Crown rot of wheat - its importance and management in southern NSW

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Take Home Messages

- Crown rot of wheat is carried over on infected plant material so, with closer rotation of cereals and increased stubble retention, it has become an important disease in southern NSW in recent years.
- The risk of crown rot can be identified with a soil test prior to sowing.
- Reduction of inoculum can be achieved by two years of break crops (ie non-cereals) however this may not always completely remove the risk, especially for durum wheat.
- Sowing varieties rated as moderately resistant in paddocks with high levels of inoculum will not avoid yield loss if moisture stress occurs during grain filling.
- Non-cereal break crops such as canola, chick peas and lupins may be more profitable than bread wheat in paddocks with a medium to high level of inoculum.

Background

During the last 10 years there has been an increase in the intensity of cereals in the cropping rotation, and an increase in the adoption of stubble retention farming practices. At the same time years with moisture stress during grain filling have increased in frequency. The combination of these factors has contributed to an increase in the occurrence of crown rot in wheat and barley in southern NSW. This report summarises some of the research into this disease that has been undertaken at DPI Horsham Victoria and Tamworth I&I NSW and details strategies that growers can adopt to reduce the impact of these diseases on production.

Biology of crown rot

Crown rot in southern NSW is caused by both *Fusarium pseudograminearum* and *F. culmorum.* There is some evidence that *F. culmorum* is more common in higher rainfall and irrigated environments. However, both are pathogens of grasses and can, therefore, attack all cereals.

Crown rot survives from one season to the next on infected plant material from previous cereal plants and grass weeds. Therefore, stubble management is important in crown rot control. Survival of crown rot is enhanced by dry conditions which limit breakdown of infected plant material during summer or a break crop. Infection of a new crop is favoured by moist conditions during winter that enables the fungus to grow from the infected stubble to an adjacent seedling. Once infection has occurred more rapid growth of the pathogen within the plant occurs when the plant is moisture stressed.

The presence of the pathogen within the stem limits water movement up the plant and when severe, particularly in moisture stressed conditions, results in premature death of the tiller and the presence of the characteristic white (dead) head. Grain does not form in these white heads. Often only single tillers on a plant are infected and white heads are often scattered across a paddock.

Importance of crown rot

In the absence of survey data from southern NSW we can see the impact that crown rot can have on a regional scale by looking at surveys in Victoria which have been conducted since 1997. These surveys have shown that crown rot causes annual average yield losses in wheat of 2.6%, with losses up to 20% in some crops. During 2008 crown rot reduced Victorian wheat yields by 3.2%, costing $20 million (Table 1). The higher than usual loss in the high rainfall zone most likely relates to the wet winter supporting infection of the young crop followed by a dry spring which favoured growth of the pathogen within the plants and expression of white heads.

Table 1. *Effect of crown rot on wheat production in western Victoria during 2008*

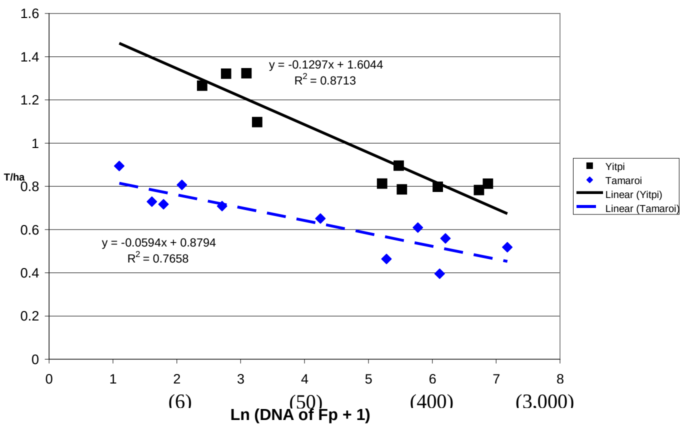
Rainfall zone	Number paddocks affected	Number paddocks classified by yield loss (% white heads)					Annual loss	
		0	<1	1-5	6-10	>10	% yield loss	$ million (@$270/t)
Low (n=24)	14 (58%)	10	9	2	2	1	1.6	5.0
Medium (n=21)	13 (62%)	8	3	5	3	2	3.2	7.5
High (n=16)	10 (63%)	6	0	4	1	5	7.7	7.8
Total	37 (61%)	24	12	11	6	8	3.2	20.3

Losses from crown rot are greatest in durum wheat crops which are highly susceptible to this disease. Bread wheat is more tolerant than durum wheats but can still suffer significant yield loss. The effect of crown rot on barley is variable depending on seasonal conditions. In some seasons barley is able to mature prior to the onset of moisture stress and, therefore, escape the effects of crown rot, whereas in other seasons it can suffer losses similar to bread wheat.

Management of crown rot

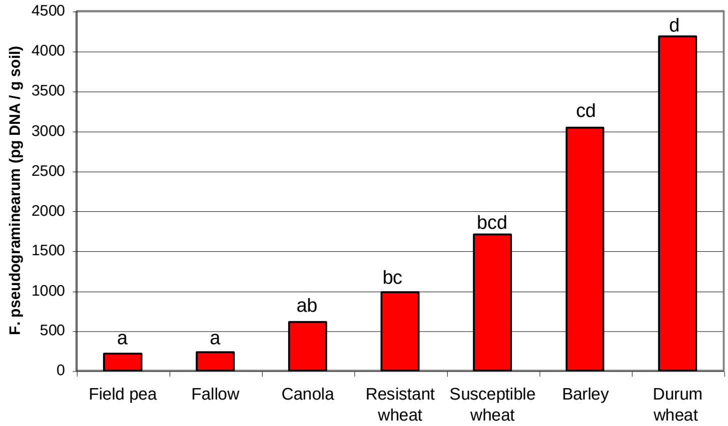
Yield loss caused by crown rot is associated with the levels of inoculum present in a paddock prior to sowing (Figure 1). In the example shown in Figure 1 the inoculum was quantified in soil using the Root Disease Testing Service (PredictaB). Identifying those paddocks that are likely to have risky levels of crown rot inoculum present is critical in the management of crown rot. This can be done by monitoring levels of crown rot symptoms in cereal crops or by undertaking a soil test before sowing.

Figure 1. *Association between sowing DNA levels crown rot (March 2007) and grain yield in plots of Yitpi and Tamaroi (durum wheat) at Dooen during 2007.*



Crown rot levels can be reduced by growing a non-host (i.e. non-cereal crops) (Figure 2). It should be noted that even though non-host crops can reduce inoculum levels DPI Victoria studies have shown that in general two years of break crop are required to minimise crown rot inoculum to a safe level. Any practice that speeds up the break down of infected plant material will accelerate the reduction of inoculum levels during a break crop.

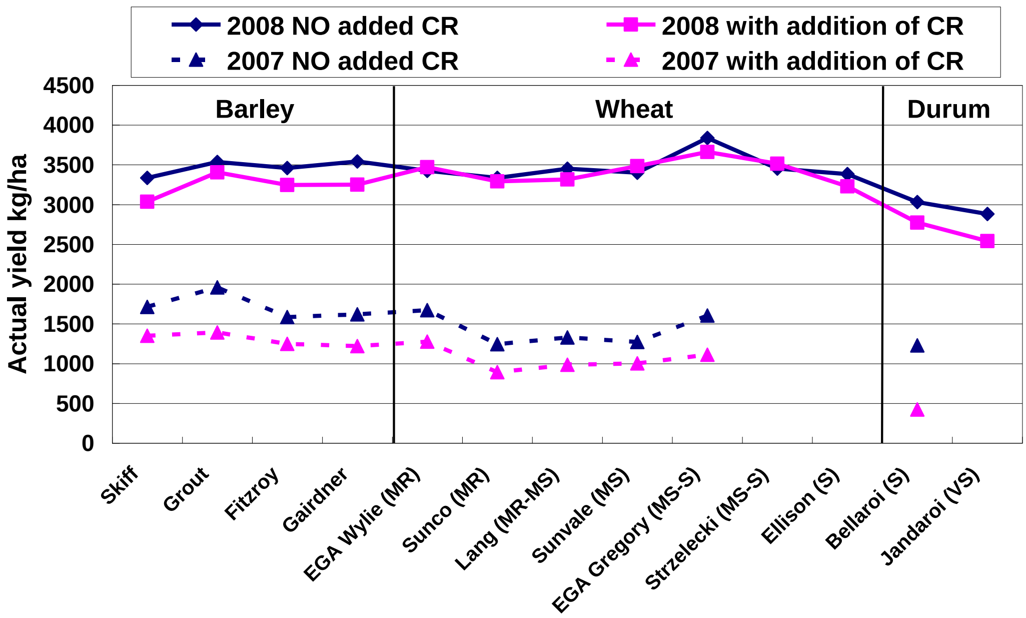
Figure 2. *Effect of crop rotation at Corack during 2004 on the level of crown rot inoculum in March 2005 (initial level 1,231 pg DNA / g soil).*



Variety selection

Current variety ratings for crown rot are based on resistance. This provides a measure of the variety's ability to limit the development of crown rot. However even moderately resistant varieties sown into moderate to high levels of crown rot inoculum are at risk of yield losses of up to 50%. Results from research from northern NSW demonstrate this clearly in Figure 3. When moisture stress occurred during grain filling in 2007, barley, bread wheat and durum, regardless of resistance level, had significant yield loss in the presence of crown rot. However in 2008 when no moisture stress occurred during grain filling, there was no significant yielded loss in the presence of crown rot.

Figure 3. *Average effects of cereal type and resistance on yield loss in the presence of crown rot in northern NSW in 2007(11 sites) and 2008 (7 sites).*



Profitable rotations

Choosing to grow a non-host of crown rot can be more profitable, particularly in cases where crown rot losses are anticipated to be at moderate to high levels. Table 2 provides an example of the gross margins of bread wheat versus canola in south eastern NSW under increasing levels of yield loss due to crown rot across a range of yield potentials. A number of assumptions have been used in these calculations. They are; all gross margin calculations are based on I&I NSW *Farm Enterprise Budget 2009* and canola yields are calculated at 60% of the bread wheat yield in the absence of crown rot.

These figures do not take account of the additional benefit of the break crop on subsequent wheat yields and the impact of reducing the inoculum levels of crown rot. Even at low yield levels canola as a break crop provides greater returns than bread wheat. The Table also illustrates that crown rot has the potential to wipe out the profit of growing wheat at low to moderate levels of yield loss between 5-30% caused by crown rot.

Table 2: *Effect of crown rot (CR) yield loss on gross margin of bread wheat in southern NSW across a range of yield potentials, compared to the potential gross margin of canola based on 60% of the bread wheat yield. All costs and income estimates derived from I&I NSW Farm Enterprise Budget 2009*.*

Wheat Yield without CR (t/ha)	1.5		2		3	
Percent Yield loss	Wheat	Canola	Wheat	Canola	Wheat	Canola
0	-$44	$42	$66	$192	$287	$492
5	-$60	$42	$44	$192	$254	$492
10	-$77	$42	$22	$192	$221	$492
20	-$110	$42	-$22	$192	$155	$492
30	-$143	$42	-$66	$192	$89	$492

*The figures provided are a guide only and should be altered for movement in crop prices, changes in seasonal conditions and the farm characteristics.

Conclusions

- Know your crown rot risk.
- Establish base line data to monitor inoculum levels in suspect paddocks.
- Early management decisions are the key to minimising losses.
- Non-host crops will reduce inoculum levels but this may take more than one year.

Useful Reference

Crown Rot in Cereals Fact Sheet, GRDC
http://www.grdc.com.au/uploads/documents/GRDC_CrownRot_SthWest.pdf

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