

Helping wheat beat fusarium

By CSIRO Plant Industry

Crown rot ranks in the top five most damaging wheat diseases in Australia. According to the NSW Department of Primary Industries (NSW DPI), crown rot causes scattered white heads with pinched or no grain, browning of crown and a pinkish colour in lower leaf sheaths. Crown rot is a chronic problem throughout the Australian wheatbelt and costs about \$79 million in lost yield to the industry each year.

It thrives if plants suffer from water stress after flowering – so does very well across most of the Australian wheatbelt, particularly in northern NSW and Queensland.

Head blight is a particular problem in the northern wheatbelt of eastern Australia. NSW DPI lists its symptoms as premature bleaching and discolouration of head and chalky white grains that may be tinged with pink. Head blight can reduce yield but more notably it produces a fungal toxin that seriously damages grain quality for human and animal consumption.

In bad years it costs growers and the export oriented industry heavily in lost yield and downgraded quality.

Tackling fusarium

Fusarium occurs across most of the wheatbelt flaring up when conditions are right. It is difficult to completely eradicate.

Minimum till practices used to conserve soil water unfortunately encourage fusarium as it survives in cereal stubbles. In dry

AT A GLANCE...

The fungus fusarium causes two of Australia's most serious wheat diseases – 'crown rot' and 'head blight'. CSIRO Plant Industry researchers in Brisbane are tackling fusarium in a unique way and making significant progress to both understanding the fungus and developing resistant wheat varieties.

weather high levels of fusarium can survive in stubble for many years. Stubble can be burnt to reduce fusarium, but burning exposes the top soil to erosion and loss of soil moisture.

Cereal crop rotations have limited success in reducing fusarium as it infects, and survives on, many grasses and other weeds commonly found throughout the wheatbelt that remain when cereals are rotated.

Using crops other than cereals in long rotations or spraying fungicides to control fusarium are not economically viable options.

Knowing the enemy

There are a number of fusarium species that can cause crown rot and head blight. Some cause severe disease and others only cause mild disease. Two fusarium species present in Australia are the main problem:

- *Fusarium pseudograminearum* that most commonly causes crown rot; and,
- *Fusarium graminearum* that causes head blight.

The species of fusarium present in a paddock greatly affects the severity of disease outbreak.

Dr Sukumar Chakraborty and Dr Chunji Liu, with their CSIRO Plant Industry research team, are studying these species to gather 'enemy intelligence' about them.

The research focuses on exploiting pathogen weakness using new knowledge of pathogen biology, epidemiology and pathogenesis mechanisms. The study also aims to improve the host plant resistance by manipulating genetic and molecular mechanisms and through pre-breeding.

By teaming up with researchers from Germany, CSIRO scientists have been able to summarise the knowledge of genetic diversity for three of the most important fusarium pathogens affecting cereals.

Each of these three species uses a distinct reproduction method and important genetic differences exist within each species.

For this reason, when breeding fusarium resistant wheat, scientists are striving to combine more than one source of resistance, in a commercial variety. This reduces the risk of fusarium species and strains overcoming resistance of a wheat variety.

Breeding resistant wheat varieties

Currently there are no fusarium-resist-



White heads caused by fusarium crown rot of wheat. (PHOTO: CSIRO)



Dr Sukumar Chakraborty checking for fusarium infection in wheat at a trial site in China. (PHOTO: CSIRO)

ant wheat varieties in Australia, but two wheat lines with high levels of crown rot resistance have been identified by the CSIRO Plant Industry team.

To identify these resistant lines, they have used a high-throughput screening method to screen over 2400 wheats from all around the world.

The newly identified wheats resistant to fusarium are now being used in a molecular marker assisted breeding program.

As a pre-breeder, CSIRO Plant Industry has released germplasm with improved crown rot resistance to commercial wheat breeding companies in Australia. These companies will now incorporate this new resistance into their elite wheat lines with good agronomic performance, quality traits and adaptation to different growing regions.

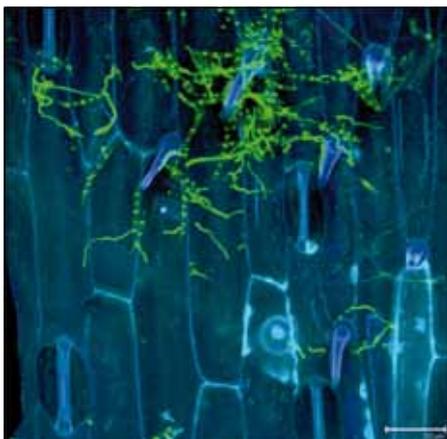
Given the economic importance of crown rot to all wheat growing regions in Australia, the breeding companies will be working hard to release commercial varieties as soon as they possibly can.

In parallel work the CSIRO Plant Industry team is also looking at how fusarium invades and colonises wheat tissues, how plants resist fusarium infection and what genes may be involved in defending the plant against fusarium or reducing its effect on yield.

Some potential fusarium resistance genes have already been identified in the model plant – arabidopsis. These arabidopsis resistance genes could provide clues about where to look for fusarium resistance genes in wheat.

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This work is being carried out with funding from CSIRO and the GRDC and in collaboration with numerous national and international groups. ■



Fusarium growing on wheat stem base. Invasion and colonisation of wheat by fusarium are being studied to identify stages where a fortification of wheat tissue may offer resistance. (PHOTO: CSIRO)



Fusarium head blight of barley. (PHOTO: CSIRO)

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