

Book reviews

Developments in Agricultural and Managed-Forest Ecology. Elsevier Scientific Publishing Company, Amsterdam – Oxford – New York, Vols 4–6.

In this series of multi-author monographs, the three recent volumes are especially relevant to phytopathologists. These texts are not from a single symposium but are the result of many years of planning and compilation concluded between 1974 and 1976. Each contribution is thus a review in itself, with little noticeable connection between the separate chapters. A further feature of all three books is the careful presentation with remarkably few printing errors. The chapters usually have long lists of references with full titles. It is regrettable that no running titles are given to facilitate the finding of these references. Although the authors were apparently not instructed to present summaries of their contributions, some have provided one or a number of conclusions. Each volume ends with a (not very exhaustive) subject index and commences with a detailed survey of contents. The binding in balacron imitation of linen seems to guarantee extraordinary durability.

Vol. 4: 'Interactions between Non-pathogenic Soil Microorganisms and Plants' edited by Y. R. Dommergues and S. V. Krupa, 1978. 475 pp. Price \$ 95/Dfl. 195. ISBN 0-444-41638-2.

Vol. 5: 'Ecology of Root Pathogens' edited by S. V. Krupa and Y. R. Dommergues, 1979. 281 pp. Price \$ 75/Dfl. 154. ISBN 0-444-41639-0.

The subjects of these two volumes are hardly separable, because saprophytes and parasites merge in a vast array of minor pathogens. Surprisingly minor pathogens and side-effects of pesticides are hardly treated, neither are the effects of modern practices in agriculture (minimal cultivation etc.) included. On the other hand, biological control of pathogens is treated twice, viz. in Vol. 5 and 6, but with relatively little duplication. The French-American collaboration in the editorship has obviously been fruitful for a broad coverage of information from linguistically differing areas.

In Vol. 4 a diversity of authors deal with interactions between plants and saprophytic or symbiotic micro-organisms in the soil; pathogenic organisms appear repeatedly as components of the environment.

In a general introduction Y. R. Dommergues surveys the whole field, connects the contributions and adds some recent information. F. M. Scott then reviews the morphology of roots with emphasis on ultrastructure; there are no light-microscopic illustrations and his chapter is not comprehensive when compared with the standard text in this field by R. Scott Russell ('Plant Root Systems', McGraw-Hill Book Co., London, 1977). H. E. Street et al. give a very exhaustive review of root physiology with much emphasis on regulation of root growth, but leave the treatment of nutrient uptake to the next chapter by D. A. Barber. This author regarded it his task to review only the influences of micro-organisms on the uptake of phosphorus, in addition to sulphur, potassium, some cations and trace elements. The basic principles of nutrient uptake were not considered. In this chapter it is concluded that very little is known about the mechanisms of microbial influences, even though effects of competition and microbial exudations are considered.

M. G. Hale et al. report that despite methodological difficulties, there is much recent progress in studies on root exudation, mainly concerning mechanisms within the plants and quantitative determination. F. R. Warembourg and R. A. A. Morrall consider the flux of assimilates (energy flow) from another angle. Photosynthetic production, translocation towards the roots, transformation in the root level, root respiration, exudation and connections with micro-organisms are studied in terms of energy turnover, an approach leading to mathematical modelling which has gained much importance in recent years. In these and other chapters the main part of the

literature covered does not go beyond 1974, and consequently some important contributions on quantitative determination of exudation in the soil (using isotope-labelled substrates) by Barber and Martin (1976) and Martin (1977) have passed unnoticed.

In their review on rhizospheres, J. Balandreau and R. Knowles confine themselves to certain selected topics: fine structure (mainly mucigel), zonation around the roots and a few microbial activities: nitrogen fixation, denitrification, sulphate reduction and methane production.

The legume symbiosis is treated in two contributions: E. L. Schmidt deals with the ecology of the nodule bacteria, and F. J. Bergersen with the physiology of the symbiosis. The former author reports considerable recent progress with the application of immunofluorescence, mainly pertaining to the survival of rhizobia in the absence of host plants; the mutual recognition between the symbionts attracts his particular interest. In view of several recent reviews on nodule physiology, Bergersen concentrates on the specificity of the symbiosis based on lectins, infection processes and nodule development and function, including ultrastructural studies. During the last ten years important progress has been made in the physiology and biochemistry of nitrogen fixation. A. D. L. Akkermans subsequently reviews nodule symbioses of non-leguminous plants and reports some progress on the physiology using nodule homogenates.

The topic mycorrhiza is dealt with in two subchapters: D. H. Marx and S. V. Krupa present a good review on ectomycorrhizae but report relatively little recent progress not yet included in other reviews. It is again emphasized that mycorrhizae present an efficient deterrent to root pathogens as shown in several studies by the senior author. Plant-parasitic and mycophagous nematodes may interfere with mycorrhiza formation, and some may feed on preformed ectomycorrhizae, thus preparing a court of entrance for other pathogens through the mycorrhizal mantle. The application of mycorrhizal fungi such as *Pisolithus* which allows plants to pioneer various kinds of waste land, is also discussed. The review of D. S. Hayman complements some other recent reviews on endomycorrhizae: The most important progress in the case of Ericaceae is the recognition of *Pezizella ericae* as the symbiotic organism; in vesicular-arbuscular mycorrhiza the recognition of physiological effects is mostly confined to total growth of the host plant and phosphorus supply; hormonal effects are just beginning to be realized and little information is available on susceptibility of mycorrhizal plants to pathogens. In reviews of this nature it would be preferable if the modern nomenclature of the symbionts were used consistently, e.g. *Glomus* instead of *Endogone*.

In a concluding chapter, Y. R. Dommergues discusses 'impacts on soil management and plant growth'. In view of the frequently inefficient and wasteful use of chemicals, particularly nitrogen fertilizers, and consequently energy, alternative methods are sought. There are few examples given in other chapters of this book, but the author presents some additional information from other recent literature. Problems are discussed which arise from excessive and deficient microbial activities, the latter being more important in non-pathogenic organisms. Non-conventional management is sought in the direction of integrated control of pathogens (to be found mainly in Vol. 6 of this series) but concerns in this volume (1) a judicious application of chemicals, e.g. to inhibit nitrification and to avoid the inhibition of nitrogen fixation by excess fertilization; (2) physical practices which affect the microclimate, e.g. by planting trees and by improved methods of drainage, irrigation and tillage; (3) inoculation with rhizosphere organisms, particularly *Rhizobium* and mycorrhizal symbionts, and (4) genetic manipulations of plants and nitrogen-fixing micro-organisms, to improve their symbiotic capacities.

In Vol. 5 a limited number of authors from St. Paul-Minnesota, Berkeley-California and Nancy treat the various groups of potentially pathogenic organisms. T. Kommedahl and C. E. Windels present a new arrangement of soil-borne pathogenic fungi with a major distinction between pathogen-dominant and host-dominant diseases. The former comprise a group of unspecialized pathogens where the relationship with the plant is more or less transitory; 52 species are tabulated and discussed singly, most of which are macerative as opposed to a few toxicogenic

pathogens. In the second group, 109 more or less specialized pathogens are listed which maintain prolonged relationships with their host plants. They are subdivided into tissue-nonspecific and tissue-specific pathogens; the former comprise 19 macerative and 7 toxicogenic species, the latter 13 vascular pathogens causing either wilt or root-rot, 3 parasites of the cambium, 50 of the cortex, 2 of the periderm and 15 of the epidermis. Each species is discussed with emphasis on enzyme equipment and toxin production in relation to spread and penetration. The distinction between macerative and toxicogenic presupposes that (contrary to common usage) enzymes are excluded from the definition of toxins. Even so some doubts arise from statements that hydrolytic enzymes or toxins are absent in certain fungi; this would seem to reflect that the authors have not covered all information in the literature. The main distinction has some bearing on biological control: Pathogen-dominant diseases may be controlled by stimulation of antagonism and modifications of the environment, host-dominant diseases by resistance breeding or crop rotations. In fact this distinction (which is not quite sharp) is not new if one compares Garrett's (1970) differentiation between unspecialized and specialized pathogens. The further distinction between macerative and toxicogenic is in some cases not supported by sufficient physiological evidence. Although the treatment of each organism is mainly concerned with arguments for the arrangement in this scheme, I feel that a thorough coverage would require at least twice as much space. On the other hand, this chapter is unproportionately long in a book of this kind, while much other information on pathogenic fungi is missing. It is disturbing that the authors have not cared to employ the correct names of pathogens. In the Snyder & Hansen system of *Fusarium*, cultivar distinctions have been applied but uncertainties of the identity subsist e.g. with *F. tricinctum*. The two major wilt pathogens of *Verticillium* are lumped in one species and similarly three different sclerotial pathogens in *Sclerotinia sclerotiorum*. *Ascochyta pinodella* is now *Phoma medicaginis* var. *pinodella*. The most recent authority for *Pythium* is not Middleton (1943) but Waterhouse (1967). The very closely related species *Armillaria mellea* and *Clitocybe tabescens* should not be placed in distinct genera, and *Ustilina vulgaris* and *U. deusta* (distinguished in Table V) are identical. The nomenclature of *Helminthosporium* is antiquated and author's names of pathogens are not given.

Pathogenic bacteria are reviewed by M. N. Schroth et al. according to a taxonomic arrangement and to ecological criteria based on Crosse's (1968) treatment. The authors conclude that too little is known about the life of these bacteria in the soil, because the methods of assessment are too insensitive.

In his review on plant-pathogenic nematodes, D. MacDonald emphasizes that eelworms are important through interaction with other micro-organisms, particularly fungi, but does not present any data on this. His review mainly concerns a) effects of plants on hatching, feeding and population dynamics of nematodes and b) effects of nematodes on higher plants, but does not present data on damage or biological control.

R. J. Zeyen presents a general survey on viruses infecting plants, with emphasis on infection of roots and other underground plant structures, and the release and survival of viruses in soil. The importance of nematodes (and zoospore fungi) as vectors is discussed, but this information is not correlated with the previous chapter.

In their chapter 'Fundamentals of biological control' F. Mangenot and H. G. Diem present much basic information on pathosystems which is missing in the previous chapters; their contribution also differs from the predecessors in that references are given from 1976 and later. Under the heading Decline, the phenomena fungistasis, antibiosis, lysis, and hyperparasitism and predation are discussed, and mechanisms and effects of decline are subsequently considered. A natural biological control occurs in the phenomenon of suppressive soils; artificially induced biological control can be exerted either by manipulation of the environment or by the introduction of antagonists, some examples being discussed. A table is presented of biocontrol agents which includes similar numbers of bacteria and fungi. However, the compilation is not very critical, and rather little consideration is given to practical application.

In an introductory glossary soil infestation is defined by the presence of infectious material of a plant pathogen, and disinfestation as comprising treatments of soil with gas, liquid or solid substances to counteract infection. Louvet and van Assche in addition specify that these treatments are applied before crop growth. The scope of this book is thus rather wide, including also biological soil disinfestation and among the physical methods flooding. Of the 21 contributors, 13 work in the Benelux countries, and most of the others in other European countries. Unfortunately, certain well-known authors are missing among the contributors.

J. Louvet and C. van Assche provide a general introduction and list the aims of soil disinfestation.

In the section on physical soil disinfestation R. H. Stover deals with flooding, which is still an important means of control in rice culture, but has lost most of its importance in banana and tobacco after the development of disease-resistant cultivars. – Steam sterilization and pasteurization is particularly important in greenhouses; technology and temperature regimes are considered by L. Nederpel. C. Sonneveld considers chemical changes in soil caused by steaming: manganese is released and its subsequent fixation as manganese oxides is reduced by steaming; nitrogen is mobilized and nitrification disturbed; organic substrates are decomposed or converted into readily decomposable components. Less adverse effects were noticed by steaming at 70°C; but no further reference is made to treatments at lower temperatures.

The section on chemical soil disinfestation begins with a brilliant review of nematode control by J. A. van Berkum and H. Hoestra. A detailed account is given of halogenated hydrocarbons, methylisothiocyanate (MIT)-active compounds, chloropicrin and methyl bromide as volatile fumigants, and systemic 'contact' nematicides comprising organophosphorous compounds and oximecarbamates which are also often applied after planting. Side-effects of these chemicals receive due attention. H. Siebering and M. Leistra subsequently deal with computer simulation of fumigant behaviour in soil, a useful tool avoiding time-consuming experiments. The behaviour of methyl bromide and a few other important fumigants is discussed. Recommendations for practice can be deduced from computer calculations. The chapter on fumigation against fungi by A. Vanachter deals only with the radical fumigants methyl bromide, chloropicrin (singly or in combination) and MIT-active compounds. Efficiency, possibilities of application and residue problems are considered but not recolonization and other side-effects. A specialized problem that can be solved by fumigation is the replant disease of apple; J. E. Jackson obtained good results with chloropicrin fumigation or by planting in a volume of compost. The latter author avoids any consideration of causal agents, but D. Mulder suggests that bacteria might be involved and that in an apple orchard artificial conditions prevail which are conducive to disease. In his commentary again no German references are given, although some relevant contributions to this problem have come from both the Federal Republic of Germany and the German Democratic Republic.

Still in the same section, J. de Tempe gives a full account of the fungicide-treated seed, and much information is given on soil fungicides in general, which was missing in the previous sections. Factors determining the efficacy of various pathogen-fungicide combinations are carefully considered. Ecological aspects are treated in a separate section; fungicide-sensitive antagonists and other side-effects require caution in fungicide application, while some antagonists may even be applied to replace the toxic chemicals. However, side-effects on macro-organisms which led to the elimination of many pesticides, are not considered here.

Contrary to other contributors, A. D. Rovira and E. H. Ridge present new information from personal investigation on effects of methyl bromide and chloropicrin on chemical and biological properties of the soil in relation to wheat growth. They studied phosphate, ammonium and nitrate concentrations, plant growth (water use, nutrient uptake, yield) and microbial com-

ponents involving total aerobic bacteria, fluorescent pseudomonads, aerobic spore-forming bacteria and actinomycetes, with due consideration of time effects after treatment. Antagonists to *Gaeumannomyces graminis* were found to be reduced by various treatments but to subsequently increase, particularly the fluorescent pseudomonads.

The section on biological soil disinfestation is broadly covered by D. Gindrat. A general terminology of interactions with discussion of inherent problems is given as an introduction, together with tabulated examples of disinfestation by lysis, competition and predation (including hyperparasitism). Subsequently practical examples are considered. This is after all the place in this book where much is said on crop rotation and on mineral and organic amendments as disinfesting agents. In a section on the introduction of biocontrol agents, *Trichoderma harzianum* and *Botryodiplodia theobromae* are considered in particular detail, and the chapter concludes with a short outlook on possibilities of integrated control. The phenomenon of suppressive soils is not treated.

A final section of this book deals with the fate of pesticides in the soil. I cannot help feeling that these chapters should have been placed before the treatment of computer simulation; this holds particularly for the informative text by G. M. Hoffman and H.-P. Malkomes on the fate of fumigants which presents many data which would have facilitated the understanding of Siebering and Leistra's account. The phenomena of sorption in the soil, diffusion, degradation and conversion, effects on soil chemistry and the fate of bromide residues are here again reviewed. M. J. Frissel and P. Poelstra then treat the more special case of mercury-containing fungicides, and E. van Wambeke the fate of certain organic fungicides, viz. benomyl, pentachloronitrobenzene, with hexachlorobenzene as a particularly persistent impurity, which all cause concern because of their long persistence in the soil.

In his concluding remarks, the editor, D. Mulder, calls for particular caution with chemical and physical soil disinfestation.

A remark on topics missing in this survey of soil disinfestation seems to be justified here. The drastic eradicant treatments are rather fully treated but the temperate ones hardly or not at all. It should be known by now that steaming at lower temperatures is particularly successful because it allows many antagonists to survive. Solar heating under a cover of plastic mulches is becoming very successful in Israel and California. Soil fungicides which only partly destroy the pathogenic population should be included. Side-effects of chemicals need more consideration. Soil disinfestation according to the broad definition given initially cannot be confined to the period before plant growth but should also involve later stages, merging with the internal therapy of plants (see this Journal 83, Suppl. 1).

Conclusion

The whole field of practical aspects of soil microbiology and soil-borne plant pathogens is not comprehensively covered in these three volumes and several sections are considered incomplete. The problem is that the subject is undergoing such rapid development that even the best review is deemed to be dated within five to ten years. Nevertheless, most of these reviews are of a high quality and the three books are recommended to students, researchers and practical workers interested in soil microbiology. The unusually high price, is, however, likely to be a deterrent of acquisition and a cheaper and less durable production would therefore be desirable for efficient spread of the knowledge.

W. Gams

J. R. S. Fincham, P. R. Day and A. Radford, 1979. Fungal genetics. 4th edition. Botanical Monographs. Vol. 4. Blackwell, Oxford. 636 pp., 113 figs. Price £ 20.

'Fincham and Day' published in 1962 as the first textbook on the genetics of fungi, has remained prominent in its field, serving the dual purpose of advanced textbook and comprehensive source of information. The present fourth edition has been thoroughly rearranged and parts of many chapters have been rewritten by Fincham and Radford. The number of chapters has extended from thirteen (402 pages) to twenty (636 pages).

To limit the increase in number of pages, the introduction has been omitted. General readers will not miss it, since they will be acquainted with the basic concepts anyhow. It seems somewhat inconsistent that some detailed information is given that is not specific to fungi. For example in Chapter 2, which deals with the fungal nucleus, chromosomes and nuclear divisions, the compact explanation on chromatin does not reveal major differences from other eukaryotes. On the behaviour of fungal chromosomes, a controversial subject for years, a few remarks and references to recent reviews would have been sufficient.

The presentation is clear and concise, but where so much detailed information is presented, some more space for summarizing the essentials and the conclusions would have been welcome at the end of each chapter.

The book is now divided into four parts. The first part introduces the biology of some fungi used in genetic experiments and a chapter on the fungal nucleus. The second part forms a third of the book and deals with genetic analysis. Mutagenesis and recombination are discussed only in direct relation to the isolation of mutants and genetic analysis. The chapter on genetic analysis based on mitotic segregation is rather short and the possibilities of protoplast fusion are hardly discussed. Population genetics is restricted to incompatibility and breeding systems. The third part dealing with gene structure and gene action contains chapters on the mechanisms of recombination and mutation, genetic control of metabolism, genes and macromolecules, regulation of protein synthesis, and vegetative and generative development. The chapter on genes and macromolecules describes various types of mutations, suppressor mutations, effects on enzyme properties including complementation and genes not coding for a specific protein (tRNA and rRNA genes). The chapter on genetic control of metabolism deals mainly with nutritional mutants and primary metabolism. Little is said about exoenzymes, antibiotic production and other points of biotechnological interest. Neither is any attention paid to pathogenicity or other phytopathological aspects. The last part of the book is called 'direct study of the genetic material' and contains a short chapter on mitochondrial genetics, and a chapter on inheritance based on plasmids and viruses. The final chapter on cloning of genes for direct chemical analysis is in my opinion beyond the scope of fungal genetics. It is an interesting treatise of (some methods for) cloning genes with examples of fungal genes cloned in *Escherichia coli*. The techniques are so specialized, however, that an understanding is difficult without a good knowledge of bacterial or molecular genetics. Moreover, progress in this field is so explosive that the chapter would require annual revision. The first section of this chapter would have been sufficient to excite interest in applications in fungi.

The book is well printed and almost free from errors (on page 499 a note refers incorrectly to a paper on protoplast fusion). A few comments may be useful for a next edition. The terms dyad and tetrad may have different genetical meanings: for the description of chromosome configurations and for the meiotic products. Here the authors use dyad in the first and tetrad in the second sense. In a book on fungal genetics in which tetrad analysis is treated, these terms must be kept for the meiotic products. In Figure 30, the scheme is confusing because chromosomes in pachytene have two chromatids.

This is an excellent textbook on the general genetics of fungi with a bibliography of 1640 references. Also to those familiar with this field, it makes good and pleasant reading, drawing the attention to important details and features. This book is more a monograph for

specialists then an introductory text for students. Plant pathologists and physiologists interested in gene function and not directly in genetic analysis will still benefit from having this text-book to hand.

C. J. Bos

F. J. Newhook, G. M. Waterhouse and D. J. Stamps, 1978. Tabular key to the species of *Phytophthora* de Bary. Mycological Papers No. 143. Commonwealth Mycological Institute, Kew. 20 pp.

Though Newhook, Waterhouse and Stamps modestly offer their key to the species of *Phytophthora* as an 'interim document', it will be of great help to all students of this genus. Because of the heterothallic nature of some *Phytophthora* species and the inducibility of inter-specific formation of oogonia, it is difficult in such species to use sexual characters in a key. The authors use many characteristics of shape, size and occurrence of the sexual and asexual reproductive structures as well as the cultural characters and the temperature/growth relations. These characteristics are conveniently arranged. The tabular form of the key is especially suitable for comparing closely related species. Illustrations of the various characteristics serve to demonstrate the terms used. An illustration of a rough oogonium could have been added. The presence of septa, which cut off chlamydospores and which are absent in hyphal swellings, is not obvious in the pictures. In the key, the sporangia of both varieties of *P. nicotianae* are mentioned as being caducous. According to Waterhouse (1963), these are not easily shed in var. *nicotianae* but break off with short pedicels in var. *parasitica*. The proliferation of the sporangiophores of *P. fragariae* is not taken up in the table. Data are given about antheridia and oospores for *P. lateralis*, but not about oogonia. The key will certainly provide a convenient practical guide to the identification of species of the genus *Phytophthora*.

A. J. van der Plaats-Niterink

G. Fröhlich (Ed.), 1979. Phytopathologie und Pflanzenschutz. Pocketbook. VEB Gustav Fischer Verlag, Jena. 295 pp. (Distribution in Western Europe by Gustav Fischer Verlag, Stuttgart). Price M 19.

The format of this booklet is dictated by the series 'Dictionaries of biology (the biological disciplines in lexical presentation)'; about 3000 entries are treated with explanations of 3–20 (or more) lines each (in double column print). Diseases (groups of diseases) are listed under their German names, pathogenic organisms appear to the level of classes (some more details given in drawings), thus Verticilliose and Fusariose are briefly explained but not *Verticillium* and *Fusarium*. Pesticides generally appear under their chemical names only. Sixty two simple line drawings illustrate the text.

It is a laudable effort to give uniform definitions of terms to be used in plant pathology not only in both parts of Germany but also in an international frame. This intention is evident from the two pages of literature cited, although in this list some important titles such as the CMI Plant Pathologist's Pocketbook, Hawksworth's Mycologist's Handbook and the 'Guide to the use of terms in plant pathology' (Phytopath. Pap. No. 17, 1973) are missing. On the whole, the definitions given agree with those in the English sources. Only a fraction of the terms used for virus symptoms (L. Bos 'Symptoms of virus diseases in plants', Wageningen, 1970; not cited) has been included and sometimes in a deviant form. This book might also help plant pathologists not familiar with German to gain access to the German phytopathological literature.

W. Gams

R. Charudattan, 1978. Biological control projects in plant pathology. A directory. Distributed by the author, Institute of Food and Agricultural Sciences, University of Florida, Gainesville 32611, USA. 80 pp.

'This publication was printed... to inform Floridians about biological control of diseases and weeds.' The main part contains a computerized list of 230 projects, listing control agents and target organisms of each, the status (ranging from preliminary studies to commercial use), and the strategy (parasitism, competition, antagonism, annual application, periodic augmentation, seed or plant treatment, soil treatment, use of natural biocontrol agents or of introduced agents). This list is followed by a comprehensive index and a bibliography of 31 pages arranged according to project numbers.

Since coverage is supposed to be complete, this publication should be useful all over the world and should stimulate collaboration in a topical discipline.

W. Gams