BIOLOGICAL PESTICIDES: NOT QUITE YET

***Biological Control of Pests, Pathogens and Weeds: Developments and Prospects.* Edited by R. K. S. Wood and M. J. May. Pp. 266. ISBN 0-5213-7108-2. (Royal Society, Cambridge University Press, Cambridge, UK: 1988).**

In their preface, the editors point out that the "impact [of biological control] on crop production has remained much less than" that of either breeding for resistance or chemical control. They also note however, an increased interest in biological control in the past few years, due to problems with chemical methods and the advent of biotechnology. This interest fostered a desire to assess the recent progress and present status of biological control. The goal of this volume, and the Royal Society Discussion that led to it, is to provide the basis for converting the burgeoning interest in biological control into increased use of biological control strategies.

The 14 papers in the book review biocontrol achievements in the context of the problems that must be overcome to develop successful biological control agents and successful application strategies. The editors succeed in presenting limitations and challenges of this area in a conceptual and historical framework. They also present some recent developments that will shape future work. The overall sense that emerges is that biological control is desirable, but highly complex; significant advances in basic and applied science are still needed before biological control will prove its potential.

Waage and Greathead provide a useful historical perspective in their chapter, "Biological control: challenges and opportunities." They point out that biological control received great interest around the turn of the 20th century, but despite the interest, met with only modest success. Unfortunately, no systematic approach was taken to analysing either successes or failures. After World War II, biological control received little applied or research interest, with the advent of the chemical pesticide era. Only in the 1960s and 1970s, with increasing awareness of the problems associated with chemical pesticides, was interest in biological control rekindled. The increased interest has not, however, significantly reduced the challenges that confront the development of biological control. These challenges are both conceptual—what are the properties of the most efficient natural enemies?—and practical—the perception of the public dealing with the release of biocontrol agents.

Cullen and Hasan consider the potential for biological weed control and the problems associated with its commercial development. A major difficulty with this approach is that tests of glasshouse effectiveness do not serve as predictors of field successes. This is presumably due, at least in part, to a lack of understanding of the detailed mechanisms of action. Another key problem is the required specificity, which has both biological and economic impact. In addition, the stability of specificity is not always known. Pathogens with a long history of specificity are desired, to avoid unforeseen problems with pathogens changing specificity in the field. Other problems must also be overcome, including mass production issues, viability during storage, and an understanding of the environmental requirements for infection. One interesting possibility may be the development of combination chemical/biological herbicides, since low doses of chemical herbicides can enhance plant sensitivity to pathogens. Despite these problems, there are currently two mycoherbicides registered for use in the USA: *Colletotrichum gloesporioides* f. sp. *aeschynomene* for *Aeschynomene virginica*, and *Phytophthora palmivora* for control of *Morrenia odorata*.

The chapters by Schippers and Deacon on controlling soil-borne plant pathogens, along with that of Cook on environmental management, provide a good perspective on problems in developing biocontrol agents directed against soil-borne pathogens. A number of the limitations to performance are becoming understood, for example soil moisture and temperatures, and competition with native microflora all limit bacterial proliferation on the root. With bacterial inoculants, such as those described by Cook and Schippers, biotechnology is readily applied, both to enhance basic understanding and to enhance the performance of biocontrol agents.

A concern appearing in many chapters, and which is covered separately by Jutsum, is the limitation imposed by commercial requirements for crop protection products. Perhaps the most important aspect is the issue of host specificity, which is desirable environmentally but not economically for companies interested in biocontrol. Commercial constraints also lead to an emphasis on organisms that must be introduced in large numbers periodically, not on classical approaches to biological control. For these and other reasons, Jutsum feels, biocontrol will only be developed where (1) insufficient chemical control is available, (2) conventional chemical agents are too expensive, (3) governments restrict the use of chemicals, or (4) the environment is controlled, such as in glasshouses.

Several authors point out the requirement for genetic engineering of biocontrol agents to achieve acceptable performance. Given the specificity of biocontrol agents, these research and development costs must be kept low if biologicals are to be developed in this way. From the industrial perspective, Jutsum notes that the most likely approaches are combinations, with specific chemicals and biologicals used together.

Other chapters deal with viruses as biocontrol agents, controlling aphids and other insects; additional examples of biocontrol strategies are also given. Overall, the volume deals with many important challenges to the successful development of biocontrol agents; it is worthwhile reading for anyone actively working in, or having some background in, this area. One hopes a future volume will focus less on problems that must be overcome to develop the full potential for biocontrol, and more on prospective solutions that will lead to the development of a successful biocontrol industry.

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