Organic Farming: The Ecological System

Charles Francis, Editor

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Foreword

The science of crop production has advanced considerably with increased understanding of genetics, cellular biology, cellular physiology, soil plant interfaces, nutrient uptake, pest interactions, stress physiology, systems biology, ecology, soil water relations, economics, and basic soil and crop sciences. The application of this knowledge to organic crop production has been relatively limited in terms of years and volume of research, but significant new information has been obtained in the past 20 years as organically produced crops have increased to more than 2% of our food consumption in the United States.

Attention to organic farming practices and systems by state, federal, and nonprofit research groups has been welcomed by the organic farming community. Long dependent mainly on farmer experiences, those who produce organic crops and livestock are now working together with scientists to uncover mechanisms and better understand how nonchemical methods work. This collaboration of researchers with farmers is a good example of the potential for cooperative research that is important in advancing our knowledge in this emerging sector of the food system. The focus on ecology of farming is an essential foundation for understanding systems and improving production.

During the past five years the amount of research has increased considerably, with a significant increase in federal funding for organic research. We have seen an increased number of presentations and posters on organic research at the past several ASA–CSSA–SSSA meetings and more publications in our major journals. The Societies' Book and Multimedia Publishing Committee has observed this growth, and yet observed that there is no general reference work on organic production in the United States that is comprehensive and suitable as a college textbook that brings all the elements together. This led us to solicit an editor to develop such a reference. We appreciate the willingness of Dr. Charles Francis, of the University of Nebraska Agronomy and Horticulture Department, to take the lead and work with colleagues in this effort. His research and teaching in sustainable systems and special focus on organic production, along with his interactions with the organic farming community, make him an appropriate editor. The efforts by experts to develop the theme for each chapter and the excellent work by Society staff to transform the manuscript into an outstanding publication are easily recognized.

While much is controversial in the comparisons of organic and non-organic systems, those students, farmers, and scientists who are interested in learning more about the practices that lead to successful certification will find this new reference to be invaluable. For instructors offering courses in organic crop and animal production this would serve well as a textbook or reference book. A definitive work such as *Organic Farming: The Ecological System* will set the stage for research, extension, and education for many years to come.

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Preface

Agriculture is going through a profound revolution, one that rivals the industrial revolution of the 19th century and the green revolution in the 20th century. These previous changes transformed industries based primarily on local resources and principally serving local markets to more complex systems using high levels of technology. These have evolved to become more fossil fuel intensive, less efficient in output per unit energy input, and more global in their markets. Some people define current agricultural changes only in terms of specific technologies, such as transgenic crops and site-specific input use determined by GPS spatial methods. Yet there is a more profound change taking place mostly at the grass roots—a recognition that the resilience and sustainability of ecology and natural systems have much to teach modern agriculture. Organic farming systems are one manifestation of this new awareness.

Over the past decade, worldwide sales of organic crop and livestock products have expanded 10 to 20% per year (Lockie et al., 2006; Greene and Dimitri, 2007; Organic Trade Association, 2007), increasing interest in organic farming as a potentially profitable and more environmentally benign alternative to conventional production methods. Sales of organic products in 2006 exceeded $16 billion in the United States and reached $40 billion globally, with no drop in this market expected in the near future (U.N. Food and Agriculture Organization, 2007). Prices at the farm gate for organic products may be 10 to 300% greater than for conventional products. In spite of this price differential, sale of organic food continues to grow in the United States, Europe, Japan, and elsewhere. Matt Liebman and Adam Davis, co-authors of Chapter 8, provide a useful overview delving into this intriguingly counter-intuitive economic situation.

To participate in the current food system, it is imperative that agronomists and horticulturists master the practices, systems design, certification process, and details of that system's organic farming sector. The last American Society of Agronomy (ASA) book on organic farming was published more than two decades ago (Bezdicek and Power, 1984); to say that much has happened in research and development since that publication would be a gross understatement. Combining farmer experience and wisdom with the best that science has to offer can lead us to a better understanding of organic systems' mechanisms, as well as how we can design them to both meet human needs and preserve an environment where we would like to live. Beyond their production, economics, and environmental impacts, we are also learning that organic farming and food systems have potential to revitalize the rural landscape and its communities—areas that, as a result of industrial agriculture, are currently highly exploited, depopulated to some degree, and lacking in essential human and ecosystem services on which our long-term well-being depends.

In a series of integrated chapters by people in academic and nonprofit groups working on organic farming and food systems, we present a window on current research and development and a glimpse of a more desirable future for us all. We recognize up front that much of both innovation and application of organic farming methods have come from farmers, and that as researchers we build on

this legacy in the United States, Europe, and elsewhere. This book represents a current look at what we know about organic farming practices and systems, primarily from the U.S. and Canadian perspectives.

A brief history of organic farming and an overview of the legal certification process in the U.S. are presented in Chapter 1 by Charles Francis and Justin Van Wart. The rapid standardization of products and their labeling were necessary steps in the growth of organic food markets, yet they introduce a number of challenges, since those efforts led much of our organic production and sales to resemble the industrial model. The ecological tone of the book is set by Laurie Drinkwater from Cornell University in Chapter 2, where she explores the importance of ecological knowledge as the foundation for not only organic farming but for sustaining food systems into the future. Studies of organic systems require holistic research strategies that can differ from traditional experimental design.

Careful systems design is essential for successful organic farming. One of the key practices that reflects the essential biodiversity needed in farming systems is crop rotation, whose principles and specific examples are described in Chapter 3 by Paul Porter from University of Minnesota. Natural systems are characterized by plants and animals, and the closest we can come in agriculture is to design crop–animal systems that are tightly integrated on the farm, a topic discussed in Chapter 4 by Martin Entz and J.R. Thiessen Martens from Manitoba. The essential role of forages in these complex farming systems is presented in Chapter 5 by E. Ann Clark of Guelph University in Ontario. How major grain, oil seed, and specialty crops are grown and marketed organically in the United States is described in Chapter 6 by Kathleen Delate of Iowa State University.

Specific organic practices are explored in the next section on soil fertility and pest management. Joseph Heckman of Rutgers University, Ray Weil of University of Maryland, and Fred Magdoff from University of Vermont are three of the best informed and most prolific authors on the subject of organic cropping and soil nutrient needs, a topic they present in Chapter 7. Innovative nonchemical methods for vegetation management in cropping systems are described in Chapter 8 by Matt Liebman of Iowa State University and Adam Davis of ARS/USDA in Urbana, Illinois. Understanding the biology of pests is critical to managing their impacts on crop plants; George Bird and colleagues from Michigan State University and Rodale Research Center provide an overview of pest classification and alternatives for pest management in Chapter 9.

Marketing of organic products is an essential part of the food chain or food web that will provide farm profits and lead to changes in the food system. In Chapter 10 Agricultural economist Hikaru Hanawa Peterson and horticulturist Rhonda Janke from Kansas State University describe the complexities and innovations that characterize the marketing of organic products in this fast-growing segment of the food industry. Sociologists Patricia Allen and Hilary Melcarek of U.C. Santa Cruz have published widely on the social impacts of alternative food systems and provide an overview of organic foods and food security in Chapter 11.

Organic research, teaching, and extension programs are new ventures for most of our land-grant universities, although they have been vital to informal education for decades. Nancy Creamer and colleagues describe in Chapter 12 the highly successful, integrated, and multi-institutional program in organic and sustainable agriculture research in North Carolina. Chapter 13, contributed by myself, Charles Francis from University of Nebraska, explores the growth of edu-

cation and extension in organics, including the important roles played by farmers and by nonprofit organizations in the United States. Chapter 14, also contributed by myself, surveys the future of organic farming and the major challenges and changes we are seeing in this sector. Finally, a perspective on the overall structure of the agricultural industry and the future of the rural sector is envisioned in Chapter 15 by Fred Kirschenmann, a North Dakota farmer and active leader at Iowa State University.

These scholarly chapters describe the past, present, and future of organic farming in the U.S. and Canada. We recognize the parochial coverage of this important topic, as there are limited references to and no contributions from scientists and educators in Europe, from the Indian sub-continent, and other important centers of organic research and development. There are also many innovative consumer-driven marketing strategies, for example the large organic consumer network in Japan. Countries in the Nordic Region and some in northern Europe have set specific national goals to achieve a certain level of organic food by a specific year. There are also important advances being made in emerging economies, where in fact much of the farming is de facto organic due to the lack of chemical pesticide and fertilizer inputs. We recognize these initiatives and urge the serious reader to explore this wide range of activities through research or through travel and personal experience.

Organic Farming: The Ecological System provides a snapshot of programs and some history of development of this emerging part of local and global food systems. There will be many changes in the near future as a result of increasing economic pressures, growing appreciation of the impacts of chemicals on our food supply, livestock and human health, and understanding of how the structure of agriculture impacts the quality of life in the rural landscape and the ecosystem services available to us all. As a team of authors, we urge the American Society of Agronomy to continue to provide timely and relevant updates in this important area of agriculture.

Charles Francis, Editor

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