CC/NUMBER 47
NOVEMBER 23, 1987

This Week's Citation Classic®

Shaw M & Manocha M S. Fine structure in detached, senescing wheat leaves. *Can. J. Bot.* 43:747-55, 1965.
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This paper described the time course of membrane disruption and sequential loss of organelles in mesophyll tissue during senescence on water. The endoplasmic reticulum was altered in two to three days with only the plasma membrane remaining intact after six days. Kinetin markedly delayed disruption and yellowing. [The *SCI*® indicates that this paper has been cited in over 135 publications.]

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September 24, 1987

In 1950 at the tender age of 26 and fresh from a postdoctoral year at the Botany School in Cambridge, I was appointed the University of Saskatchewan's first and, for some years, only plant physiologist. One morning in 1952 the university president, W.P. Thompson, a geneticist who had been instrumental in promoting research on the breeding of rust-resistant wheats in western Canada, appeared unannounced at the door of my office. He came to extend an offer of generous research support, provided I agreed to work on the "physiology" of rust. His invitation was inspired by the devastating effects of a virulent strain of stem rust, Race 15B, on the prairie wheat crop and the mounting clamour for help from farmers' organizations. With a vision of the antique devices then constituting the department's physiological equipment clearly in focus, I took the bribe! Thus it was that my research career became and has remained devoted to the rusts.

J.W.T. Spinks, who later succeeded Thompson as president of the University of Saskatchewan, kindly arranged for my instruction there in the use of radiotracer techniques. When D.J. Samborski joined me in 1953, we showed that the increase in respiration rate and accumulation of radiotracers at rust infection sites in wheat leaves were accompanied by increased activity of the pentose phosphate pathway.[1] These and other results,[1] together with classical observations on the swelling of host-cell nuclei,[2] focussed my attention on the nucleic acids. My colleague, J.M. Naylor, and my students, H.S. Whitney, W.A. Quick, and P.K. Bhattacharya, then began chemical and cytochemical analyses of nucleic acid and protein levels following infection. Since infection accelerates senescence, uninfected leaves senescing on water or kinetin were also examined.

Joining me in 1963, Mohan S. Manocha, now professor of biology at Brock University, quickly became our resident electron microscopy expert and began studies on fine structure in mesophyll cells of detached wheat leaves during infection and senescence.

The paper thus arose from research on the physiology of wheat rust. The overall sequence of the changes in fine structure that it describes is still generally applicable, and it is also true for cells without chloroplasts.[3] Its companion paper[4] demonstrated, on the same time scale, that senescence was characterized by rapid losses in protein and RNA from chloroplasts, and in RNA, but not in histone or DNA, from nuclei.

Taken together the two papers were not only among the first that provided a sequential picture of cytochemical and fine structural changes during the progress of senescence, but they also provided a basis for comparison with the effects of rust infection on susceptible host tissue. These, I suppose, are the reasons why the paper is frequently cited by both physiologists[3,5] and pathologists.[6]

1. **Shaw M.** The physiology and host-parasite relations of the rusts. *Annu. Rev. Phytopathol.* 1:259-94, 1963. (Cited 125 times.)
2. **Allen R F.** Cytological studies of infection of Baart, Kanred and Mindum wheats by *Puccinia graminis* forms III and XIX. *J. Agr. Res.* 21:571-604, 1923.
3. **Noodén L D & Thompson J E.** Aging and senescence in plants. (French C E & Schneider E L, eds.) *Handbook of the biology of aging*. New York: Van Nostrand and Reinhold, 1985. p. 105-27.
4. **Shaw M, Bhattacharya P K & Quick W A.** Chlorophyll, protein, and nucleic acid levels in detached, senescing wheat leaves. *Can. J. Bot.* 43:739-46, 1965. (Cited 50 times.)
5. **Thimann K V,** ed. *Senescence in plants*. Boca Raton, FL: CRC Press, 1980. 276 p.
6. **Bushnell W R.** Structural and physiological alterations in susceptible host tissue. *The cereal rusts*. (Bushnell W R & Roelfs A P, eds.) New York: Academic Press, 1984. Vol. I. p. 477-507.

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