Iron acquisition by the phytopathogenic fungus *Ustilago maydis*

Britta Winterberg[1], Jan Schirawski[1], Uwe Linne[2], Franziska Leßing[1], Heiko Eichhorn[1], Regine Kahmann[1]

[1] Max Planck Institute for Terrestrial Microbiology, D-35043 Marburg, Germany
[2] Philipps-University, Department of Biochemistry, D-35043 Marburg, Germany

Ustilago maydis is a phytopathogenic fungus infecting maize. Although it can live as a saprotroph, *U. maydis* depends on biotrophic infection of its host plant to complete its life cycle. The infection is characterized by the appearance of tumors, in which the diploid fungal spores develop. During all stages of its life cycle, *U. maydis* needs iron. To acquire iron during its different states of development *U. maydis* possesses two high affinity iron uptake systems. The ferroxidation/permeation high affinity iron uptake system was shown to be necessary for full virulence on maize (Eichhorn et al., 2006: A ferroxidation/permeation iron uptake system is required for full virulence in *Ustilago maydis*. Plant Cell 18, 3332-3345). In addition, *U. maydis* is able to assimilate iron via the siderophores ferrichrome and ferrichrome A. These low-molecular weight compounds solubilize, bind and transport iron.

Recently, we identified three clusters of iron-regulated genes in *U. maydis* (Eichhorn et al., 2006). HPLC analysis of culture supernatants of mutants carrying single gene deletions showed that some genes of the iron-regulated clusters encode proteins with a function in siderophore biosynthesis. Based on these results we are proposing a pathway for ferrichrome A biosynthesis, which is currently corroborated by generation and analysis of additional mutants.

To investigate whether siderophores are needed during pathogenic development, plant infection assays were performed with strains that lacked the ability to synthesize siderophores. To this end, double deletion mutants of the two non-ribosomal peptide synthetase genes sid2 and fer3 were generated. These mutants were unable to grow on low-iron medium in axenic culture. However, they were as pathogenic as the wild type and produced viable spores. Interestingly, spore progeny were diploid, indicating a meiosis defect. This suggests that the *U. maydis* siderophores have a role in iron uptake during saprophytic growth as well as iron storage during spore development of *U. maydis* in planta.

Book Review

Khan, J.A. and J. Dijkstra (eds.), Handbook of Plant Virology.
Food Products Press, an Imprint of the Haworth Press, New York, London, Oxford, 2006, 452 pages, Hard cover ISBN: 978-1-56022-978-0, Soft cover ISNB: 978-1-5622-979-7, Pricing: Hard cover $ 89.95, Soft cover $ 69.95

In the past decade different techniques have been developed for the diagnosis of plant viruses. In most general handbooks and publications of plant virus diseases the authors have dealt with not only the symptoms of plant virus diseases, but also the methods of virus identification and diagnosis. Normally it is not the purpose of these books to recall the modern molecular biology or genetic techniques to identify the different viruses. Therefore the authors mention only the short form of modern techniques such as RFLP (restriction fragment length polymorphism), SCAR (sequence characterized amplified region), RT-PCR (reverse transcriptase polymerase chain reaction), cDNA (complementary deoxyribonucleic acid), SSR (simple sequence repeat), or primer, probe, restriction enzyme, hybridization etc. For agricultural students at the Bachelor level these techniques are difficult to understand or can not be found easily.

The Handbook of Plant Virology covers the whole field of virology with a number of selected representative topics in 19 chapters written by international well known experts. The chapters deal with topics of plant virus taxonomy according to the system of the ICTV (International Committee on Taxonomy of Viruses), purification of viruses and virus architecture, virus transmission, virus replication, resistance to viral infection and control strategies. The second part of the book describes the most important of virus families and genera according to the ICTV systems. Five appendices describe positive-sense single-stranded RNA and double-stranded DNA viruses of nine large families and unassigned genera with respect to virion properties. Research workers and students working in plant virology and plant pathology will find this guide a highly valuable resource for the overview of virology and plant virus diseases. The Handbook of Plant Virology is thus a compact resource for scientists and students at all levels of study and research.

Firous Ebrahim-Nesbat, Göttingen, Germany