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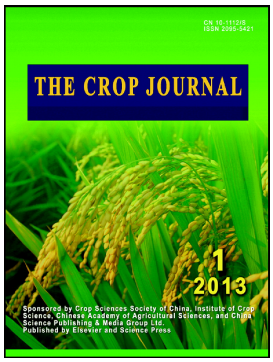

Understanding the lifestyles and pathogenicity mechanisms of obligate biotrophic fungi in wheat: The emerging genomics era

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Review

Understanding the lifestyles and pathogenicity mechanisms of obligate biotrophic fungi in wheat: The emerging genomics era

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Abstract: Obligate biotrophic fungi cause serious and widespread diseases of crop plants, but are challenging to investigate because they cannot be cultured *in vitro*. The two economically important groups of biotrophic fungi parasitizing wheat are the rust and powdery mildew pathogens, but their obligate biotrophic lifestyles and pathogenicity mechanisms are not well understood at the molecular level. With the advent of next generation sequencing technology, increasing numbers of pathogen genomes are becoming available. Research in plant pathology has entered a new genomics era. This review summarizes recent progress in understanding the biology and pathogenesis of biotrophic fungal pathogens attacking wheat based on pathogen genomics. We particularly focus on the three wheat rust and the powdery mildew fungi in regard to genome sequencing, avirulence gene cloning, effector discovery, and pathogenomics. We predict that coordinated study of both wheat and its pathogens should reveal new insights in biotrophic adaptation, pathogenicity mechanisms, and population dynamics of these fungi that will assist in development of new strategies for breeding wheat varieties with durable resistance.

Keywords: Common wheat; Biotrophic fungus; Pathogenicity; Pathogenomics; Powdery mildew; Rust

1 Introduction

Wheat, the staple food crop for more than 50% of the world population [1], is threatened by fungal diseases. Two major groups of destructive biotrophic fungi parasitizing wheat are the rusts and powdery mildew fungi that are Basidiomycetes and Ascomycetes, respectively. The rust pathogen species are *Puccinia striiformis* f. sp. *tritici* (*Pst*), *Puccinia graminis* f. sp. *tritici* (*Pgt*), and *Puccinia triticina* (*Pt*) that cause stripe rust, stem rust and leaf rust, respectively. These *Puccinia* species have different sexual and asexual propagation styles [2], whereas the powdery mildew pathogen *Blumeria graminis* f. sp. *tritici* (*Bgt*) infects wheat primarily by means of asexual (haploid) conidiospores [3].

The rusts and powdery mildew are the most widespread damaging diseases on wheat worldwide, and cause

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