

This Week's Citation Classic

Weatherley P E. Studies in the water relations of the cotton plant. I. The field measurement of water deficits in leaves. *New Phytol.* 49:81-97, 1950. [Department of Botany, University of Manchester, England]

Various bases for expressing the water content of leaves which would give a measure of their water deficit were compared. The field water content expressed as a percentage of the turgid water content proved satisfactory. Practical details are given. [The SCI® indicates that this paper has been cited over 170 times since 1961.]

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August 15, 1980

"This work was carried out in Uganda where I was in the Colonial Agricultural Service. Cotton was the main cash crop of the country and its depredation by pests and diseases a matter of great economic importance. One of these pests was the *Lygus* bug which attacked leaves causing extensive shot-holing and hence loss of crop.

"It was pointed out to me by an entomologist colleague that the ease with which *Lygus* could insert its proboscis into the leaf cells might be a question of the turgidity of the cells—the more inflated the cells, the more easily were they punctured. It might therefore be useful to study the response of water stress in the cotton plants to environmental factors and attack by *Lygus*. The question was how to measure the water stress in plants growing in the field. I had little recollection of methods described in the

literature and library facilities in Uganda at that time were virtually non-existent. However I recalled that T.G. Mason of the Cotton Research Station in Trinidad had suggested that leaf discs floated on water would become fully turgid and their increase in water content might give a measure of the water deficit in the tissues. This was tried out by a fellow student at Imperial College, Trinidad, on cocoa leaves but it failed to work. Nonetheless, it seemed worth trying on cotton. Leaf discs were sampled at dawn and in the middle of the day at weekly intervals throughout the season. Fresh and dry weights were measured before and after flotation. It was found that there were marked age trends in water content expressed on a dry weight basis. The water content decreased with age and fluctuations in relation to changes in environmental conditions were completely masked. In contrast the field water content expressed as a percentage of the turgid water content (which I called the 'relative turgidity') showed no age trends, but revealed fluctuation which appeared to be related to environmental conditions.

"Clearly the applicability of this technique went beyond the *Lygus* problem in Uganda. However I still had this in mind when I coined the term relative turgidity. Of course, there was no suggestion that this was a measure of the relative turgor pressure, but some plant physiologists have protested that relative turgidity is confusing in its connotation. I agree that the term 'relative water content' is preferable and indeed this is now generally used.

"The saturation method was not new. A number of workers (Thoday, 1921;¹ Stocker, 1929;² Runyon, 1936;³ and Killian, 1947⁴) saturated leaves or whole shoots by placing them in a saturated atmosphere with their cut ends underwater. However this paper represents the first use of leaf discs which permit the sampling of a whole group of plants in the field. Further it gave a precision to the measurements which had not been attained previously. No doubt this is why so much use has been made of it and it still has its place today."

1. Thoday D. On the behavior during drought of leaves of two Cape species of *Passerina*, with some notes on their anatomy. *Ann. Bot. Lond.* 35:585-601, 1921.
2. Stocker O. Eine Fieldmethode zur Bestimmung der momentanen Transpirations—und Evaporationsgrösse. *Ber. Deut. Bot. Ges.* 47:126-9, 1929.
3. Runyon E H. Ratio of water content to dry weight in leaves of the creosote bush. *Bot. Gaz.* 97:518-53, 1936.
4. Killian C. Le déficit de saturation hydrique chez les plantes sahariennes. *Rev. Gén. Bot.* 54:81-101, 1947.