PREFACE

Since the very earliest developments in agriculture, and probably even before then, diseases affecting crop plants have posed an ever-present, yet ever changing, threat to human survival. The Bible, for example, explicitly mentions blights, blasts, and mildew diseases of wheat. Not surprisingly, people sought to understand and mitigate the effects of disease on crop productivity, and many earlier cultures have sought divine aid in the fight against crop disease. The Romans, according to some historians, celebrated the festival of Robigalia: an attempt to mollify Robigus, the god thought to protect crops from disease, and his less benign sister Robiga (or Robigo), a primary goddess of Roman farmers, known as the spirit of mildews and rusts. However, even during this period there were attempts to understand plant diseases through the application of reason: an approach exemplified in the writings of Theophrastus (372–287 BC), who theorized about the nature of the diseases of cereals and other plants. Meanwhile, over many centuries farmers all over the world practiced domestication of plants from wild populations and selected the best and hardiest plants grown under agricultural conditions, thereby incidentally breeding plants resistant to disease.

In the modern world the deployment of crops possessing genetically based resistance is generally considered the best and most economical approach for disease control. This is especially true for protection against viruses because, so far at least, no chemicals are available that could provide the same degree of protection in the field against these pathogens, as fungicides do against fungi and oomycetes. The transfer by breeding of naturally occurring resistance genes from wild plants or land races to cultivated lines is still an ongoing process, and has been supplemented with other methods such as mutation, polyploidy breeding, and the generation of haploids. Genetic resistance against virus diseases can be surprisingly durable. A good example is that of cucumbers bred for resistance to *Cucumber mosaic virus*. This resistance, which depends on several genes, was found to be stable for many decades against different strains of this virus.

Even though the majority of plants are resistant to most viruses (the phenomenon of non-host or basal resistance), when viruses *are* able to infect a crop plant, obtaining durable resistance by breeding is not always possible. In certain cases, new virus strains overcome the

resistance and once again may cause severe crop losses. In addition, for some crops and viruses, no suitable sources of resistance can be identified among the wild relatives of a crop plant. Hence the need for greater understanding of natural resistance, and for the insights its study can provide for the development of novel crop protection approaches.

In the last few years, much has been learned concerning the mechanisms underlying several natural resistance mechanisms including *inter alia* RNA silencing, induced resistance, and resistance conferred by recessive and dominant genes, which will be discussed in this and the following volume of the *Advances*. In addition, research over the last two decades has made it possible to move resistance–conferring gene sequences between plants from different botanical genera, or into plants from other organisms, and even from the viruses themselves (*pathogen-derived resistance*). This work opened a new vista for plant virus control, and if combined with engineering for insect resistance could potentially provide protection not only against the viruses themselves, but also against their vectors. The work on pathogen-derived resistance also led directly to the discovery of a natural resistance and gene regulation mechanism, RNA silencing, that has ramifications throughout the whole of biomedicine. Nevertheless, these technologies face technical and sociological challenges, which are also addressed in these volumes.

In all parts of the world, but especially among the developing nations, agriculture faces the looming problems of emerging virus diseases, population growth, and ecological change. We hope that the articles in this volume and the following one will inform and stimulate research on natural and engineered resistance, and thereby contribute to the development of new approaches to disease control and the creation of new resistant varieties that are desperately needed.

We want to thank Professor Karl Maramorosch for inviting us to edit these thematic volumes; all of our contributors who have prepared comprehensive, stimulating, and thought-provoking reviews; the technical staff of the *Advances*, and specifically Mr. Ezhilvijayan Balakrishnan and Ms. Narmada Thangavelu from Chennai, India.

October 2009

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