

Rovira A D. Plant root exudates. *Bot. Rev.* 35:35-57, 1969.

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Plant roots exude a wide range of organic substances that act as substrates for certain groups of soil microorganisms. These exudates influence the biological and chemical properties of soil and are important in plant nutrition and root diseases. [The SCI® indicates that this paper has been cited in over 175 publications since 1969.]

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When I was first asked for this commentary in 1981, I didn't take up the offer because my current research on root diseases is a long way from the basic root exudate research that I started some 25 years previously. Also, I asked, "Who will bother to read my explanations why an article on root exudates should be so widely quoted?" However, when a cynic told me recently that scientific articles are cited as often for putting forward a wrong hypothesis as for making a significant contribution to science, I thought it time to look for reasons for the popularity of my review. I wrote the review after 14 years in the field of root exudates because I felt a need to produce an article for soil and plant scientists as well as for soil microbiologists and root pathologists.

My research on root exudates began in 1954 at the Microbiology Institute of the Royal Agricultural College of Sweden, Uppsala, where I had gone on a CSIRO student-

ship because Uppsala was a centre of excellence for the then-new technique of paper chromatography. It was known that organic compounds were exuded from roots, but before paper chromatography, the identification and quantification of the components of exudates were difficult and time consuming. I had the equipment and greenhouse facilities at the Microbiology Institute, while there were chromatography experts at the nearby Biochemistry Department of the University of Uppsala. So began a fruitful period of research.

It is interesting how in science discoveries are often made at the same time by individuals working independently in different parts of the world. The root exudate field is a good example. Katznelson and colleagues in Canada¹ and I in Sweden² quite independently applied paper chromatography to root exudates in 1954, and each of us had "papers in press" by 1955. There followed many papers, mainly by soil microbiologists, so by 1969 I felt the need for a review of the field and the need to interest plant physiologists. At that time, most plant physiologists and soil chemists ignored the fact that "rhizosphere chemistry" may differ from soil chemistry and hold the key to the availability of nutrients to plant roots. Recent publications on the root-soil interface indicate that the review alerted researchers in these disciplines to the importance of root exudates.

Recent ¹⁴C studies with plants growing in sand or soil have shown that 10 to 20 percent of the total photosynthate is released from roots into soil.^{3,4} Much of this carbon is released as "root-derived carbon" that includes cortical cell residues, lysates, and exudates.⁵ Such large amounts of carbon entering the soil under pasture or crop affect microorganisms, root pathogens, soil animals, and nutrient availability.⁶

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