

Barnett N M & Naylor A W. Amino acid and protein metabolism in Bermuda grass during water stress. *Plant Physiol.* 41:1222-30, 1966.
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During water stress in Bermuda grass leaves, free proline accumulates to ten to 100 times its control concentration. This is accompanied by a general loss of soluble protein, inhibition of protein synthesis, and turnover of most other free amino acids. [The *SCI*[®] indicates that this paper has been cited over 185 times since 1966.]

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"As a beginning graduate student in plant physiology at Duke University in 1961, I first elected to study water relations with Paul Kramer. I soon traded the physical uncertainties of water potential measurements for the more tolerable uncertainties of metabolism. So I proposed to Aubrey Naylor that I study the biochemistry of water stress in plants. Three reports in the literature had shown in passing that water-stressed plants accumulated proline.¹⁻³ Bruce Roberts, a forestry student in plant physiology, had found that many plants consistently accumulated large amounts of proline. I decided to determine the extent, correlation with stress, and time course of this proline accumulation in some crop plant. I grew Bermuda grass plants, pulse-labeled them with ¹⁴CO₂ or ¹⁴C-glutamic acid, and

measured amounts and radioactivities in each of the free and protein amino acids. One complete cycle of measurement and resin regeneration on our newly assembled amino acid analyzer took 27 hours; it was a circadian rhythm to which I was never successfully entrained.

"One reviewer of the resulting paper was H.B. Vickery, biochemist emeritus of the Connecticut Agricultural Experiment Station. He called the station to inquire about water relations. New staff member John Boyer, recently from Duke University, was put on the line anonymously. Vickery: 'I have an interesting paper on amino acids and drought. The authors measured water potential with a thermocouple psychrometer [slowly pronounced] described by Boyer. Can you enlighten me about that?' Boyer: 'Of course. I'm Boyer!' After a few seconds of silence, conversation resumed, and the reviewer recommended publication.

"The publication of two PhD theses, mine at Duke University and Cecil Stewart's at Cornell University,^{4,5} established proline accumulation as a general phenomenon during drought. I mistakenly thought that there would be little further interest. Instead, I have been surprised by the citations, and Stewart has become the acknowledged expert on this topic.⁶

"Naylor's support and encouragement were of course crucial. His interests span all of plant metabolism and growth and development, and he has never hesitated to make contributions in new areas of plant physiology. Partly for his wide range of contributions, he received the Charles Reid Barnes Life Membership Award of the American Society of Plant Physiologists in 1981."

1. Chen D, Kessler B & Mommelle S P. Studies on water regime and nitrogen metabolism of citrus seedlings grown under water stress. *Plant Physiol.* 39:379-86, 1964.
2. Kembel A R & MacPherson H T. Liberation of amino acids in perennial ryegrass during wilting. *Biochemical J.* 58:46-50, 1954.
3. Prusakova L D. Influence of water relations on tryptophan synthesis and leaf growth in wheat. *Fiziol. Rost.* 7:139-48, 1960.
4. Stewart C R & Hanson A D. Proline accumulation as a metabolic response to water stress. (Kramer P J & Turner N C, eds.) *Adaptations of plants to water and high temperature stress.* New York: Wiley, 1980. p. 173-89.
5. Thompson J F, Stewart C R & Morris C J. Changes in amino acid content of excised leaves during incubation. I. The effect of water content of leaves and atmospheric oxygen level. *Plant Physiol.* 41:1578-84, 1966.
6. Stewart C R, Morris C J & Thompson J F. Changes in amino acid content of excised leaves during incubation. II. Role of sugar in the accumulation of proline in wilted leaves. *Plant Physiol.* 41:1585-90, 1966.