This Week's Citation Classic®

McCree K J. Equations for the rate of dark respiration of white clover and grain sorghum, as functions of dry weight, photosynthetic rate, and temperature. *Crop Sci.* **14**:509-14, 1974.
[Department of Soil and Crop Sciences, Texas A&M University, College Station, TX]

Respiratory rates of whole plants were separated into growth and maintenance components and related to photosynthetic rates through a simple linear equation. This equation is designed to be used in computer models of crop production, using carbon dioxide exchange rates as primary input data. [The *SCI*® indicates that this paper has been cited in over 120 publications since 1974.]

Keith J. McCree
Department of Soil and Crop Sciences
Texas A&M University
College Station, TX 77843-2474

August 6, 1985

The approach that is outlined in this 1974 paper was not really originated by me but developed over almost 10 years of discussions with several very sharp people, beginning with John Troughton. When John first joined the New Zealand Department of Scientific & Industrial Research, we decided to see whether or not we could predict plant growth rates from rates of photosynthesis and respiration. While photosynthetic rates of clover swards behaved as we had expected, respiratory rates did not.[1] There apparently was a link between rates of respiration (R) and photosynthesis (P): when P was reduced, R decreased too. We had to question the common assumption that R was proportional only to the biomass and that this must lead to an "optimum" leaf area index for crop production.[2]

Shortly after the publication of our data, I was invited to spend a year with Bob Loomis and Bill Williams in Davis, California. They were working on simulation models of crop production. When Cornelius de Wit from the Wageningen modeling group visited Davis, he immediately recognized the implications of our data and secured an invitation for me to present them at an upcoming International Biological Program workshop to be held in Trebon, Czechoslovakia. I reworked the data following suggestions of the people in Davis and presented them alongside de Wit's models[3] at the Trebon symposium.[4]

It was a heady meeting. With the help of the local organizer, Ivan Setlik, who arranged for some free beer from the local brewery, discussion of both science and politics continued into all hours of the night. It was a difficult time for our Czech hosts, but they succeeded in making this a landmark conference.

By this time I had decided to stay and work in the US and in 1968 had obtained a job in academia at Texas A&M University. This turned out to be quite a culture shock for a modest, peace-loving research scientist from New Zealand, but I survived and was able to keep up the good work with the help of some able graduate students. I have reviewed our more recent work on respiration as it relates to modeling of crop production for a lecture at Iowa State University.[5] Jeff Amthor has recently published a review of the various treatments of maintenance respiration.[6]

While both the *Crop Science* paper and the Trebon paper (which I've always found more interesting) have been highly cited, in the *Crop Science* paper I was able to expand on the ideas regarding the principles that govern respiratory rates and growth rates, in plants as well as in other living organisms. I was also able to show how data make more sense if one puts these principles in mathematical form. The idea that plant behavior can be explained by a linear equation with only two components (essentially the growth and maintenance components of respiration) seems to have stood the test of time.

1. **McCree K J & Troughton J H.** Prediction of growth rate at different light levels from measured photosynthesis and respiration rates. *Plant Physiol.* 41:559-66, 1966. (Cited 70 times.)
2. --------------. Non-existence of an optimum leaf area index for the production rate of white clover grown under constant conditions. *Plant Physiol.* 41:1615-22, 1966. (Cited 50 times.)
3. **de Wit C T, Brouwer R & Penning de Vries F W T.** The simulation of photosynthetic systems. *Prediction and measurement of photosynthetic productivity: proceedings of the IBP/PP technical meeting, Trebon, 14-21 September 1969.* Wageningen: Pudoc, 1970. p. 47-70. (Cited 55 times.)
4. **McCree K J.** An equation for the rate of respiration of white clover plants grown under controlled conditions. *Ibid.*, p. 221-9. (Cited 145 times.)
5. --------------. The role of respiration in crop production. *Iowa State J. Res.* 56:291-306, 1982.
6. **Amthor J S.** The role of maintenance respiration in plant growth. *Plant Cell Environ.* 7:561-9, 1984.

