

This Week's Citation Classic®

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Boyer J S. Leaf enlargement and metabolic rates in corn, soybean, and sunflower at various leaf water potentials. *Plant Physiol.* 46:233-5, 1970.
(Department of Botany, University of Illinois, Urbana, IL)

Direct comparison was made of activities of photosynthesis, respiration, and leaf enlargement in plants from which water was withheld. Leaf enlargement was inhibited earlier and more severely than photosynthesis or respiration. When water was adequately supplied, growing leaves exhibited water potentials substantially below the water potential of the soil water. [The SCI® indicates that this paper has been cited in over 210 publications.]

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I arrived at the University of Illinois in 1966 carrying my newly developed isopiestic psychrometer for measuring the water status of plant tissue (water potential, osmotic potential, pressure potential). J.B. Hanson took over as head of the department, and, with much enthusiasm, encouraged me to work on how water affects plants. I began by experimenting with leaves that were still attached to the plant. In the psychrometer, they grew rapidly but had lower water potentials than the water supply. When their water potential was lowered slightly more, growth stopped.¹ This strange behavior made

me wonder whether leaf metabolism had been affected, and so I compared the sensitivity of leaf growth with the sensitivity of leaf metabolism.

I was amazed to learn that photosynthesis and respiration occurred at high rates throughout the growth response. This indicated that substrates were available and could be used even when the leaves did not grow.

However, it was difficult to reconcile how low water potentials could be associated with growth and also inhibit growth. Our concepts were helped when Fred Molz spent a summer in my laboratory, and we worked out the physical basis for water uptake by growing tissue. We called the associated water potentials "growth-induced" because they appeared to be caused by the properties of the enlarging cell walls.² We now know much more about them, and why growth may be inhibited when water potentials move slightly lower.³

The paper probably is cited because it compared some important physiological processes and was the first to show that growth is so sensitive to limited supplies of water. The persistence of photosynthesis and respiration indicated that other factors were controlling the growth process, and the presence of growth-induced water potentials suggested a possible means of growth regulation that had not been considered before.

I look back on this paper with pleasure because its observations were so unexpected. Virtually everything came as a surprise, probably to my readers as well. We find ourselves still working on some of its implications 16 years later.

1. Boyer J S. Relationship of water potential to growth of leaves. *Plant Physiol.* 43:1056-62, 1968. (Cited 160 times.)
2. Molz F J & Boyer J S. Growth-induced water potentials in plant cells and tissues. *Plant Physiol.* 62:423-9, 1978.
3. Boyer J S. Water transport in plants. *Annu. Rev. Plant Physiol.* 36:473-516, 1985.