

King R W, Wardlaw I F & Evans L T. Effect of assimilate utilization on photosynthetic rate in wheat. *Planta* 77:261-76, 1967.
[Division of Plant Industry, CSIRO, Canberra, Australia]

The photosynthetic rate of wheat leaves can be rapidly (3-15 hrs.) and reversibly inhibited by up to 50 percent following alteration in the requirement for photosynthetic assimilate by a growing organ such as a wheat ear. Alteration in demand by the ear not only influences supply by the leaf but also the pattern of transport of ^{14}C -labelled assimilate. [The SCJ[®] indicates that this paper has been cited in over 125 publications since 1967.]

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"When I joined the Division of Plant Industry, CSIRO, as a young graduate, my research future had already been decided. The wheat plants were growing and I was immediately pointed toward an infrared gas analyser—I think I had actually read in some undergraduate text that gas analysis was a technique for measuring leaf photosynthesis. The problem was laid out: to show that utilization of photosynthetic assimilate by a wheat ear—a growing organ—could regulate the rate of photosynthetic fixation of carbon dioxide by a nearby leaf. However, instant success was not expected. Earlier efforts of Lloyd Evans had been unsuccessful and others had concluded that there was no such regulation of photosynthesis in wheat. Happily, both my colleagues were involved in offering advice, in providing extra hands, and in preparation of the final publication so my contribution was more that of persistence.

"Our first positive response of leaf photosynthesis to ear removal came after five months and many man-hours of tedious and

often depressing repetition involving endless guesses at the 'best' kind of plant system to use. That day, the celebration for me was not of scientific success but of my engagement to be married—it was thought I should have done it much sooner and more often.

"Having found evidence that leaf photosynthesis could be regulated by sink demand we further examined mechanisms and processes and it is probably this solid groundwork which accounts for the continued citation of this paper. Three criteria were regarded as important. First, the response should be rapid. Secondly, the depression of photosynthesis following ear removal should be reversible in the same leaf. Thirdly, changes in the distribution of photosynthetic assimilate—as measured with radioactive ^{14}C —should support our assumptions of how leaf assimilate was being utilized. Different manifestations of source-sink control were also examined so that we had, in effect, formulated a hypothesis, tested it, and tested predictions of the hypothesis.

"Others working with wheat have sometimes had difficulty reproducing our results;¹ however, their failure was not surprising. Plants of quite different shapes and sizes had been used and we had emphasized in our paper that alternative sinks had to be restricted. On the other hand, rapid and reversible control of photosynthesis by sinks has now been established in a number of other species.² We examined then only one possible mechanism of control involving the plant growth regulator indoleacetic acid. Hormones still feature and one current explanation links failure to export assimilates with failure of the leaf to export 'toxic' compounds such as abscisic acid.³ Another explanation is that phosphate required for photosynthesis is 'sequestered' as sugars build up in the leaf.⁴ Whatever the mechanism, our paper has helped crop physiologists to accept that photosynthesis not only drives growth and storage but is also conditioned by them. This conclusion has been important in discussions of the relationship between photosynthesis and yield."

1. Austin R B & Edrich J. Effects of ear removal on photosynthesis, carbohydrate accumulation and on the distribution of assimilated ^{14}C in wheat. *Ann. Bot.* 39:141-52, 1975.
2. Geiger D R. Effects of translocation and assimilate demand on photosynthesis. *Can. J. Bot.* 54:2337-45, 1976.
3. Setter T L, Brun W A & Brenner M L. Effect of obstructed translocation on leaf abscisic acid, and associated stomatal closure and photosynthesis decline. *Plant Physiol.* 65:1111-15, 1980.
4. Herold A. Regulation of photosynthesis by sink activity—the missing link. *New Phytol.* 86:131-44, 1980.