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A free electronic spreadsheet to calculate shade parameters of single trees and tree strips

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Introduction

The tree shade effects on crops, pasture and animals grown in integrated systems has been widely studied. For some crops and livestock there are estimates of tree shade amount which allows optimizing the consortium benefits. Therefore, knowing shade parameters, such as area and orientation, is important for planning the spatial arrangement of components in integrated system areas as for production as for scientific research. In this paper, we present a free electronic spreadsheet to assess tree hade parameters for planning agroforestry implementation.

Material and Methods

The spreadsheet was developed to return the following final results: shade area, shade length, shade width, shade dislocation from the trunk and shade orientation (azimuth). The parameters were estimated from equations proposed by Silva (2006) for trees with cylindrical-shaped canopies. The spreadsheet was developed in LibreOffice Calc 4.3, but saved in .xlsx format for due its compatibility with other spreadsheet programs. For validation, field measurements were taken from 21 single trees and 4 tree strips (with 4 rows of 33 plants each, in 3x3 m spacing), except for azimuth. Data form in loco measurements and from spreadsheet estimations were compared by the paired t-test at the 5% significance level.

Results and Conclusions

Table 1. Comparison between averages of the estimated and measured shade parameters of 21 single trees and 4 tree strips (with 4 rows of 33 plants each, in 3x3 m spacing). Means followed by the same letter in the column do not differ significantly by the paired t-test at the 5% level.

	Single trees				Tree strips (with four rows of trees			
	Length (m)	Width (m)	Dislocation (m)	Area (m²)	Length (m)	Width (m)	Dislocation (m)	Area (m²)
Estimated	7.52a	6.67a	7.26a	44.02a	102.89a	11.10a	5.45a	1040.51a
Measured	6.02b	5.17b	6.82b	37.58a	98.98b	12.60a	5.77a	1135.72a
Difference ± standard error	1.50 ±0.39	1.50 ±0.46	0.44 ±0.14	6.44 ±5.90	3.91 ±0.42	-1.50 ±1.24	-0.32 ±1.95	-95.21 ±112.77

The difference between estimated and measured shade areas for single trees was not significant. Also, no differences were found between measured and calculated shade width, dislocation and area for the tree strips. The spreadsheet tended to overestimate shade length, shade width and shade dislocation from the trunk of individual trees and shade length of tree strips. These differences, however, were relatively small. Thus, it is recommended the use of the spreadsheet for estimation of tree shade parameters, especially shade area. The spreadsheet can be downloaded from: https://www.embrapa.br/documents/1354309/1529241/C%C3%A1lculo+Sombra+V1/56460a8f-fbe9-4a39-a67e-f2854fc59aa4.

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