
Volume Preface to the Second Edition

Fungi are of great relevance to human agriculture, as they may provide food, enrich food, contaminate food, be symbiotic partners of plants, or be plant pathogens. As such, fungi have a tremendous impact on humanity and of course are highly relevant for agriculture. This volume is the second edition of *Mycota XI Agricultural Applications*. While some of the authors of the first edition were willing or available to provide an updated version or new topic for the second edition, quite a number of new authors contributed gladly. Now fourteen excellent chapters have been put together, which belong to five different sections, i.e. ***Food and Fodder, Fungal Secondary Metabolites and Detoxification, Biology, Disease Control and Management, Symbiotic Fungi and Mycorrhiza, and Phytopathogenicity***. While the 14 chapters cover a broad area, it was not possible to include all possible aspects of agricultural applications, due to size limitations of this volume, availability of authors, and to avoid overlaps with *The Mycota X Industrial Applications*.

Two chapters belong to the first section, ***Food and Fodder***. Jean-Michel Savoie (INRA, France) and colleagues report about **genetics and genomics of cultivated mushrooms as well as applications to breeding of agarics**, which is believed to contribute significantly to the improvement of fruiting induction or food quality. This chapter deals mainly with the saprophytic edible mushrooms belonging to the genus *Agaricus*. Breeding strategies using molecular markers and quantitative genetics are suggested for genetic improvement. The second chapter by Jan Dijksterhuis (CBS, the Netherlands) and colleagues highlights the relevance of **fungal spoilage of crops and food**. Food spoilage is a major threat for our food stock and is responsible for enormous losses worldwide, which makes this a research area that is highly relevant with respect to the increasing demand on food during the next decennia.

The second section with three chapters is devoted to ***Fungal Secondary Metabolites and Detoxification***. Nancy p. Keller (Madison, Wisconsin, USA) and coworkers report on **genetics, biosynthesis and regulation of *Aspergillus flavus* secondary metabolites**, among these aflatoxins being the most potent natural carcinogens known. The chapter discusses recent advances in the understanding of aflatoxin and sterigmatocystin production and regulation. The second chapter by Richard D. Johnson (AgResearch, New Zealand) and colleagues deals with **fungal toxins of agricultural importance**. While it is devoted to secondary metabolites it also would fit into the ***Food and Fodder*** or ***Plant Pathology*** sections of this volume, as the authors describe phytotoxins which have defined roles in plant disease as well as mycotoxins which generally have no direct role in disease but have significant impacts on animals that feed on infected host

plants. The third chapter by Yitzhak Hadar (Hebrew University of Jerusalem, Israel) and Daniel Cullen (USDA, Madison, Wisconsin, USA) covers **organo-pollutant degradation by wood decay basidiomycetes**. Ligninolytic ‘white-rot fungi’ degrade a wide range of organopollutants including polycyclic aromatic hydrocarbons, pharmaceuticals, pentachlorophenol or pesticides. The biochemistry of enzymes like lignin peroxidase, manganese peroxidase and laccase is described in great detail by the authors.

The third section **Biology, Disease Control and Management** is comprised of four chapters. Harry C. Evans (CAB International, United Kingdom) writes about **biological control of weeds with fungi**, involving the use of classical biological control and inundative biological control. The later is based on the development of a product or mycoherbicide, incorporating an indigenous necrotrophic fungal pathogen that can be produced with high yield and formulated, and applied in the same manner as a chemical herbicide. Johannes Wöstemeyer (Friedrich-Schiller-University of Jena, Germany) provides data regarding **disease management of *Phoma* infections**. Fungi belonging to the genus *Phoma* form a phylogenetically heterogeneous group with a broad range of possible plant hosts. *Phoma lingam* is the causative agent of devastating field losses in rapeseed cultivation. Efficient disease management requires profound fundamental knowledge on biology and genetics of these organisms for disease control in the field. Stefan G.R. Wirsal (Martin-Luther-University, Halle, Germany) and colleagues report about the current knowledge on **biology, diversity and management of *Fusarium* species in small-grain cereals**. *Fusarium* Head Blight is an important cereal ear disease with potential for provoking high economic losses. In addition, the fungi accumulate a variety of mycotoxins in the grain, providing another link to the **Food and Fodder** section. The chapter presents achievements in the taxonomy and population biology of *Fusarium* Head Blight. Kerstin Voigt (Friedrich-Schiller-University of Jena, Germany) and colleagues present a comprehensive view on the **ecological and economical importance of parasitic zoosporic true fungi**. Most of the described species are saprotrophs or mutualists, but there are also examples of parasites of higher plants or animals, which play significant ecological roles or cause economically important diseases.

The fourth section **Symbiotic Fungi and Mycorrhiza** is new and was not part of the first edition. Symbiotic interactions and in particular mycorrhizal associations are highly relevant for plant growth and as such provide an important addition to agricultural applications. Claire Veneault-Fourrey and Francis Martin (Université de Lorraine-INRA, France) provide us with **new insights into ectomycorrhizal symbiosis evolution and function**. Understanding of the biology of ectomycorrhizal fungi is important for sustainable forest management and to improve the productivity of tree plantations in marginal soils. This chapter includes eco-biotechnological applications in forestry and bioremediation. Likewise Erika Kothe (Friedrich-Schiller-University of Jena, Germany) and coworkers provide a view into signaling processes in the mutually beneficial symbiosis on the basis of transcription analyses. This is summarized in the section genome-wide expression profiling. The authors provide examples of genetic modifications as tools for functional gene analysis.

In the fifth and final section, **Phytopathogenicity**, three chapters look into different aspects of plant-pathogenic interactions. Diana Fernandez (Institut de

Recherche pour le Développement, France) and colleagues investigate **rust fungi: achievements and future challenges on genomics and host-parasite interactions**. The authors focus on the most recent progresses in molecular research of the rust fungal genomes and biology, but also the interaction with the plant host and the establishment of a successful infection. Importantly, the latest antifungal strategies available, including novel drug targets discovery and the use of RNA interference to engineer plants resistance to rust fungi, are covered as well. This provides a link to the section on *Disease Management*. Ralf Horbach and Holger B. Deising (Martin-Luther-University, Halle) focus on **the biotrophy–necrotrophy switch in fungal pathogenesis**. Increasing numbers of plant pathogenic fungi have been identified as hemibiotrophs, i.e. pathogens sequentially differentiating biotrophic and necrotrophic hyphae in the host tissue, allowing to analyse biotrophic and necrotrophic lifestyles at the molecular level in the same genetic background. The chapter provides a great overview on the recent development and understanding of fungal hemibiotrophy. Last but not least, Lisha Zhang and Jan A.L. van Kan (Wageningen University The Netherlands) report in their chapter about the role of **pectin as a barrier and nutrient source for fungal plant pathogens**. They show that plant cell walls are both, a barrier for penetration and a food source for fungi.

The fourteen chapters provide a comprehensive view on agricultural applications, which I hope will prove to be useful for scientists working in the field, but also as important insight for people from other areas of research. I thank all authors for their contributions, and also the Springer staff for their help.

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