

## ***This Week's Citation Classic***

**Clemons G P & Sisler H D.** Formation of a fungitoxic derivative from Benlate. *Phytopathology* 59:705-6, 1969. [Dept. Botany, Univ. Maryland, College Park, MD]

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**Benlate fungicide rapidly decomposes in aqueous solutions to form benzimidazole carbamic acid, methyl ester (BCM). This compound is as toxic as Benlate to *Neurospora crassa* and *Rhizoctonia solani*. The rapid rate of Benlate breakdown (half-life is one hour) suggests that BCM is responsible for fungitoxicity at sites removed from the point of application. [The *SCI*<sup>®</sup> indicates that this paper has been cited over 140 times since 1969.]**

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October 2, 1980

"This paper was prepared during my tenure in graduate school at the University of Maryland in College Park. Hugh Sisler was my thesis advisor and we were pursuing the toxic mechanism of the fungicide, benomyl. At that time, this compound was known as Benlate and was being developed as an agricultural pesticide by DuPont. Its appearance had generated intense interest among plant disease experts because of its plant systemic and therapeutic properties. Plant disease fungicides at that time were generally protectants on plant surfaces. The majority of available chemicals lacked the ability to penetrate plant tissues and control established fungal pathogens. Plant pathologists recognized the value systemic insecticides, long available, provided to the control of insect pests.

"We noted early in our work that thin layer chromatograms of benomyl consisted of two fungitoxic compo-

nents. After pursuing this as a research problem, we discovered that benomyl changed rapidly and spontaneously to benzimidazole carbamic acid methyl ester, a compound that was also potentially toxic to several fungi. This material is presently known as carbenbazim and is marketed as a fungicide in Europe.

"Initially, we were reluctant to interrupt our larger research pursuit, elucidation of benomyl's toxic mode of action, to publish on a singular finding. After more consideration, we decided the knowledge of benomyl's instability would be useful to other plant disease experts also involved in benomyl research. For our work, for example, this information was critical in positioning the radioactive label in tracer experiments designed to study the fungal metabolism of benomyl.

"After preparation and submission of the paper, several weeks had passed and we had not received acknowledgment of receipt from the editor. This delay caused us some concern about the possible loss of the manuscript in the mail.

"Around this same time, the November issue of *Phytopathology News*, the newsletter of the American Phytopathological Society, headlined an article describing a fire in the editorial offices. Only a few manuscripts were thought to have been lost. Evidently, ours was one. At any rate, we quickly mailed another copy and matters proceeded smoothly from that point until the article was published.

"There are likely several reasons that promote frequent citation of a scientific paper. This paper appeared very early in the research development of benomyl. Its findings were basic to virtually every succeeding benomyl related research project. Since this chemical has been the foremost plant systemic fungicide in the past decade, it has been the center of a lot of scientific attention and research publications. Hence, the frequent citation of this paper."