Nitrogen Fixation in Crop Production

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Foreword

Nitrogen is an essential constituent of proteins required for plant, animal, and human life. While earth's atmosphere contains an abundance of N, it must be transformed into chemical forms that are usable by plants, and which can then be used by people and animals. As world populations increase, biological N fixation for crop production becomes increasingly important. The editors of *Nitrogen Fixation in Crop Production* have brought together an outstanding group of scientists from around the world to address the various issues surrounding biological N fixation and to summarize scientific advances since the 1984 American Society of Agronomy, Crop Science Society of America, and Soil Science Society of America publication on the same topic.

Major advances have recently occurred with enhanced knowledge of legume and microbe genomes. The authors of *Nitrogen Fixation in Crop Production* summarize the scientific advances and present the implications for improved biological N fixation by crops, both legumes and nonlegumes, and in short- and long-term time frames. In addition, biological N fixation is an important economic issue for the global economy, as it represents the potential to reduce manufactured fertilizer N use in certain cropping systems. The economic and societal benefits of biological N fixation, especially where soil N supplies and funds for purchased inputs are limiting, are addressed, as is the potential for mitigation of greenhouse gases.

Our Societies are pleased to support the work of our scientists and editorial staff in developing this timely publication, and we thank them for this work. *Nitrogen Fixation in Crop Production* will serve as an outstanding resource for research scientists and graduate students, and for individuals developing public policy for research programs to improve crop production throughout the world.

Marcus M. Alley, President of the American Society of Agronomy
Kenneth H. Quesenberry, President of the Crop Science Society of America
Paul M. Bertsch, President of the Soil Science Society of America

Preface

The term "Green Revolution" was first used in 1968 by former USAID director William Gaud, who noted the spread of new technologies in agriculture. A major component of the revolution was a heavy reliance on chemical fertilizers, pesticides, and herbicides derived from fossil fuels, making agriculture increasingly reliant on petroleum products. The Green Revolution of this millennium is more broadly applied to clean energy sources, agricultural sustainability, and environmentally favorable industrial processes. The increased application of symbiotic nitrogen fixation in agriculture world-wide is but one aspect of the new revolution, but a critical one. The world's population continues to grow while the tillable acreage declines with each passing year. Agricultural resources will be partitioned between the traditional food, feeds, and fiber and the newly emerging need for bioenergy. Agriculture production is tied to political and economic relations between nations. Nitrogen fixation provides a means to meet the needs of a growing population with a nutritious, environmentally friendly, sustainable food supply.

Since the last book on nitrogen fixation in crop production was published by the American Society of Agronomy, Crop Science Society of America, and Soil Science Society of America in 1984, many exciting discoveries in nitrogen fixation have been reported—genomes have been sequenced, the "omics" approaches have been applied to both symbionts, new genetically modified crops have become commonplace in agriculture, and new nitrogen fixing plants discovered. Past books have focused on the applications of biological nitrogen fixation research to agronomic applications, with chapters on basic research from which readers could acquire a broad and thorough understanding of biological nitrogen fixation. Although the goal of this book is to continue this format and provide current information on the state of nitrogen fixation research and its applications, the economic consequences of symbiotic nitrogen fixation are also included in this volume. The chapters of this book were contributed by knowledgeable scholars—from basic and applied scientists to agricultural economists. It is our hope that these collected writings will provide a valuable resource and a stimulus to continue the rapid pace of exploration of symbiotic nitrogen fixation. As editors, we express our sincere thanks to all the authors who devoted their time and energy to this book.

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