

Staples R C & Stahmann M A. Changes in proteins and several enzymes in susceptible bean leaves after infection by the bean rust fungus.

*Phytopathology* 54:760-4, 1964.

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Small changes in the chromatographic patterns of leaf proteins were found after infection of bean leaves by *Uromyces phaseoli*, an obligate fungal pathogen. The infection process was accompanied by shifts in protein synthesis both in the fungus and in the leaf. [The SCI® indicates that this paper has been cited in over 105 publications since 1964, making it one of the most-cited papers ever published in this journal.]

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"When a pathogen like the bean rust fungus colonizes a bean leaf, all of the materials needed for growth and sporulation are obtained from the host plant. In order to know more about the kinds of things that the pathogen does to the host plant, I wanted to study the changes in the quantities and properties of some of the proteins during the course of infection. Barrett and McLaughlin<sup>1</sup> had reported in 1954 that there were changes in electrical charges on several proteins, but in the meantime, newer techniques in protein separation had been developed.<sup>2-4</sup> Improved techniques in enzyme histochemistry had also become available.<sup>5</sup> Mark A. Stahmann was then one of the leaders in the field of protein separation technique, and I took a sabbatical leave from Boyce Thompson Institute in order to learn some of this technology from him.

"Stahmann was in the biochemistry department at the University of Wisconsin, and his group then included 13 graduate students and eight postdoctoral fellows. It was a happy group, and learning all those techniques was virtually painless. Courses of study in protein chemistry were a different matter.

"The primary problem that we had to solve was to prepare an extract of undegraded proteins. This was a very difficult problem using plant material, and Stahmann had given considerable thought to it. It was for this reason that I looked for changes in particular enzymes rather than simply changes in soluble proteins which was then the fashion. I think that this made for a more useful and rigorous paper, and perhaps it is one of the reasons it has been cited so frequently. Even so, the techniques that we developed or assembled for study were not sufficiently sensitive to allow for an analysis of many of the dehydrogenases that we had been interested in because of their central role in metabolism.

"From all of this, we were able to show that there were small shifts in the synthesis of particular proteins both in the host and in the pathogen. We were also able to demonstrate that proteins from the pathogen were detectable constituents in extracts of the infected host, an important finding because until then one tended to overlook the contribution of the fungus.

"Most of my subsequent work has primarily dealt with metabolism of the pathogen alone. Very recently, using related but much newer techniques, we have begun to examine again the problem of gene activation during pathogen development.<sup>6</sup>

"In 1980, I was awarded the Humboldt-Preis by the Alexander von Humboldt Foundation, Bonn, Federal Republic of Germany. The work reported in this paper surely contributed to my selection for the award."

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