Crop Ecology

Productivity and Management in Agricultural Systems

Second Edition

Food security and environmental conservation are two of the greatest challenges facing the world today. It is predicted that food production must increase by at least 70% before 2050 to support continued population growth, although the size of the world's agricultural area will remain essentially unchanged.

This updated and thoroughly revised second edition provides in-depth coverage of the impact of environmental conditions and management on crops, resource requirements for productivity, and effects on soil resources. The approach is explanatory and integrative, with a firm basis in environmental physics, soils, physiology, and morphology. System concepts are explored in detail throughout the book, giving emphasis to quantitative approaches, management strategies and tactics employed by farmers, and associated environmental issues.

Drawing on key examples and highlighting the role of science, technology, and economic conditions in determining management strategies, this book is suitable for agriculturalists, ecologists, and environmental scientists.

David J. Connor is Emeritus Professor of Agriculture at the University of Melbourne, Australia. His research programs deal with land and environmental relationships of a range of irrigated and rainfed cropping systems. In 2003 he was awarded the Donald Medal for outstanding contributions by the Australian Society of Agronomy.

Robert S. Loomis is Emeritus Professor in the Department of Plant and Environmental Sciences at the University of California, Davis, USA. His research interests include photosynthetic productivity, nutrient and water management, and integrated simulation models. He holds numerous honors from scientific societies and universities worldwide. Most recently, in 2001, he was awarded Douter honoris causa, Universidade Técnica, Lisboa.

Kenneth G. Cassman is Professor of Agronomy at the University of Nebraska, USA. His research focuses on nutrient cycling and crop nutrient requirements, crop yield potential, and water productivity of irrigated crops. In 2006 he received the Agronomic Research Award from the American Society of Agronomy.

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DAVID J. CONNOR
University of Melbourne, Australia

ROBERT S. LOOMIS
University of California, Davis, USA

KENNETH G. CASSMAN
University of Nebraska, Lincoln, USA

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Preface

Humans make extensive use of land, water, energy, labor, and other resources in the production of crops and pastures. We do this because it is essential to our survival and well-being. As world population grows, so does demand for continuing success in agriculture. And as more land is used in agriculture, concerns for loss of natural ecosystems and biodiversity increase as well. The conflict between production and conservation can only be resolved with cropping systems that are highly productive, efficient, and sustainable.

Agricultural management involves plant communities and areas of land. It requires knowledge of individual plant behavior under crowded conditions and interactions of plant communities with aerial and soil environments. These organismal and higher levels of biological organization are the subjects of ecology at different spatial scales, but explanation of these behaviors depends upon integration of relevant knowledge spanning lower levels from molecules and cells to organs. Ecology can thus be characterized as an integration of other disciplines. In turn, however, it provides specialist disciplines with context and relevance and, further, explains that in isolation they rarely affect system outcome. Crop ecology has additional dimensions in agricultural technology that interface with engineering, information and social sciences, and perspectives provided through history.

The tools of crop ecology (strong basic physics, chemistry, and mathematics) are not different from those of other biological disciplines. Mathematical models are especially useful in integration and are generally appropriate to crop ecology. In essence, ecological thinking derives from an eagerness to understand the whole and a willingness to maintain a broad appreciation of component disciplines.

We designed this book as a text and reference for advanced undergraduate and post-graduate students and for practicing educators and industry professionals. It derives from our experience in teaching over many years and our frustration with the great breadth and diffuse nature of appropriate readings. We especially want to encourage young scientists to use information in orderly ways to expand our understanding of crop ecology, and to develop new ways in which it can be applied to the changing problems of plant production. We do not, however, see the book limited to agriculturalists. It can also provide ecological context for courses in environmental sciences that would benefit from an agricultural perspective.

Our approach is explanatory and integrative. Although we review many topics, and introduce some new topics slowly, the text generally builds quickly on basic plant

biology, soil science, environmental physics, and chemistry. Integration is apparent in system themes introduced at the outset and brought to a focus in several case studies (Chapters 16 and 17) that can serve as models for analysis of evolution and management in other farming systems. The final chapter seeks a vision and analysis of the challenges facing agriculture to 2050.

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