APPS

Jan 20

Pathogen of the month – January 2020

Fusarium graminearum sensu stricto (Schwabe)

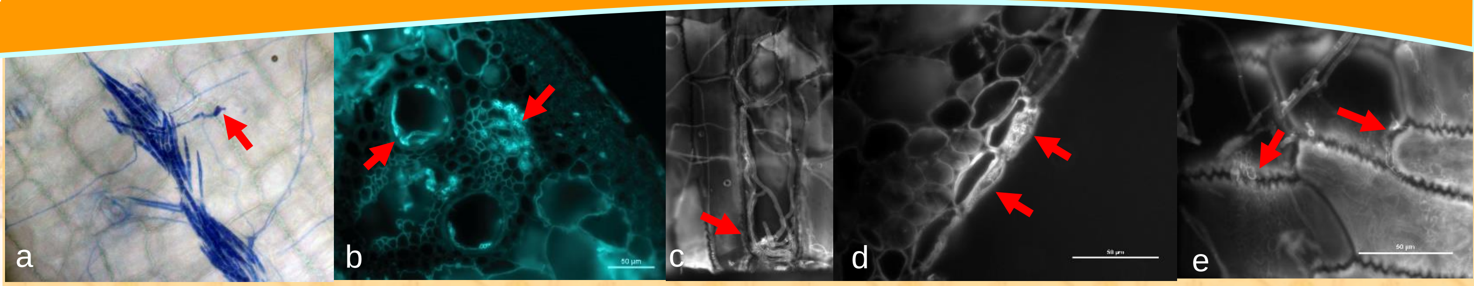

Fig. 1. a) ***Fusarium graminearum*** **(FG) spores germinating on maize leaf sheath surface forming a lobate appressorium (red arrow); b) and c) intracellular and intercellular FG hyphae in maize leaf sheath respectively (red arrows); d) and e) FG sub-cuticular hyphal growth on maize leaf sheath (red arrows). Hand-cut sections were either cleared in chloral hydrate solution and stained with Lactophenol blue as shown in (a) while (b- e) were stained with Calcofluor White. Colour and fluorescence images were captured using a Nikon Ti Eclipse inverted microscope with a Nikon DS-Fi1 high-definition colour/DS-Qi1Mc cooled CCD cameras and an Olympus BX50 upright microscope with SPOT Camera within the LIMS Bioimaging Facility at LIMS (La Trobe University).**

Common Name: *Fusarium graminareum sensu stricto*
Disease*:* *Fusarium* head blight (FHB); seedling blight (FSB); crown and root rot; Gibberella ear and stalk rot
Classification: K: Fungi P: Ascomycota C: Sordariomycetes O: Hypocreales F: Nectriaceae
The filamentous hemibiotrophic ascomycete*, Fusarium graminearum* (FG) (teleomorph: *Gibberella* zeae (Schwein.) Petch) produces type B trichothecene mycotoxins. These include deoxynivalenol (DON or vomitoxin), nivalenol (NIV) and their derivatives. It is a member of FG species complex (FGSC) which includes 16 phylogenetic species such as *Fusarium pseudograminearum* and *Fusarium meridionale,* which are found in Australasia*.*

Biology and Ecology:

In asexual phase, slender shaped macroconidia are multicellular with five to seven septa. Upon germination, epiphytic runner hyphae produce lobate appressoria, foot structures and infection cushions for entry into its plant host. This is depended on plant growth stage of the host, site of infection and climatic conditions. Growth occurs in the intercellular spaces, stomatal and subcuticular tissues in wheat during biotrophic stage. During the necrotrophic stage, mycotoxins and cell wall degrading enzymes are produced by all FG to grow intracellularly, killing the host cells. Spores can overwinter in soil or on plant debris for up to 16 months. FG survival is enhanced within reduced tillage systems. In the sexual stage, ascospores are released in spring from the perithecia. Rain, wind and insects aid in ascospore dispersal. In wheat, flowering spike tissue with FG infection, causes FHB if airborne or via wounding by insects and causes crown/root rot and seedling blight if soilborne. FHB symptoms appear after flowering in warm/humid climates. Damaged wheat grains appear white in color, shriveled with low weight. In maize, the fungus forms pink to red discoloration of the kernels (ear rot) and piths. In Gibberella stalk rot, pith shredding causes the plants to die prematurely.

Impact:

Around 33 million tons of durum wheat produced worldwide is used for human consumption and wheat straw used for bedding material and for consumption in livestock production. If mycotoxin contaminated grains/straw are consumed, NIV is more toxic than DON to humans and livestock though DON has a higher phytotoxic potential. In the US and Canada, Gibberella ear rot reduces yield by over 1 million metric tons per year.

Distribution:

It has a worldwide distribution.

Host Range:

It can infect wheat, barley, rice, oat and maize and other small grain cereals. It causes seed decay and damping-off in soybean in the US.

Management options:

There are 5 types of resistance to FHB disease, for example targeting kernel infection (Type III). However complete resistance to the pathogen has not been detected in any plant species. For wheat, durum varieties appear to be more susceptible than bread wheats. Foliar fungicides and seed dressings are used in various countries however it is quite expensive. In Australia, no fungicides are registered for the control of seedling blight caused by the FHB pathogens. Removal of crop residues/debris and stubbles and crop rotations with non-grass species such as sunflower, cotton are used to lower FG inoculum in the field. Planting bread wheat after, in or around maize or durum paddocks should be avoided. In addition, crop rotations with other cereals may affect other *Fusarium* sp. populations belonging to FGSC in various cereal growing regions around the world, such as the mycotoxin producing *F. pseudograminearum,* which causes crown rot in Australia. If any FG or other species in the FGSC are identified, it is recommended that crops should be tested for the presence of mycotoxins.
For maize, moderately resistant hybrids and transgenic lines against pest damage are used overseas to reduce Gibberella and Fusarium ear rot respectively as well as to reducing mycotoxin levels. Under field studies, novel transgenic maize plants reduced FG ear rot.

Further Reading: Anderson et al (2017) Plant Health Prog, 18:186-191; Bissonnette et al. (2018) Plant Dis. 102: 1141-1147; Cromey et al. (2002) New Zeal J Crop Hort Sci. 30: 235-247; Díaz-Gómez et al. (2016) World Mycotoxin J. 9(3): 475 – 486; GRDC GrowNotes (2016) https://grdc.com.au/__data/assets/pdf_file/0032/369464/GrowNote-Durum-North-9-Diseases.pdf; Kant et al. (2012) AJCS 6 (12): 1598-1605; Marburger et al. (2015) Crop Sci. 55:365–376; Obanor and Chakraborty (2014) Plant Pathol. 63: 1218–1229; Taheri (2018) Eur J Plant Pathol. 152:1-20; Trail (2009) Plant Physiol 149: 103–110; van der Lee (2015) Food Addit Contamin Part A. 32(4):453-460

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