



# **BIOLOGICAL CONTROL**

*Proceedings of an AAAS Symposium  
on Biological Control, held at Boston, Massachusetts  
December 30-31, 1969*

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**PLENUM PRESS • NEW YORK-LONDON • 1971**

Library of Congress Catalog Card Number 79-157149  
SBN 306-30532-1

© 1971 Plenum Press, New York  
A Division of Plenum Publishing Corporation  
227 West 17th Street, New York, N. Y. 10011

United Kingdom edition published by Plenum Press, London  
A Division of Plenum Publishing Company, Ltd.  
Davis House (4th Floor), 8 Scrubs Lane, Harlesden, NW10 6 SE, England

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Printed in the United States of America

## PREFACE

The explosive increase in the world's human population, with consequent need to feed an ever-increasing number of hungry mouths, and the largely resultant disturbances and pollution of the environment in which man must live and produce the things he needs, are forcing him to search for means of solving the first problem without intensifying the latter. Food production requires adequate assurance against the ravages of insects. In the last three decades short-sighted, unilateral and almost exclusive employment of synthesized chemicals for insect pest control has posed an enormous and as yet unfathomed contribution to the degradation of our environment, while our insect pest problems seem greater than ever. Properly viewed, pest control is basically a question of applied ecology, yet its practice has long been conducted with little regard to real necessity for control, and in some cases, with little regard to various detrimental side-effects or long-term advantage with respect, even, to the specific crop itself. This book deals fundamentally with these questions.

The development of pesticide resistance in many of the target species, against which the pesticides are directed, has occasioned an ever-increasing load of applications and complexes of different kinds of highly toxic materials. This has been made even more "necessary" as the destruction of natural enemies has resulted, as a side effect, in the rise to pest status of many species that were formerly innocuous. The application of broad-spectrum pesticides thus has many serious and self-defeating features. Yet the greatest fault is the environmental pollution by chemical residues or the immediate harmful action on non-target species (including the natural enemies serving to control the insect pests), fish, birds, and other wildlife, and even man himself.

The need for greater use of non-chemical methods of pest control has been a recurrent theme from many quarters. The President's Science Advisory Committee report "Restoring the Quality of Our Environment," The National Academy of Sciences' volume, "Scientific Aspects of Pest Control," the formal

worldwide program of the International Biological Program (IBP), and many other sources emphasize this need.

Some novel and highly successful results such as the sterile male technique developed by Dr. E. F. Knipling have recently been obtained, and promising avenues of pest control include the use of biochemical controls (e.g., hormones and pheromones) highly specific to the insects. However, a feasible non-chemical method of control is already available—i.e., biological control (the action of parasites, predators and pathogens). These agents, together with intrinsic resistance factors, constitute Nature's own method. This method is often grossly underrated, under-researched, and only minimally applied. This statement applies significantly to much of the United States and Western Europe where pesticides have been most widely used. In these regions, many entomologists highly competent in their own disciplines commonly dismiss biological control as a significant option even though little or no real effort has been made and little insight offered upon which such a negative attitude could be based. Such men appear to assume, erroneously, that the method has been adequately tried but has failed.

If we are to reverse the trend toward an ever-intensified overloading of the environment with polluting and highly toxic pesticides, we must show that biological control, combined with restricted usage of selective chemicals, use of resistant varieties and other integrative measures can, in fact, solve many of our pest problems without resort to such disturbing and polluting chemicals. Biological control, where effective, is cheap, usually persistent, without need for recurrent expense, entails no significant genetic counter-attack in the pests in nature (with reference to insect pests and insectan parasites or predators), does not occasion the rise to pest status of forms normally innocuous, does not add to the ever-growing problem of man's pollution of the environment, and is not attendant with the serious toxic hazards to the workers using the methods, to consumers of the products, or to our cherished and declining wildlife. Moreover, because of the expense in the use of other methods, it is often the only method available in underdeveloped countries—a contributing reason why the IBP is sponsoring this method. Biological control, moreover, is compatible with enlightened integrative control programs wherein restricted use of chemicals combined with cultural and other ecological methods are employed. In fact, biological control is usually a key aspect of integrated control programs, for this technique is manipulatable and augmentable, whereas other major aspects of natural control, e.g., the weather, are not.

The objective of this book is to present this approach as a significant and realistic option in our pest control programs.

The science and theoretical basis of biological control has made rapid strides in recent years, and there have been many recent successful applications of the method. At the same time, concepts have been advanced that

challenge the premises and indict the practices in this field. This book examines these concepts, premises and practices and lays before the scientific world and the lay public an expose of the potentialities for a much wider employment of biological control.

The book is essentially a *Proceedings*, being a collection of papers presented as a symposium of the Ecological Society of America and the American Association for the Advancement of Science held at Boston, Massachusetts, December 30 and 31, 1969.

Each paper is presented as a chapter, for convenient cross referencing. The papers have, however, been arranged, coordinated and edited for cohesiveness and unity of philosophy, for the most part. A unified document is presented, representing recent outstanding developments in both theory and application. The unity centers around the concept that biological control could be far more successful and find far greater use in pest control if adequate support were available and intensified effort could be made along sound ecological lines.

The emphasis is on documented cases of biological control and the use of biological control in developing integrated control programs around the world. The scope of the examples, geographically, systematically, and ecologically is sufficient to suggest that with persistence and imagination, biological control can be utilized anywhere. General procedures and the facilities used in this work, and even the important and fundamental areas embracing the systematics and biologies of the major groups of natural enemies available, are necessarily omitted. For an authoritative account of these areas, the reader is referred to the books "Entomophagous Insects" by C. P. Clausen, published in 1940 by McGraw Hill Book Company and "Biological Control of Insect Pests and Weeds," edited by Paul DeBach and published in 1964 by Reinhold Publishing Corporation, N.Y. and Chapman and Hall Ltd., London.

This book is divided into four logical sections. In Section I, the background to the problems posed by past practices in the use of pesticides (and a preview of the possibilities to be elaborated in later sections) are treated in the opening paper. Other papers deal with the theory, ecological basis, and technical means of assessing the action of biological control agents.

Section II presents outstanding recent examples wherein *classical* biological control has borne successful results, some of them involving a unique or novel approach. They deal with biological control of weeds in both terrestrial and aquatic environments, with scale insects, pests in glasshouse crops, a major threatening forest and orchard pest in eastern Canada, and a unique means of mass production and distribution of a parasite lacking good powers of dispersion in the control of a most severe pest of range grasses in hot, dry land regions of the U.S.A., Brazil, and other countries.

Section III is included because so many ecologists and economic entomologists around the world have long looked at biological control as something that just pertains to instances where *exotics* are involved. This section emphasizes that biological control exists all around us—that indigenous species, no less than exotics, may be very capable natural control agents. The cases considered in this section are restricted to the U.S.A. and Canada.

Section IV represents the culmination of all that is presented in Sections I, II, and III. It highlights the sorts of informational input required in a systems approach to ascertaining the strategies and tactics of an ecological pest control and points to the “pitfalls” along the way. Integrated control workers have been working at this for many years and in some outstanding cases, much headway has been made. These are reported as exemplary of what might be accomplished on a grander scale. The examples include control of cotton pests in California, of apples and peaches in Washington and California, use of a pathogen in the control of that real headache, the codling moth, and striking results obtained in recent years in Malaysia and Israel.

Lastly, I will make no effort to acknowledge individually the genuine and enthusiastic assistance and response from a great many people to whom I am grateful and who have contributed in many ways not obvious here to give the book its value.

I do wish, however, to express my deep appreciation to all the authors, to Dr. William S. Osburn, Jr., whose invitation led to development of the symposium, to Drs. F. R. Lawson, Philip S. Corbet and Maurice Tauber for their excellent chairing of sessions of the symposium, to Drs. P. S. Messenger and Robert van den Bosch who greatly assisted me in the planning, to Dr. J. E. Laing for much of the indexing, and to Mrs. Nettie Mackey and Barton Matsumoto for much technical assistance, and finally to Miss Shirley Tiangsing for excellent typing and computerized composition.

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