Ecological Management of Agricultural Weeds

Concerns over environmental and human health impacts of conventional weed management practices, herbicide resistance in weeds, and rising costs of crop production and protection have led agricultural producers and scientists in many countries to seek strategies that take greater advantage of ecological processes. This book provides principles and practices for ecologically based weed management in a wide range of temperate and tropical farming systems. After examining weed life histories and processes determining the assembly of weed communities, the authors describe how tillage and cultivation practices, manipulations of soil conditions, competitive cultivars, crop diversification, grazing livestock, arthropod and microbial biocontrol agents, and other factors can be used to reduce weed germination, growth, competitive ability, reproduction, and dispersal. Special attention is given to the evolutionary challenges that weeds pose and the roles that farmers can play in the development of new weed management strategies.

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Preface

Of the many books that have been written about weed management, most have focused on the use of herbicides. This volume is different. Instead of providing information about chemical weed control technologies, the emphasis here is on weed management procedures that rely on manipulations of ecological conditions and relationships. By focusing on ecologically based methods of management, we have been able to provide in-depth treatment of subjects that most weed science books treat only briefly.

Although the reader will find much information on the ecology of weeds here, the primary purpose of the book is not to explain weed ecology. Rather, our intent is to elucidate the role of ecological principles in weed management. We believe that ecology can provide a theoretical basis for weed science, much as physics provides a theoretical basis for engineering and biology acts as the theoretical basis for medicine. Accordingly, throughout this book we show ways in which insights into ecological processes provide explanations for the successes and failures of weed management and avenues for developing better management strategies.

This volume could be used as a textbook for an advanced course in weed management, but it was not written primarily for that purpose. Rather, we have attempted to offer the reader a critical analysis and synthesis of the literature on ecological weed management and relevant aspects of weed ecology. Several goals motivated this review process. First, we wanted to identify clearly the principles that underlie ecological management practices. Second, we wanted to assess the strengths and weaknesses of specific weed management tactics in different cropping systems. Third, we sought to identify the current gaps in understanding of ecological approaches to weed management. As we wrote, we regularly asked ourselves, "What are the interesting research questions relating to this subject, and how could they be answered?" Fourth, we wanted to point out possible new roles for weed scientists within

the context of dynamically changing agricultural systems. Finally, we sought to develop the argument that ecological weed management can greatly reduce herbicide use through the creation of agricultural systems that suppress weeds and resist their impacts.

We recognize that the latter point is likely to be controversial. Some controversy is desirable, however, for spurring discussion of the issues involved. In any case, we have attempted to be fully honest in disclosing our agenda.

Science, and particularly an applied discipline like weed science, has important effects on society. Those effects depend on which topics scientists choose to pursue and which they choose to ignore. The volume of work on ecological weed management is increasing rapidly due to rising public demand for environmentally friendly agricultural systems and food products, increasing environmental regulation of agriculture by governments, and changing priorities for public funding. Simultaneously, the increasing industrialization of farm production makes herbicides appear more essential than ever to many farmers and weed scientists. These conflicting pressures on the weed science community need to be confronted and addressed with a maximum of clarity and collegiality and a minimum of acrimony. The ways in which weed scientists resolve this tension will largely determine the fate of weed science as a discipline. We hope our book contributes perspectives that are useful during that process.

This book was conceived and created as an integrated work. The scope and organization of the book were decided at the outset, and we have striven to create unity in tone and perspective throughout. Every draft of each chapter received detailed scrutiny and comment from the other authors/editors. This developed consistency in style and allowed each successive chapter to build on concepts and information presented in previous chapters. Nevertheless, the essential ideas in any particular chapter were generated primarily by one or two of us, and it seemed desirable to indicate that fact with chapter bylines. Despite the identification of authorship on the chapters, we hope that readers will view this as a whole book rather than as a compilation of papers on assorted topics.

A work of this scope cannot be accomplished without the help and support of many people. We are especially indebted to the many colleagues who provided critical reviews of various parts of the manuscript. These include Carol Baskin, Susan Boyetchko, Robert Bugg, Douglas Buhler, Brian Caldwell, John Cardina, Nancy Creamer, Moacyr Dias-Filho, Francis Drummond, Michael Duffy, Frank Forcella, Eric Gallandt, Monica Geber, Carol Greiner, Vern Grubinger, Robert Hartzler, Jeff Herrick, Wayne Honeycutt, John Ikerd, Nicholas Jordan, Peter Marks, Diane Mayerfeld, Milton E. McGiffen Jr., Catrin

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