Preface

Why Study Plant Pathology?

Plant pathology is the study of plant diseases. We could not survive on earth without plants, so their health is important to us. Photosynthesis is the source of the free oxygen necessary for aerobic respiration. Long ago, free oxygen became a component of the early atmosphere, leading to the creation of the ozone layer, which helps to protect us from ultraviolet radiation and makes life on land possible. Photosynthesis also is the source of fixed carbon, from which all organic molecules (including the components of our bodies!) are then produced. Directly or indirectly, plants provide all of the food on which the human population relies. In addition, plants provide feed for animals, shelter, fiber for clothing and paper, fuel, and ornamental flowers and landscape plants for our enjoyment.

Plant diseases reduce yields of food and cash crops, mar the beauty of ornamental plants, and reduce our ability to shelter and feed ourselves. In some cases, pathogens even produce toxic compounds that poison our food. It is impossible to separate plant diseases from the history and culture of humans. Plant diseases limit where crops can be grown and determine what foods are available to us. A single disease, late blight of potato, triggered the Irish potato famine of the 1840s and forever changed the history of Ireland and of North America, where many starving Irish peasants took refuge. Dutch elm disease has killed more than 5 million elm trees on the formerly tree-lined streets of cities in the United States and Europe. Citrus canker and soybean rust currently threaten multibillion dollar crops in the United States and around the world. Each year, local, state, and federal governments spend funds on quarantines and plant inspection services to control the movement of dangerous pathogens that threaten our food supply and the livelihoods of growers. The concern that bioterrorism may threaten genetically uniform crops, as well as farm animals and human populations, has made us more aware of the potential for damage by introduced pathogens. Billions of dollars are spent each year on the management of plant diseases, and yet it is estimated that plant diseases cause a 20% yield loss in food and cash crops. Of course, that does not mean that all yields are reduced by that amount. Some crops remain healthy, but others may be nearly destroyed, potentially causing starvation for large populations of people or loss of livelihood for farmers.

Aside from the practical aspects of keeping plants healthy, plant pathology is an amazing biological science that focuses on the interactions among host plants, pathogens, and the vectors that transmit the pathogens in various environments. Studies of the physiology and genetics of these interactions lead us to new discoveries in molecular biology and their applications in biotechnology. Knowledge of the ecological interactions of hosts and pathogens will help us understand our natural ecosystems, global climate change, and maintenance of biological diversity on our planet. All aspects of biology are encompassed in the study of plant pathology. This textbook and its accompanying CD-Rom are designed to introduce students to the fascinating study of plant diseases.

How to Use This Textbook and CD-Rom 

Hints for Students

Textbook Resources. The pages of each chapter are arranged in two columns. The inner column is text, with summaries in bold type at the ends of sections. The purpose of these summaries is to help you to determine the important points of the preceding section and to find information more easily when you review the text of each section. The outer column contains images, illustrations, content summary boxes, and Disease Classics. Disease Classics are short summaries of important diseases that are typically studied in introductory courses. Most of the Disease Classics also exist as disease lessons in the APSnet Education Center (www.apsnet.org/education), where you will find full disease cycles, color photographs, and more detailed information. Appendix 1 is a list of the Disease Classics, with their locations in the textbook. Some boxes in the outer column have the heading "Did you know?" These are interesting cultural and historical facts about plant diseases. At the end of each chapter in the textbook, you will find recommended resources, study questions, Words to Know, CD-Rom exercises, and Internet research exercises.

Additional Resources. These include print references, titles of APS*net* Education Center publications on the accompanying CD-Rom, and (on the CD-Rom) direct links to additional online references and websites that require Internet access. The textbook provides the basic information related to the subjects in each chapter, but most students want to learn more about certain topics or about specific diseases that attack plants of interest to them. These resources provide color photographs and the additional information to help students do this.

Study Questions. Standard review questions and challenge questions are provided in the textbook. You should be able to answer the standard review questions when you complete the materials for each chapter. They will help you prepare for tests. To answer the challenge questions will require some research outside the textbook. Challenge

questions are designed to help you explore beyond the basic information in the textbook.

Words to Know. Important new vocabulary words are printed in bold in the textbook. One of the hardest parts of any new field of study is to learn its vocabulary. We are trying to make this easier by indicating which words are important and by providing direct links on the CD-Rom to the definitions in the Illustrated Glossary. When you go to the CD-Rom and click on a chapter, you will find a list of all of the Words to Know for that chapter, with each word linked to the glossary definition. Most of the definitions have an illustration or photograph that makes the new word easier to understand and remember. You do not need Internet access to use the Illustrated Glossary.

CD-Rom Exercises. These are designed primarily for identification practice. Included in these exercises are important symptoms, signs, vectors, and common diseases that beginning plant pathologists should know. Answers are provided. The exercises and images are on the accompanying CD-Rom. You do not need Internet access to complete these exercises.

Internet Research. You may have an interest in a specific crop or plant type, and the Internet research exercises have been designed to help you begin to study diseases that affect that commodity at the very beginning of your plant pathology course. As a starting point, Appendix 2 provides a list of common diseases of some economically important plants. Direct links to recommended websites are found in the descriptions of the Internet research exercises on the CD-Rom.

Plant pathology is a rapidly changing and important field of biology. Although this textbook is designed to provide the "essentials," there is much more to learn. We encourage you to continue to read, consult online resources, and take additional courses for a comprehensive education in plant pathology.

Hints for Instructors

Plant pathology courses vary in length and topics covered. Some include a laboratory component, and others do not. This textbook is arranged to meet the needs of students in these varied courses. The materials are presented in various formats, and students are asked to complete a variety of exercises. These provide opportunities for students with different learning styles to master the material.

This book should be used along with the resources available in the APSnet Education Center (www.apsnet.org/education). Many of the introductory materials from that site have been placed on the accompanying CD-Rom. All APSnet Education Center publications are peer-reviewed and updated every five years. Although this textbook refers students to existing publications, students should be encouraged to explore the more recent publications. Direct web links on the CD-Rom are included for additional materials, so students can access them easily. Updated CD-Roms will be made available periodically through APS Press.

CONTENTS

This textbook begins with an introduction to plant diseases and covers some basic concepts and vocabulary, illustrated by a case study of apple scab. Chapters 2–6 cover the major pathogen groups. We have tried to write these to be independent chapters, so they can be taught in the order preferred by the instructor.

A special note for Chapter 2. The fungal terminology taught in introductory courses varies, often depending on whether the course includes a laboratory or not. The first section of Chapter 2 emphasizes the basic biology and terminology required to understand fungi as plant pathogens. More detailed biology and terminology are in the second section of Chapter 2 for instructors who wish to include this material.

Chapter 7 describes abiotic problems. Chapter 8 describes plant diseases organized by symptoms because many students in introductory courses think about plant diseases based on their impact on the plant rather than according to the type of pathogen that causes the disease.

Chapter 9 helps students understand host-pathogen relationships: ecological, physiological, and genetic. The final two chapters are designed to help students understand plant disease epidemics, how human beings affect plant diseases and are affected by them, and the management of plant diseases.

CLASSROOM RESOURCES

Textbook Illustrations. Electronic versions of all textbook images, both photographs and diagrams, are provided on the CD-Rom for use in classroom presentations. For some illustrations, additional identification information has been added for instructor use.

Content Summary Boxes. These are all reproduced electronically for classroom presentations.

Study Questions. Instructors may wish to recommend certain questions for exam preparation or class discussions. Challenge questions require more information than is provided in the textbook and may be appropriate for group assignments.

We hope you find these new instructional resources for the study of plant pathology exciting and useful. We welcome your comments and suggestions.

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