Management practices for crown rot

Simon Craig (BCG)

Take Home Messages

- If crown rot is a concern, conduct a DNA test before sowing a susceptible cereal in 2007.
- Break crops and grass free fallows are still the best practice for reducing crown rot inoculum levels.
- If inoculum levels are high, it will take at least two years free from grass and volunteers, to reduce levels significantly.

Background

In recent years there has been an increase in the level of cereal root disease crown rot due to poor spring conditions and an increase in no-till and stubble retention. Crown rot costs Victorian wheat growers between $4 and 16 million per annum in lost production. Yield losses can be more than 50% in susceptible crops when seasonal conditions, such as a dry spring following a wet winter, favour the disease. Losses of 20-30% have been common in bread wheat over recent years.

Crown rot is caused by two pathogens;

- F.*pseudograminearum*, found in most cereal growing regions.
- F.*culmorum*, common in cooler high rainfall regions of SA and Victoria.

The disease survives as hyphae in cereal and grass residues. Cereals grown in the same paddock as these residues become infected. If infected residues are on the soil surface and not incorporated into the soil, infection will usually occur through the crown and basal stem region. If residues are incorporated, infection is usually found in the sub-crown internode and lower crown. Infection can occur at any time under warm moist conditions.

The rate of infection will depend on the susceptibility of the variety. Crown rot is most noticeable in dry years and is most commonly seen in durum wheats, followed by bread wheats and to a lesser degree in barley. However, all cereal crops and grasses are hosts for this fungus with recent work indicating that triticale is the most susceptible followed by barley, oats, wheat (note: durum wheats are more susceptible than bread wheats). Crown rot inoculum can build up under these crops and susceptible cereal varieties should be sown at least two years apart in a rotation with non-hosts. Canola seems to be the best crop for reducing disease inoculum levels followed by fallow then vetch. Once infection occurs, the fungus restricts the vascular system by blocking water flow to the grain heads resulting in the presence of dead heads (or whiteheads). As a general rule of thumb, 1% dead heads equates to 1% wheat yield loss. Break crops that dry the soil profile can actually lead to a greater level of dead heads in cereals sown the following year if there are dry seasonal conditions; the dead heads are a symptom of the disease and are only partially related to the actual level of the disease. Dead heads can also be caused by other root diseases, such as Take All.

Rainfall is a big driver of crown rot infection. Recent studies have shown that if infection occurs early, the severity of the disease can be influenced by the growing season rainfall. Dry winters can increase the severity of crown rot, whereas wet winters will see a reduction in the frequency of dead heads. A wet finish, such as in October 2005, will also cause a reduction in losses attributable to crown rot.

Aim

The aim of the BCG trial conducted at Hopetoun was to demonstrate the symptoms of crown rot and how different varieties tolerate the disease pressure. The trial included the durum wheat variety Tamaroi as a crown rot highly susceptible control variety, Yitpi and Young as two common bread wheat varieties that are both considered susceptible to crown rot, and an experimental breeding line from Queensland, 2-49, which reputably has the best level of crown rot resistance (rated MR) amongst the bread wheat varieties.

Methods

The seeds were inoculated with the crow rot fungus.

Location: Hopetoun
Treatments: 8
Plot size: 3m × 24m
Crop Type: Wheat
Sowing Date: 16th May 2006
Soil Type: Mallee Sandy Clay Loam with moderate subsoil constraints
Seeding Density: 175 plants/m^2
Seeder: Smale Bar (7-inch row spacings, narrow points, coil harrow)
Sowing Speed: 6km/hr
Fertiliser: Supreme 10Z (55kg/ha),(N 11%,P 21.5%,S 4%,Zn 0.5%)
Herbicides: 10/5/06 Roundup PowerMax® (1.5L/ha)

Results

For all varieties except Yitpi, the addition of the inoculum increased the incidence of the disease as measured by the percentage of dead heads in the crop. No differences in grain yield were observed in this extremely drought affected trial. The experimental breeding line 2-49, with reputedly higher levels of crown rot resistance, had higher levels of dead heads than the other bread wheat varieties, with an increase in the level of dead heads observed with the addition of inoculum. As expected, the durum variety had the highest level of crown rot, with a substantial increase in dead heads observed when inoculated with crown rot.

Table 1: Symptoms of crown rot, measured as the percentage of dead heads for the three bread wheats and the durum variety Tamaroi in plots with and without the application of a crown rot inoculum.

Treatment	Inoculum (+/-)	Plant Counts (m^2)	Dead Heads %	Yield (t/ha)
Yitpi	-	166	3.1	0.21
Yitpi	+	160	1.7	0.24
Young	-	183	1.0	0.22
Young	+	166	13.0	0.23
2-49	-	160	9.9	0.07
2-49	+	149	22.2	0.07
Tamaroi	-	166	17.1	0.05
Tamaroi	+	149	33.3	0.04

Whilst it is important to remember this trial was not replicated and was designed to only demonstrate how wheat varieties may tolerate the disease pressure and the symptoms of crown rot, the trends in numbers of dead heads observed indicate that the inoculation treatment worked well and the trial gave confidence in the use of dead heads as a means of monitor the presence of crown rot. All varieties, with the exception of 2-49, responded as expected. The high level of dead heads in 2-49 is cause for concern, and requires further investigation prior to breeding programs adopting this line as a parent for improved crown rot resistance.

Commercial Practice

There are a couple of ways to test the crown rot inoculum level in paddock.

The most accurate, but costly, is through DNA analysis, using the Predicta B testing service. The advantage of this test is that it can be used prior to planting to simultaneously test for a number of root diseases. The test requires 30 – 45 core samples, preferably only of 1cm in diameter, to be taken from across the paddock to a depth of 10cm.

The cheapest and easiest way to monitor crown rot levels in a paddock is to estimate the percentage of infected wheat plants in a dry year; this will provide an indication of the level of crown rot in the paddock, assisting with crop rotation decisions for that paddock in subsequent years. The average percentage of dead wheat heads should be determined from head counts taken from a few random areas across the paddock. If the average number of infected plants reach 50% it will take more than two break crops (or grass free fallows) to reduce the risk to a low status. With relatively low incidence of crown rot (less than 30% infected plants), it would be safe to plant cereals after 1-2 years break, providing grasses and volunteers are controlled. Note that the low incidence of dead heads in a wet year does not necessarily mean low levels of crown rot in the crop; rather it means there is a low level of expression of the disease. This can give the mistaken impression that a paddock is a low crown rot risk when the converse is true.

Rotations appear to be the best and most effective method to reduce inoculum levels. Incorporating a fallow period or break crop is still the best practice for reducing the level of crown rot. In break years it is important that paddocks are kept free of grasses and cereal volunteers which may act as hosts.

Burning stubbles can reduce the risk of crown rot infection providing the burn is hot and provides enough heat to burn the crown and basal stem region, however burning will not destroy buried crowns.