

Book review

Plant–pathogen interactions – Annual Plant Reviews, Volume 11. Edited by Nicholas J. Talbot. 2004. 264 pp. Blackwell Publishing, Oxford, UK. ISBN 1405114339. £89.50.

This monograph offers descriptions of the state-of-the-art of eight plant pathogen systems which have been selected for three main reasons. Firstly, they represent contrasting lifestyles and taxonomic groups; secondly, some of the most exciting developments in plant pathology have been made using these systems in recent years, and thirdly, they are (in general) important plant pathogens. Interestingly, the majority of these developments did not involve *Arabidopsis*. In this respect, it should be noted that the emphasis is on the pathogen rather than the host. The level of detail varies – some authors cover the biology of the selected organism in less than 20 pages, one uses 40. The emphasis is on describing the state-of-the-art of the system in question rather than comparing the different systems to each other.

The introductory Chapter (1), ‘Emerging themes in plant–pathogen interactions’ by Nicholas J. Talbot, University of Exeter, UK, provides an introduction to the molecular field by selecting some of the most recent developments. These are both exciting and new. Talbot does an excellent job in summarising them, discussing why they are new and exciting and raises issues as yet unresolved. Topics include: the increased knowledge of signal transduction systems in pathogens, specifically different protein kinase cascades; the cunning pathogenicity factors which are deployed to subvert host defences and metabolism by biotrophs; an overview of the host race-specific disease resistance genes; a brief presentation of the guard hypothesis, and genome projects for pathogens. The role *Arabidopsis* plays in understanding these general principles is made clear in this chapter. Given that chapters 6, 7 and 8 each describe in some detail the signal transduction pathways

regulated by protein kinases, chapter 1 could have used a little more space to draw out their differences and similarities.

My main problem with the remainder of this book is the audience. It is aimed at active researchers. Who are they? Molecular biologists and post-genomicists who want to learn about a particular pathogen? Traditional plant pathologists who want to obtain an overview of recent molecular developments? New post-docs and postgraduate students who need a comprehensive introduction to their new project? The level of detail is often too high for those who wish to gain a general impression of knowledge of a particular interaction with the consequence that most would only be interested in reading the chapter which concerns their own interaction and not bother with the remainder. Nevertheless all chapters provide exciting knowledge and are all written by real authorities in their field. Several of the chapters also assume a high level of prior knowledge. Much of this knowledge would be provided by a good textbook, such as Lucas (1998) or Dickinson (2003). Though there is a risk that the book will date rapidly as all these organisms are subject to intense research programmes, I predict that overall these accounts will survive the passage of time.

The eight specific pathosystems covered are: Chapter 2 (40 pp): ‘Tobacco mosaic virus’ by John Carr, University of Cambridge, UK. This is the ‘original’ plant virus the study of which has provided major insights into the nature of plant gene function, including the genetic code and transgenic disease resistant plants. There is nothing quite like a pathogen to probe the nature of a plant! Carr starts by stating that there are several comprehensive reviews providing the historical perspective of the system; he firmly establishes the perspective and fills in the gaps with recent knowledge. An excellent and comprehensive presentation of the system for non-experts.

Chapter 3 (22 pp): ‘Infection with potyviruses’ by Minna-Liisa Rajamäki, Tuula Mäki-Valkama,

Kristiina Mäkinen and Jari Valkonen, Department of Applied Biology, University of Helsinki, Finland. In contrast to the other chapters, these authors review a whole group of viruses, the potyviruses, creating a synthesis of knowledge of this group, representing 30% of known plant viruses. An authoritative introduction to these important pathogens.

Chapter 4 (20 pp): 'The *Ralstonia solanacearum*-plant interaction' by Christian Boucher and Stéphane Genin, CNRS-INRA, Castanet Tolosa, France. As an outsider, I do wonder how one should describe the taxonomy of this group of organisms. Various classifications are used (races and biovars). Essentially there seem to be several species which each exhibit more or less a broad host range (the definition of the 4 races) and physiological attributes (the biovars). According to the chapter, Race 3 matches biovar 2 fairly closely, but otherwise it does not. Molecular studies indicate two to three groupings of organisms originating from the tropical Americas, Asia/Australasia and Africa. Sensibly the authors do not offer an opinion on these problems; they describe them. Much of the remainder of the chapter provides excellent up-to-date accounts of the major pathogenicity factors: e.g. exopolysaccharide, the various secretory systems and quorum sensing.

Chapter 5 (24 pp): 'The *Pseudomonas syringae*-bean interaction' by Susan S. Hirano and Christen D. Upper, University of Wisconsin, Madison, USA. The other bacterial system presented is *Pseudomonas syringae* pv *syringae* and represents the exception in the book: the focus is not the detailed description of the molecular biology of the organism, but concerns its population biology. Population biologists who would otherwise complain that the use of word 'interactions' is usurped once again by the molecular biologists have an interesting account in this chapter of the real biology of the interaction between populations of bacteria. Issues include developing model systems for studying pathogenicity, and determining why the presence of large numbers of bacteria can cause disease (as manifested in necrotic lesions) but do not always do so. Of course there is a description of pathogenicity mutations in *Pss*. These provide the biological basis for many of the studies described thus integrating the molecular and population biology of the interactions.

Chapter 6 (27 pp): 'Fungal pathogenesis in the rice blast fungus *Magnaporthe grisea*' by Chaoyang Xue, Lei Li, Kyeyong Seong and Jin-Rong Xu, Department of Botany and Plant Pathology, Purdue University, West Lafayette, Indiana, USA. That this fungus generates the highest pressure by a living organism is sufficiently well known not to be noted by these authors who otherwise present the molecular biology of the infection process in some detail. However, the details of how the appressorium develops have rarely been presented so clearly.

Chapter 7: (35 pp) 'The *Ustilago maydis*-maize interaction' by Maria D. Garcia-Pedrajas, Steven J. Klosterman, David L. Andrews and Scott E. Gold, Department of Plant Pathology, University of Georgia, Athens, USA. This chapter includes authoritative accounts of the life cycle, morphogenesis and pathogenicity of this fascinating interaction, summarised in a table filling over four pages. The mating system is also covered in some detail. An interesting subject for future study concerns the mechanisms by which this organism obtains its nutrients. Is it a biotroph or an endophyte?

Chapter 8: (16 pp) '*Blumeria graminis* f. sp. *hordei*, an obligate pathogen of barley' by Maike Both and Pietro D. Spanu, Department of Biological Sciences, Imperial College, London, UK. Whereas *Magnaporthe* is a necrotroph, the other Ascomycete covered in this tome is an obligate biotroph. This chapter describes the biology of the pathogen with emphasis on the expression of pathogen genes involved in the infection process. In particular, the elucidation of various signal transduction pathways is interesting, a theme already presented in chapter 6 on *Magnaporthe*. No reference is made to the extensive knowledge of host resistance to this pathogen nor to studies of host defences induced by infection, not even by reference to any recent review articles on these subjects beyond referral to the monograph on the powdery mildews published recently (Belanger et al., 2002).

Chapter 9: (24 pp). 'The *Phytophthora infestans*-potato interaction' by Pieter van West, Department of Molecular and Cell Biology, University of Aberdeen, UK and Vivianne G.A.A. Vleeshouwers, Laboratory of Plant Breeding, Wageningen University, The Netherlands.

The only Oomycete presented and the pathogen which costs more money in the developed world than any other in terms of the vast quantities of pesticides used to combat it. It is sobering to realise that this pathosystem that led to the dawn of scientific plant pathology over 150 years ago still presents major challenges to agriculture. The life cycle is described in detail and gaps in the knowledge emphasised. Satisfyingly, pathogenicity, defence and the interactions (i.e. mechanisms of disease resistance) are all covered and the authors look ahead to the ways by which a greater understanding of the system should lead to new, durable means for its control.

Can this information be gained elsewhere? Yes and no! Slusarenko et al. (2000) has a chapter on the infection biology of the barley powdery mildew fungus as does Belanger et al. (2002). The former also has a chapter on TMV. Of course only the editor and book reviewers will read the whole book though this was a rewarding and inspirational experience. Should one argue about the choice of systems presented? I think not. The eight pathogens or pathosystems chosen here would fall into many a pathologist's top ten league. Perhaps the most obvious omission is a rust: *Uromyces* or *Puccinia*. Rusts are fascinating organisms which differ substantially from *Ustilago* and *Blumeria*. Perhaps a hemibiotroph such as *Cochliobolus*? *Fusarium* on cereals due to the focus on mycotoxins? *Peronospora* on Brassicas and *Arabidopsis*? Overall, I think there is a fine balance in this book.

Nicholas Talbot deserves praise for a well chosen anthology.

Should you buy this book? Yes, if you are a librarian for a department which contains molecular biologists who need to understand plant pathology or traditional plant pathologists who need an up-to-date account of the developmental biology underlying the life cycles of pathogens. Yes, if you are running a department where several groups are working on each pathosystem. No, if you are a PhD student or post-doc working on one of these interactions: you should put pressure on your departmental librarian to prioritise buying this book. My review copy is already well thumbed.

References

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DAVID B. COLLINGE
The Royal Veterinary and Agricultural University
Department of Plant Biology
Thorvaldsensvej 40
DK-1871 Frederiksberg C
Denmark