Foreword

Agriculture is the indispensable base of human society and the nature and productivity of agriculture are determined by water and climate and largely directed by the products of agricultural research. Today, the world's population is 6.6 billion, and 5.1 billion live in the developing world where most of the world's existing poverty is concentrated. Currently, a billion people live on less than one dollar a day and spend half their income on food, 854 million people are hungry, and each day about 25,000 people die from hunger-related causes. The United Nations Millennium Declaration, agreed upon in September 2000, commits the world's nations to "eradicate extreme poverty and hunger." Solving the current problem would be sufficiently challenging, but what makes it even more daunting is that several aggravating features are magnifying. Over the next 50 years, the world population will increase by about 50% and climate change will probably result in more extreme variations in weather and cause adverse shifts in the world's existing climatic patterns. Water scarcity will grow and the demand for biofuels will result in competition between grain for fuel and grain for food, resulting in price increases. Furthermore, 75% of the world's people will live in cities, whose populations will need to be largely supported by a continuous chain of intensive food production and delivery. All of these adverse factors are occurring at a time when the developed nations are both reducing their investments in agricultural research and turning their remaining research investments away from productivity gains. If all of this weren't bad enough, the elite rice cultivars that dominate the food supplies of the millions of poor people in Asia have approached a yield barrier and production growth is slowing.

Each hectare of land used for rice production in Asia currently provides food for 27 people, but by 2050 that land will have to support at least 43 people. Feeding the 5.6 billion Asians in the 21st century will require a second Green Revolution to boost yields by 50% using less water and fertilizer. Theoretical models have been used to examine this problem and they suggest that this can be done only by increasing the efficiency with which photosynthesis uses solar energy. Fortunately, evolution has provided an example of a much more efficient photosynthetic system (C_4) than that possessed by rice or wheat (C_3). Maize, for example, is one of these C_4 plants. Boosting the photosynthetic efficiency of rice by changing it from C_3 to C_4 photosynthesis will be like supercharging a car's engine by fitting a new fuel injection system. Until the era of modern plant breeding, including genetic engineering, this was thought to be an intractable problem; now, there are many reasons for being optimistic about finding a solution. The chapters in this book are written by world-renowned experts and each of them offers special insights into the various forms of C_4 photosynthesis and how they might be introduced into rice.

The imperative for this project is necessity rather than curiosity. It will take an international consortium of research institutions to make C_4 rice a reality over the next 10 to 15 years. To that end, IRRI has formed a C_4 Rice Consortium to stimulate and conduct the research needed to invent C_4 rice. I am delighted to be able to use IRRI's resources to provide initial funds and we hope that donors will provide the support necessary to complete this important task.

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