

Magnaporthe grisea, rice blast

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Brief facts

- *Magnaporthe grisea* is a filamentous ascomycete, which causes **rice blast disease**.
- Rice blast is the most serious disease of cultivated rice and therefore poses a threat to the world's most important food security crop. Losses of US\$55 billions are estimated in South and Southeast Asia each year due to this pathogen.
- In addition to rice, *M. grisea* causes disease on a wide variety of alternative hosts, including barley, wheat and millet (*Eleusine coracana*).
- Blast was first reported in Asia more than three centuries ago and is now present in over 85

countries. It is highly adaptable to environmental conditions and can be found in irrigated lowland, rain-fed upland, or deepwater rice fields - virtually everywhere the rice is grown.

- Blast can survive on seeds and can easily move over borders if proper safety checks are not in place. In 1996 in California, USA, despite the enforcement of strict safety measures to prevent the entry of blast, the disease managed to find its way into the state's paddy fields for the first time.

Developmental stages

- **sexual**

sexual reproduction occurs when two strains of opposite mating types meet and form a perithecium in which ascospores develop

- **asexual**

conidiogenesis; the appearance of necrotic disease lesions is accompanied by the development of aerial conidiophores; conidia are arrayed at the tips of these aerial hyphae; mitotic division of a single progenitor nucleus occur in the conidiophore, leading to the production of the first three-cell conidium; thereafter, the hyphal tip moves to the side of the conidium and produces a second spore until three to five conidia are produced in a whorl at the conidiophore tip

- **appressorium formation**

a stage in fungus development characterized by development of appressoria that infect aerial tissues of the host

- **vegetative**

vegetative growth of the fungus mycelium (hyphae) in tissues of the host or on the laboratory medium

Tissues

- perithecium

a small flask-shaped fruiting body that develops during sexual cycle of the fungus and contains ascospores

- appressorium

a specialized cell produced from the germ tube of the conidium (appressorium formation stage); development of the appressorium requires a hard, hydrophobic surface and/or the absence of exogenous nutrients; once formed the appressorium is a dome-shaped cell with a highly differentiated cell wall structure; the cell wall is rich in chitin and contains a layer of melanin on the inner side of the wall; the melanin is a virulence characteristic of the fungus; it is well known that the appressorium is able to generate an enormous turgor pressure and physical force, allowing the fungus to breach the host cuticle and invade plant tissue; it is also known that melanin-deficient mutants cannot generate the pressure of the magnitude required for penetration of the plant cuticle; it is believed that melanin provides effective means of preventing solute efflux and allows appressoria to accumulate the substantial turgor; the region of the appressorium adjacent to the substatum, **appressorium pore**, lacks both, chitin and melanin; following appressorium expansion, melanization and some quiescence, the pore develops a new cell wall; the **penetration peg** emerges through this new wall, perforates the host surface and conveys the content of the appressorium into cells of the leaf epidermis

- mycelium

body (biomass) of the fungus consisting of hyphae which can grow in tissues of the plant or on a suitable laboratory medium

- germinated conidia

onset of appressorium formation stage; spore germination requires the presence of free water and is very rapid: within 2-4 hours of landing on the leaf, a polarized germ tube extends for a short distance from one of the apical cells of the conidium; then it swells at its tip and changes direction while becoming flattened against the leaf surface; this process, known as **hooking**, precedes formation of the appressorium and is thought to constitute a **recognition phase**

- hypha

microscopic threadlike filaments that forms mycelium of the fungus; hyphae grow intracellularly, invading adjacent epidermal cells as well as underlying mesophyll cells; the pathogen hyphae can account for up to 10% of the biomass of infected leaf tips by three days after inoculation; after penetration of the plant cuticle and cell wall, the **penetration peg** enlarges to form a primary infection hypha that subsequently differentiates into a branched and bulbous secondary hypha, which enables proliferation throughout the host tissue

- conidium

asexual spore of the fungus produced on conidiophore by hyphae fragmentation; mature conidia are three-celled, pear-shaped, and bear a basal appendage at the point of attachment to the conidiophore; as spores reach maturity, the apical cell wall of the conidium breaks open, and a droplet of viscous sticky material is produced while the conidium is still attached to conidiophore; this material serves to attach the conidium to the wax-covered host surface upon contact

in a nonspecific manner; once attached, even vigorous attempts to dislodge adherent conidia from surfaces are typically unsuccessful

Mating types

M. grisea is **heterophallic**, i. e., two mating types of the fungus are present. When fertile isolates carrying opposite mating types are paired on an appropriate growth medium, they will form sexual fruiting bodies, perithecia within 21 days. Rice pathogenic strains are very rarely fertile.

- Mat1-1
- Mat1-2

a commonly studied strain, **Guy11**, is a Mat1-2 strain from French Guiana and has proved very valuable in a large number of genetic studies

Strains

- Guy11

Mat1-2 mating type

- 70-15

Mat1-1 mating type

- P2

could not find corresponding mating type

- K261

Mat1-2 mating type

- K364

Mat1-2 mating type

- [4454-R-1](#)

wild type; Mat1-1 mating type

References

PubMed articles

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- Howard RJ, Valent B. Breaking and entering: host penetration by the fungal rice blast pathogen *Magnaporthe grisea*. *Annu Rev Microbiol*. 1996; 50: 491-512. **PMID: 8905089**
- Major topic *Magnaporthe*: **Free full text articles in PubMed**

Websites

- **Wikipedia: *Magnaporthe grisea***
- **Rice Blast**
- **Blast, biotech and big business: implications of corporate strategies on rice research in Asia**



Last updated 03/15/09

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