May 19

Pathogen of the month – May 2019

Blumeria graminis (DC.) Speer, f. sp. hordei (Em. Marchal)

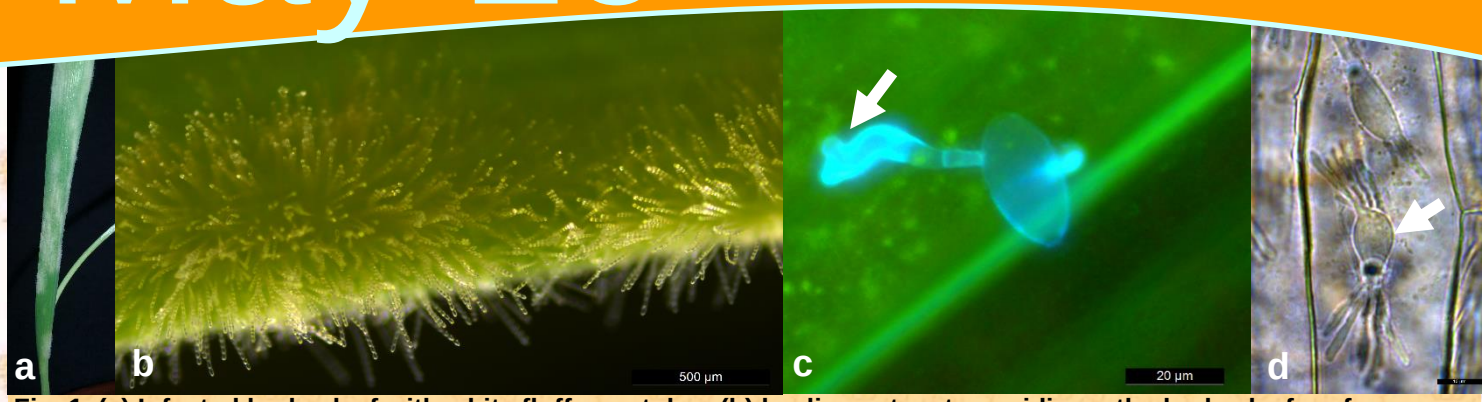

Fig. 1. (a) Infected barley leaf with white fluffy pustules; (b) hyaline catenate conidia on the barley leaf surface; (c) germinating conidium stained with calcofluor white with the appressorium penetrating the leaf cuticle (white arrow) using a fluorescent microscope and (d) the palmate shaped haustorium formed by the invagination of the plant plasma membrane (white arrow) within the leaf epidermal cell under light microscopy. Scale bars represent 500µm in (b), 20µm in (c) and 10µm in (d).

Common Name: *Blumeria graminis f. sp. hordei*
Disease: Barley Powdery Mildew
Classification: **K:** Fungi **P:** Ascomycota **C:** Leotiomycetes **O:** Erysiphales **F:** Erysiphaceae

Blumeria graminis. f. sp. hordei (Bgh; anamorph *Oidium monilioides* Link) is an obligate biotrophic fungal pathogen which specifically causes powdery mildew in barley. It is also known as *Erysiphe graminis* f. sp. hordei. Barley grain in Australia is an extremely important economic commodity, second only to wheat and it is used also as a valuable rotational crop for breaking host specific leaf and root disease cycles.

Biology and Ecology:

In susceptible barley crops, the dispersal of powdery mildew occurs via the spread of asexual haploid conidia by wind. Once on the surface of a leaf, the conidium forms two morphologically distinct germ tubes: (i) The primary germ tube (PGT) for adhesion and orientation, water acquisition and transduction of leaf derived signals and; (ii) the appressorial germ tube (AGT) for host cell wall penetration via a penetration peg. The successful penetration leads to the formation of haustoria which are specialised feeding structures where the fungi absorb proteins and amino acids. After the establishment of the haustoria, secondary hyphae elongate on the host epidermal leaf surface and approximately 72h post infection, powdery colonies, composed of both masses of mycelia and catenate conidia, oblong to cylindrical in shape ranging 32–44 x 12–15 µm in size linked to conidiophores, form on the adaxial surface of the leaf.

Barley powdery mildew infections are characterised by white to grey fluffy pustules which occur on all aerial parts of the plant from the stem to the leaves and awns. Cleistothecia (fruiting bodies forming sexual spores or ascospores) develop late in the season and are embedded in the mildew pustules as minute black dots on crop debris. While asexual reproduction is the quickest means of exponential population growth, sexual reproduction provides an added advantage through the generation of novel pathotypes through genetic recombination. Mild temperatures (15-22^{o}C) and humidity above 70% favour the spread of conidia and wet and cool conditions activate the release of ascospores.

Impact:

Most Australian barley varieties certified as malt, feed or food grades range from very susceptible to moderately resistant. Severe infection by Bgh reduces yield and can cause the grains to be downgraded to feed.

Host Range:

The main host of the pathogen is *Hordeum vulgare* (barley) and *Hordeum glaucum* and *Hordeum leporinum,* both commonly known as barley grass.

Distribution:

Bgh occurs in the barley growing regions of the world including Australia. A survey in 2010-2011 detected twenty-seven pathotypes in Australia.

Management options:

The most effective means of Bgh control are the seed and foliar application of effective triazole or demethylase inhibitor (DMI) fungicides and the use of robust cultivars with resistance genes related to the non-race specific loss-of-function *mlo* alleles and race/pathotype specific dominant resistant (R) genes such as *Mla-3*, *Mla-9* and *Ml-k.* As the efficacy of dominant R genes is usually short-lived, the utilisation and rotation of barley cultivars with effective R genes can help in managing Bgh population in barley crops. In addition, tebuconazole has been found to be ineffective in WA due to single nucleotide mutations in the *Cyp51* (lanosterol demethylase) gene in the Bgh population. In such regions, growers should avoid susceptible varieties and apply other effective triazoles with strobilurin fungicides (Group 11 - QoI inhibitors).

Further Reading: Dean et al. (2012). Molecular Plant Pathology 13(4), 414–430; Dreiseitl et al. (2013) Australasian Plant Pathol. 42:713–721; GRDC (March 2012) Barley Powder Mildew Fact Sheet; GRDC Grownotes (September 2018) – Barley, Section 9- Diseases; Tucker (2015) Adaptation of Barley Powdery Mildew (Blumeria graminis f. sp. hordei) in Western Australia to Contemporary Agricultural Practices. PhD Thesis. Curtin University Qld; Zulak et al. (2018) Front Microbiol. 2018; 9: 706.

Key Contacts: Dr Francine Perrine-Walker, email: marie.perrine-walker@sydney.edu.au