This Week's Citation Classic


[Depts. Agronomy and Physics, Univ. Kentucky, Lexington, KY and Dept. Agronomy, Univ. California, Davis, CA]

The paper gives the mathematical logic for building a model for calculating the rate of photosynthesis of leaves of a uniformly distributed plant leaf canopy for any sun position. The parameters supplied in the input to the model are leaf angle, leaf area, leaf distribution, leaf reflectivity and transmissivity, solar elevation and brightness, skylight brightness, and the relationship between leaf illumination and photosynthetic rate. (The SCP indicates that this paper has been cited over 165 times since 1967.)

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"In 1966, I went to the University of California at Davis for a sabbatical and had the good fortune to work with Bob Loomis and Bill Williams. They appreciated the value of what I had been trying to do and gave me the help and encouragement needed to polish up the model. Also, the next computer generation had arrived on the Davis campus and it had enough speed to work through the calculations in a reasonable time. I went on from Davis to work with John Hesketh in the Phytotron at Canberra leaving the details of getting the model published to Loomis and Williams. They did all of the dirty work. Had it been left to me, the manuscript might still be gathering dust in my filing cabinet.

"It was a surprise to learn that the publication has been so widely cited. Considering its length and the mathematics it contains I strongly suspect that it may have been cited more frequently than it has been read. The work was one of the first attempts to develop a method for getting quantitative answers for an important problem. It couldn't have been done earlier because computers were not generally available. The model as published was based on sound mathematical principles and was free of arbitrary assumptions of any consequence so not much room was left for further progress. My fellow agronomists, however, have always had more faith in experimental results than in mathematical equations so at least two independent studies2,3 were devoted to testing the accuracy of the model. Fortunately, no discrepancies were found so it has not been necessary to revise Euclid's geometry or the calculus.

"The 1950s and 1960s saw a great deal of activity by crop ecologists in quantifying the nature and photosynthetic performance of foliage canopies. The concept of leaf area index was widely employed but the geometry of this relative to sunlight was more difficult. Models came forth from Japanese, English, Dutch, and Estonian workers. The *Hilgardia* paper is probably widely cited because it is perhaps the simplest complete solution."