

Detection and Diagnostics of Plant Pathogens

Plant Pathology in the 21st Century

Volume 5

For further volumes:
<http://www.springer.com/series/8169>

Maria Lodovica Gullino • Peter J.M. Bonants
Editors

Detection and Diagnostics of Plant Pathogens

 Springer

Editors

Maria Lodovica Gullino
AGROINNOVA
University of Torino
Grugliasco, Torino, Italy

Peter J.M. Bonants
Plant Research International,
Wageningen UR
Wageningen, The Netherlands

ISBN 978-94-017-9019-2 ISBN 978-94-017-9020-8 (eBook)
DOI 10.1007/978-94-017-9020-8
Springer Dordrecht Heidelberg New York London

Library of Congress Control Number: 2014950799

© Springer Science+Business Media Dordrecht 2014

This work is subject to copyright. All rights are reserved by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed. Exempted from this legal reservation are brief excerpts in connection with reviews or scholarly analysis or material supplied specifically for the purpose of being entered and executed on a computer system, for exclusive use by the purchaser of the work. Duplication of this publication or parts thereof is permitted only under the provisions of the Copyright Law of the Publisher's location, in its current version, and permission for use must always be obtained from Springer. Permissions for use may be obtained through RightsLink at the Copyright Clearance Center. Violations are liable to prosecution under the respective Copyright Law.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

While the advice and information in this book are believed to be true and accurate at the date of publication, neither the authors nor the editors nor the publisher can accept any legal responsibility for any errors or omissions that may be made. The publisher makes no warranty, express or implied, with respect to the material contained herein.

Printed on acid-free paper

Springer is part of Springer Science+Business Media (www.springer.com)

Foreword

This volume continues the series of books on “Plant Pathology in the 21st Century”, which started in 2010, in cooperation with the International Society for Plant Pathology and contains the lectures given at the 10th International Congress of Plant Pathology (ICPP 2013) held in Beijing, August 25–30, 2013.

At such Congress, several sessions dealt with aspects of detection and diagnosis of plant pathogens, which represent two fundamental steps in disease management decisions.

For both detection and diagnosis, new tools and technologies have been developed, which are often replacing old methodologies, permitting to be faster, more specific and more precise.

A quick and reliable detection method in combination with decision support systems is fundamental in order to reduce the damages caused by old and new pathogens, thus permitting to reduce the number of treatments and to contain the potential losses.

Molecular methods are available for a number of pathogens and the volume provide good examples of application in different production sectors. Innovative techniques and methods will be described to detect and identify different targets: destructive and non-destructive, air- or soil-borne, human and plant pathogens, in plants or seed-borne, native or emerging pathogens, on-site or lab-based. All to support international organizations to secure global trade and agriculture all over the world.

We believe that, besides representing a written testimony of ICPP 2013, this book will be useful for all plant pathologists as well as students in advanced courses.

We wish to thank all the colleagues who accepted to be part of this book, Zuzana Bernhart and her group at Springer for their continuous support and Laura Castellani for her skilful technical assistance.

Maria Lodovica Gullino
Peter J.M. Bonants

Contents

Part I Technologies

New Developments in Identification and Quantification of Airborne Inoculum	3
Steph Heard and Jonathan S. West	
siRNA Deep Sequencing and Assembly: Piecing Together Viral Infections	21
Jan Kreuze	
Use of Airborne Inoculum Detection for Disease Management Decisions	39
Walter F. Mahaffee	
Proximal Sensing of Plant Diseases	55
Erich-Christian Oerke, Anne-Katrin Mahlein, and Ulrike Steiner	

Part II Case Studies and Special Applications

Diagnostic Challenges for the Detection of Emerging Pathogens: A Case Study Involving the Incursion of <i>Pseudomonas syringae</i> pv. <i>actinidiae</i> in New Zealand	71
Robert K. Taylor, Joanne R. Chapman, Megan K. Romberg, Bevan S. Weir, Joel L. Vanneste, Kerry R. Everett, Lisa I. Ward, Lia W. Liefting, Benedicte S.M. Lebas, and Brett J.R. Alexander	
Detection of Human Pathogens on Plants	87
Li Maria Ma, Jacqueline Fletcher, and Guodong Zhang	
Plant Disease Diagnostics for Forensic Applications	103
Jacqueline Fletcher, Francisco M. Ochoa Corona, and Mark Payton	

Part III Role of Diagnostics in Plant Disease Management

Results of the EU Project QBOL, Focusing on DNA Barcoding of Quarantine Organisms, Added to an International Database (Q-Bank) on Identification of Plant Quarantine Pathogens and Relatives 119
Peter J.M. Bonants

On-Site Testing: Moving Decision Making from the Lab to the Field 135
Neil Boonham

Virtual Diagnostic Networks: A Platform for Collaborative Diagnostics 147
James P. Stack, Jane E. Thomas, Will Baldwin, and Paul J. Verrier

Development and Implementation of Rapid and Specific Detection Techniques for Seed-Borne Pathogens of Leafy Vegetable Crops 157
Maria Lodovica Gullino, Giovanna Gilardi, Giuseppe Ortu, and Angelo Garibaldi

Diagnosis of Plant Pathogens and Implications for Plant Quarantine: A Risk Assessment Perspective 167
Vittorio Rossi, Thierry Candresse, Michael J. Jeger, Charles Manceau, Gregor Urek, and Giuseppe Stancanelli

Index 195

Contributors

Brett J.R. Alexander Plant Health and Environment Laboratory, Ministry for Primary Industries, Auckland, New Zealand

Will Baldwin Department of Plant Pathology, Biosecurity Research Institute, Kansas State University, Manhattan, KS, USA

Peter J.M. Bonants Plant Research International, Wageningen UR, Wageningen, The Netherlands

Neil Boonham Plant Protection Programme, The Food and Environment Research Agency, York, UK

Thierry Candresse INRA and University of Bordeaux Virology Team, UMR 1332 Biologie du Fruit et Pathologie, Villenave d'Ornon Cedex, France

Joanne R. Chapman Previously Plant Health and Environment Laboratory, Ministry for Primary Industries, Auckland, New Zealand

Section for Zoonotic Ecology and Epidemiology, Linnaeus University, Kalmar, Sweden

Kerry R. Everett The New Zealand Institute for Plant and Food Research Ltd., Auckland, New Zealand

Jacqueline Fletcher Department of Entomology & Plant Pathology and National Institute for Microbial Forensics & Food and Agricultural Biosecurity, Stillwater, OK, USA

Angelo Garibaldi Center of Competence Agroinnova, University of Torino, Grugliasco, Italy

Giovanna Gilardi Center of Competence Agroinnova, University of Torino, Grugliasco, Italy

Maria Lodovica Gullino AGROINNOVA, University of Torino, Grugliasco, Torino, Italy

Steph Heard Department of Plant Biology and Crop Science, Rothamsted Research, Harpenden, UK

Michael J. Jeger Centre for Environmental Policy, Imperial College London, Ascot, UK

Jan Kreuze Laboratory of Virology, Peru International Potato Center (CIP), La Molina, Peru

Benedicte S.M. Lebas Plant Health and Environment Laboratory, Ministry for Primary Industries, Auckland, New Zealand

Lia W. Liefing Plant Health and Environment Laboratory, Ministry for Primary Industries, Auckland, New Zealand

Li Maria Ma Department of Entomology and Plant Pathology, National Institute for Microbial Forensics & Food and Agricultural Biosecurity, Oklahoma State University, Stillwater, OK, USA

Walter F. Mahaffee United States Department of Agriculture – Agricultural Research Service, Horticultural Crops Research Unit, Corvallis, OR, USA

Department of Botany and Plant Pathology, Oregon State University, Corvallis, OR, USA

Anne-Katrin Mahlein INRES – Phytomedicine, University of Bonn, Bonn, Germany

Charles Manceau Anses, French Agency for Food, Environmental and Occupational Health and Safety, Angers, France

Francisco M. Ochoa Corona Department of Entomology & Plant Pathology and National Institute for Microbial Forensics & Food and Agricultural Biosecurity, Stillwater, OK, USA

Erich-Christian Oerke INRES – Phytomedicine, University of Bonn, Bonn, Germany

Giuseppe Ortu Center of Competence Agroinnova, University of Torino, Grugliasco, Italy

Mark Payton Department of Statistics, Oklahoma State University, Stillwater, OK, USA

Megan K. Romberg Previously Plant Health and Environment Laboratory, Ministry for Primary Industries, Auckland, New Zealand

USDA-APHIS, Beltsville, MD, USA

Vittorio Rossi Università Cattolica del Sacro Cuore, Piacenza, Italy

James P. Stack Department of Plant Pathology, Biosecurity Research Institute, Kansas State University, Manhattan, KS, USA

Giuseppe Stancanelli European Food Safety Authority, Animal and Plant Health Unit, Parma, Italy

Ulrike Steiner INRES – Phytomedicine, University of Bonn, Bonn, Germany

Robert K. Taylor Plant Health and Environment Laboratory, Ministry for Primary Industries, Auckland, New Zealand

Jane E. Thomas Department of Plant Pathology, National Institute of Agricultural Botany (NIAB), Cambridge, UK

Gregor Urek Kmetijski inštitut Slovenije, Ljubljana, Slovenia

Joel L. Vanneste The New Zealand Institute for Plant and Food Research Ltd., Hamilton, New Zealand

Paul J. Verrier Department of IT and Computing, National Institute of Agricultural Botany (NIAB), Cambridge, UK

Lisa I. Ward Plant Health and Environment Laboratory, Ministry for Primary Industries, Auckland, New Zealand

Bevan S. Weir Landcare Research, Auckland, New Zealand

Jonathan S. West Department of Plant Biology and Crop Science, Rothamsted Research, Harpenden, UK

Guodong Zhang Center for Food Safety and Applied Nutrition, Food and Drug Administration, College Park, MD, USA