

Review of *Plant Nematology*

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Perry, R. N., and Moens, M. (Eds). 2006. *Plant Nematology*. CABI Publishing: Wallingford, UK. 447 pp. ISBN-10: 1-84593-056-8; ISBN-13: 978-1-84593-056-1. Price, £55, \$US100.

There can be few professional plant nematologists practising today who have from school days set their ambitions on plant nematology as a career. There may be one or two exceptions, where parents may have consciously or unconsciously taken a leadership role, but for the majority of today's professionals, their introduction will have been either at the very earliest as undergraduates, perhaps following some minor course of study of one form or another, or more usually as postgraduate students. Therefore, the need for an up-to-date text book that covers all the nematological bases, so to speak, is essential for students wishing to specialize in the area. Such a publication needs to balance a number of competing factors. It needs to be broad without sacrificing detail. It needs to be timely and authoritative, while maintaining a sense of the history from which the subject has developed and where the subject currently is. It also needs to do all of this without sacrificing the excitement as to where future progress may lie! To maintain this balance is not easy at a time when traditional biology, based on whole organisms and population biology, must be reconsidered in the light of molecular biology and its integration with mathematics, computing and information technology. Therefore, the book *Plant Nematology* has to balance these issues. There may be some specialists, and I include myself in this group, who will feel that their pet interests have not been given sufficient emphasis, but, as the editors make clear in the preface, their intention was to provide a '... book on plant-parasitic nematodes aimed at a broad readership, especially one including students specializing in the subject at undergraduate and postgraduate levels;' from this perspective, I think, it accomplishes its task most successfully.

As a structural template, the editors claim their book has followed that of *Plant Nematology* edited by John Southey. This book was first published in 1959 with a second edition in 1965. If they have followed this format it is only in very broad and loose terms; Southey's book is divided into four parts (Introduction, three chapters; The Principle Genera of Plant-Infesting Nematodes, seven chapters; Cyst-Forming Nematodes in Agriculture, four chapters; and Control Methods,

five chapters), while their book is divided into three parts. Each part starts with a contextual introductory paragraph by the editors (Part I: Taxonomy and Principal Genera, six chapters; Part II: Nematode Biology and Plant Responses, four chapters; Part III: Quantitative Nematology and Management, six chapters). In Southey's book the references are given at the end of each chapter, with more general references collected together at the end of the book, whereas in the new book all references are provided at the end, together with a useful glossary; as with Southey, both books are well indexed by subject.

Part I: Taxonomy and Principle Genera opens the book with two general chapters, one on *Structure and Classification*, by Wilfrida Decraemer and David Hunt, which covers nematode morphology, life cycle stages and the feeding groups before finishing on a description of nematode classification based on what might be regarded as traditional morphometric approaches. This then naturally leads into the second chapter, *Molecular Taxonomy and Phylogeny*, by Sergei Subbotin and Maurice Moens. This chapter begins by introducing students to the idea of developing a hierarchical classification system around DNA and proteins and how to use this information to build a system of classifying organisms according to their phylogenetic relationships. It then describes the most common molecular techniques, including protein electrophoresis, the various types of PCR, use of microsatellites and gene sequencing. Having described these techniques, it then covers the various computer-based programs and databases that can be interrogated and used to build reliable phylogenetic trees. The chapter finishes by giving some up-to-date examples of molecular phylogenies.

Following these introductory chapters, the next four chapters focus on various groups of plant-parasitic nematodes that are of principal economic importance. There are individual chapters focusing on *Root-knot Nematodes*, Gerrit Karssen and Maurice Moens, *Cyst Nematodes*, Susan Turner and Janet Rowe, *Migratory Endoparasitic Nematodes*, Larry Duncan and Maurice Moens, and *Ectoparasitic Nematodes*, Wilfrida Decraemer and Etienne Geraert. The way in which the various subsections of the chapters have been divided follows a general format, although this is not always obvious from the book's contents page. Each chapter starts with an introductory section, followed by information on the nematode life cycles and their distinctive behaviour. Each chapter also covers aspects of traditional morphology together with the more recent biochemical and molecular approaches to diagnosis and the interactions the nematodes have with other plant patho-

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gens, including viruses where applicable. Each of these chapters then finishes by describing recommended approaches to nematode pest management and control.

Part II: Nematode Biology and Plant Responses aims to integrate the functional biology of plant-parasitic nematodes with the recent developments that have occurred in this post-genomic era. The first two chapters in this section are an up-to-date look at *Reproduction, Physiology and Biochemistry* (Chapter 7), Denis Wright and Roland Perry, which is in turn subdivided into six sections covering reproduction and development, musculature and neurobiology, the biosynthesis of macromolecules and intermediary metabolism, lipids and carbohydrates, osmotic regulation and, lastly, survival strategies. This chapter is followed by *Behaviour and Sensory Perception* (Chapter 8), Forest Robinson and Roland Perry; it builds on the previous chapter and is subdivided into five sections that broadly cover the sense organs, movement and propulsion, response to chemical signals and responses to physical stimuli. The next chapter, *Molecular Aspects of Plant-Nematode Interactions* (Chapter 9), Godelieve Gheysen and John Jones, then gives an overview that focuses on the most recent molecular approaches to dissecting the interactions that parasitic nematodes have with plants. This starts with a broad approach covering the major groups of plant-parasitic nematodes with subsections on their migration and invasion, followed by the plant defense mechanisms and the way that nematodes attempt to protect themselves from them. The authors then focus on cyst and root-knot nematodes, as the most economically important genera, containing two subsections looking at nematode feeding cells and the induction of feeding sites. They finish by comparing root-knot and cyst nematodes before closing on a discussion of resistance and avirulence genes. The broad view of the molecular biology of plant-nematode interactions is followed by a chapter that applies this knowledge. *Genetic Engineering for Resistance* (Chapter 10), Chris Thomas and Amanda Cottage, starts with a discussion on the nematodes that are the most applicable to a genetic engineering approach and provides an overview of the past and present approaches to engineering resistance. Although some references to some key historical work here may have been overlooked, the authors look at the different possible approaches (employing enzymes, plantibodies, lectins, protease inhibitors and RNAi) and go on to discuss the need and role of promoters, reporter genes and the development of anti-nematode gene constructs. The chapter finishes by describing the practicalities of undertaking a research program aimed at developing engineered resistance and where the future benefits of transgenic technology may lie.

Part III: Quantitative Nematology and Management concentrates on the applied aspects of plant nematology and picks up from the applied aspects of the previous chapters very much with the farmer's field in

mind. Starting with an overview of *Plant Growth and Population Dynamics* (Chapter 11), Corrie Schomaker and Thomas Been look at the quantitative relationships between nematodes and plants that can be used to predict yield. They discuss the use of population dynamics models that can take into account both the density of different nematodes in the soil and the tolerance of the plants to nematode damage. Having introduced the reader to these concepts, they then use these models to look at the effect of nematicides and different cropping regimes on this relationship and how this can be used to inform the farmer. This chapter is then complemented with a following chapter that focuses on nematode *Distribution Patterns and Sampling* (Chapter 12), Thomas Been and Corrie Schomaker, which again takes a mathematical modeling approach to discuss the distribution of nematodes in the soil and the sampling necessary to obtain reliable information on the horizontal and vertical distribution of nematodes. In both these chapters, the theoretical aspects of these models, which are mathematical, are placed in boxes in an attempt not to intimidate the reader.

Having dealt with the population dynamics of nematodes and sampling, the remaining four chapters deal with the practical aspects of nematode control in one form or another. These chapters begin with *International Plant Health – Putting Legislation into Practice* (Chapter 13) by Sue Hockland and others, which in 11 subsections look at the issues surrounding the movement of plants and associated material around the world in respect to minimizing the spread of pest nematodes. Accepting historical constraints, it then looks at phytosanitary frameworks in an international context and the importance of legislation. Such legislation needs to be built upon risk assessments and then the implementation of procedures to manage the problems that are identified, including the certification of material. The chapter finishes with an assessment of costs and benefits from such schemes in relationship to some case studies and the challenges that this will present in the future.

The next three chapters all deal with nematode control: *Biological and Cultural Management* (Chapter 14), Nicole Viaene and others; *Resistant Cultivars* (Chapter 15), Roger Cook and Jim Starr; and *Chemical Control of Nematodes* (Chapter 16), Pat Haydock and others. In my view, the *Resistant Cultivars* chapter, which is a wonderful summary of the interactions between nematodes and their host plants and the subtle specificities that can be observed and how to exploit them, is somewhat misplaced and would have been better situated in Part II of the book between Chapter 8, *Behaviour and Perception* and Chapter 9, *Molecular Aspects of Plant-Nematode Interactions*. Despite this slight misgiving, I feel that the combining of biological and cultural control into a single chapter probably works quite well but looks extremely strange in the contents page of the book, as it

appears at first sight to be a chapter very thin on material. I think the sub-sectioning of the chapter could have been structured more revealingly for the contents page. The last, but by no means the least important, chapter focuses on nematicides, as they are still one of the major methods to control plant-parasitic nematodes. This chapter begins with a historical overview before providing the details of active ingredients, formulations, and human and environmental safety issues and ending on the use of naturally occurring nematicides.

From my perspective, the book combines both an appreciation and summary of the past and current knowledge needed for students of plant nematology,

while at the same time maintaining the excitement of the subject and identifying where future progress will lie. The book has been wonderfully prepared with the punctiliousness one would expect of the editors, and it is also well illustrated with very good quality figures, even if there is at least one spelling error in one legend (Fig 14.4 K. Davis should read K. G. Davies!). The book was designed as an accompanying textbook to the MSc course in Nematology run by the University of Ghent, Belgium, and this book will fulfill this task most admirably. I would readily recommend the book to any students wishing to get an overview of the subject area, and I am sure that it will become an accepted text for future students of plant nematology.