.041	15.897	0.635	16.582	0.685	4.131
10	14	0.990	13.866	9.152	0.660	9.182	0.030	0.321
11	13	0.966	12.563	8.156	0.649	8.319	0.163	1.960
12	12	0.841	10.090	6.584	0.653	6.681	0.097	1.455
13	12	0.875	10.502	6.845	0.652	6.955	0.110	1.574
14	12	1.131	13.574	8.951	0.659	8.989	0.038	0.420
15	14	0.287	4.017	2.825	0.703	2.660	-0.166	-6.226
16	13	0.446	5.795	4.003	0.691	3.838	-0.165	-4.294
17	13	0.469	6.101	4.124	0.676	4.040	-0.084	-2.067
18	13	0.579	7.532	5.213	0.692	4.988	-0.225	-4.515
19	14	0.348	4.869	3.254	0.668	3.224	-0.030	-0.922
20	14	0.584	8.172	5.269	0.645	5.411	0.143	2.633
21	15	0.422	6.330	4.256	0.672	4.192	-0.065	-1.541
22	13	0.509	6.620	4.622	0.698	4.384	-0.238	-5.430
23	14	0.389	5.445	3.626	0.666	3.605	-0.020	-0.565
24	13	0.421	5.476	3.626	0.662	3.626	0.000	0.004
25	14	0.401	5.615	3.689	0.657	3.718	0.029	0.791
Mean	14.04	0.99	14.29	9.357	0.662	9.378	0.107	-0.005
t-test						0.950		
r		0.986*	0.999**	0.999	-0.536	0.999 **	0.533	0.536

* Statistically significant at probability 0.05

** Statistically significant at probability 0.01.

add them up, but this is cumbersome and time consuming. Instead, many workers just measure the leaf area of the third leaf, using Murray's method, and multiply by the total number of leaves, but this is unsatisfactory as leaf size varies during development. The objective of this study was to estimate a second constant 'K_2' to obtain a better estimate of the total leaf area of the plant.

Materials and methods

Twenty-five plants of banana comprising 15 'Robusta' (AAA), 5 'Rasthali' (AAB) and 5 'Karpooravalli' (ABB) were removed at various stages of growth: 3 months after planting, 5 months after planting and at shooting. The number of leaves were counted and the area of the third leaf was estimated using the formula A=L x B x K, where A= estimated leaf area, L= leaf length, B= leaf breadth and K= 0.8. The estimated area of the third leaf was multiplied by the number of leaves to obtain the estimated total leaf area. The actual total leaf area of each plant was measured in a conveyer belt leaf area meter LICOR Model 3001.

An individual K_2 value for each plant was obtained by dividing the actual total area by the estimated total area. Then the mean of all individual K_2 values was calculated to obtain the value of 0.662 for the constant K_2. This value was used to calculate the predicted total leaf area which was then compared to the actual total leaf area. A t-test was carried out and the difference between actual leaf area and predicted area was worked out.

Results and discussion

The difference between the estimated total area using the third leaf method and the actual and predicted total areas was large for all 25 plants (Table 1). A t-test performed on the estimated and predicted leaf area showed that they were significantly different.

A positive and significant correlation was obtained between actual and predicted leaf area (r=0.999), suggesting that a value of 0.662 for K_2 is a good way to estimate *in situ* the total leaf area of a banana plant.

Based on this result, we propose to measure the total leaf area of a banana plant by counting the total number of leaves (N), measuring the length (L) and breadth (B) of the third leaf from the top and calculating the total leaf area (TLA) as follows: TLA=L x B x 0.80 x N x 0.662. ■

References

Murray, D.B. 1960. The effect of deficiencies of the major nutrients on growth and leaf analysis of the banana. Trop. Agric. (Trinidad) 37:97-106.

Watson, D.J. 1947. Comparative physiological studies on the growth of field crops. I. Variation in NAR and LAI between species and varieties. Ann. Bot. 11:41-76.

Yeboach, S.O., J.I. Lindsay & F.A. Gumbs. 1984. Estimating leaf area of cowpea from linear measurements. Trop. Agric. (Trinidad) 60:149-150.

The authors work at the Department of Fruit Crops, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore-641003, Tamil Nadu, India.