Upper North Farming Systems

Stubble Management Guidelines

Crown rot

White heads develop in crown-rot affected wheat plants if there is moisture stress during grain fill. The whole head is affected, unlike frost damage, where commonly only part of the head is affected. Photo: Dr Margaret Evans, SARDI

Key facts

- Know the risk — check for stem browning in wheat and barley crops or use soil tests (PreDicta™ B) — don't rely on white heads as a disease indicator.
- Keeping crown rot inoculum at low levels is the most effective way to reduce yield losses. A grass-free break from cereals will reduce crown rot inoculum, but it can take several years to lessen high inoculum levels.
- If wheat must be sown into infected cereal stubble, keep the stubble intact to minimise contact between infected residues and emerging plants, lowering infection rates.
- Inter-row sowing can reduce plant infection by 50% and increase yields by 5–10%.

Crown rot in the Upper North can reduce bread wheat yields by up to 40%. Even where the commonly-recognised symptom of white heads is not present, yield losses can occur due to crown rot.

Biology

All winter cereals (including oats) and many common grass weeds can act as crown rot hosts.

The fungi causing crown rot do not grow through soil (unlike rhizoctonia and take-all). Infection in a new crop occurs when plants come into contact with infected cereal or grass residues. Even tiny pieces of residue can cause infection. Following infection of plant tissue, fungal growth rates are: slower in more resistant plants, faster in stressed plants (particularly those unable to access sufficient moisture due to low rainfall or high temperatures) and faster in plants with filled grain drying off toward harvest (plant tissue is dying and the fungus continues to grow, feeding off the dead plant material).

As infected residues break down, inoculum levels drop, but this process takes time and crown rot inoculum can survive for many years.

White heads develop in affected wheat plants if there is moisture stress during grain fill. Affected plants are most commonly seen scattered through the crop. The whole head is affected, unlike frost damage, which often affects only part of the head. Barley and oats do not usually develop white heads.

During grain fill, pull back leaf sheaths on the main stems to check for a honey to dark-brown colour. There may be pink under leaf sheaths at nodes or inside stems, which also indicates crown rot on the stem bases.

Project information

This crown rot management guideline has been developed for the Upper North Farming Systems Group (UNFS) as part of the Maintaining Profitable Farming Systems with Retained Stubble Initiative, funded by the Grains Research and Development Corporation (GRDC).

The Stubble Initiative involves farming systems groups in Victoria, South Australia and southern and central New South Wales, collaborating with research organisations and agribusiness, to address challenges associated with stubble retention.

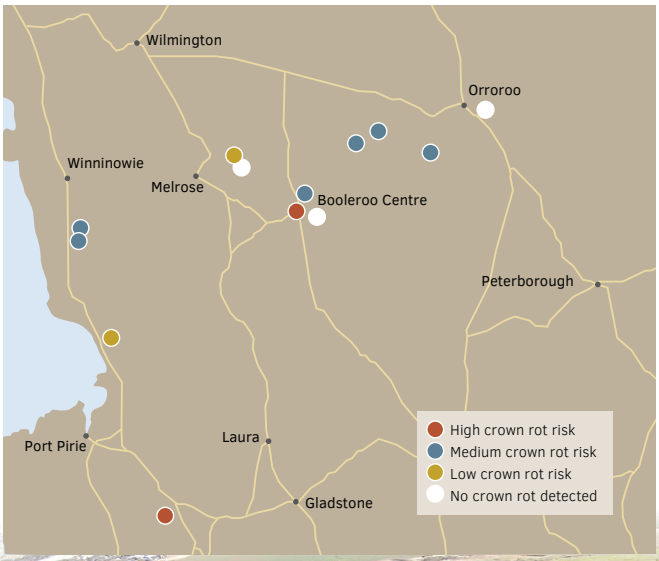
The GRDC, on behalf of growers and the Australian Government, is investing $17.5 million in the initiative that has been instigated by the GRDC Southern Regional Panel and the four Regional Cropping Solutions Networks that support the panel.

Basal stem browning is a common symptom of crown rot.
Photo: Dr Margaret Evans, SARDI

Crown rot in the Upper North

Thirteen paddocks were sampled for soil-borne diseases during late April 2014 and samples were submitted to the DNA-based PreDicta™ B service for analysis. Ten paddocks, 77% of those sampled, had crown rot present (See Figure 1).

FIGURE 1. Paddock survey for crown rot in the Upper North



Assessing the crown rot risk

Soil sampling

- PreDicta™ B soil analysis provides risk levels for many soil-borne diseases, including crown rot.
- For accurate results it is critical to use the correct sampling strategy — for details contact a PreDicta™ B-accredited adviser.
- To ensure the crown rot risk is not under-estimated, sample on old cereal rows and add stubble to the sample.
- Other strategies include random sampling (useful after a break crop) or sampling between old cereal rows (useful if inter-row sowing).

Infection rates — stem browning

Check cereal crops between grain fill and harvest. Collect five plants from 10 sites across the paddock (total of 50 plants), count the plants with stem browning and calculate the percentage of plants showing symptoms.

Use this percentage to assess the rule-of-thumb risk for a cereal next season:

- Low — less than 10% plants infected
- Medium — 10 to 25% plants infected
- High — more than 25% plants infected.

Reducing yield losses in cereals in the current season

Paddock selection: Know what inoculum is present in your paddocks — the lower the inoculum level, the lower the potential for yield loss due to crown rot. Check inoculum levels as previously described. Avoid paddocks with high nitrogen levels at sowing and/or low stored soil moisture as these crops are more likely to become moisture stressed during spring.

Cereal type: All winter cereals can host crown rot but yield loss will vary between species (see Table 1). Barley usually has lower yield losses as it finishes earlier and grain fill can occur before moisture stress occurs.

Varietal resistance and tolerance to crown rot is limited and selecting a well-adapted cultivar will give the best results. If a range of well-adapted cultivars is available, then select the one least likely to incur yield losses from crown rot (see Figure 2).

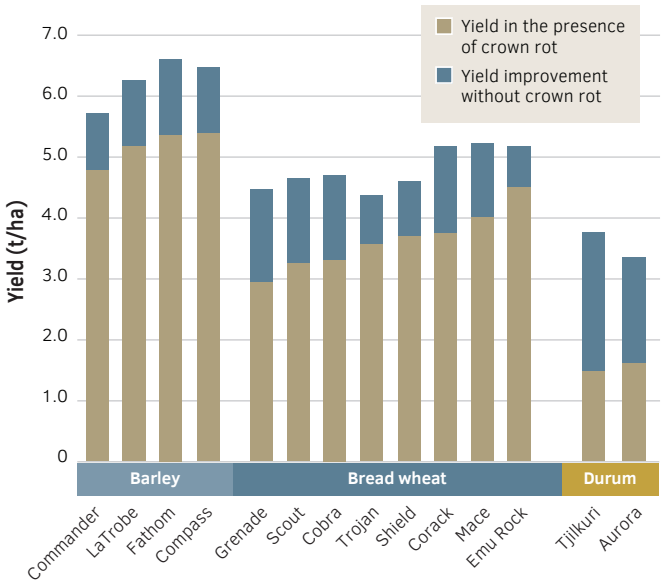
Viewed from the air crown rot-affected wheat plants can form large, diffuse patches associated with soil types and/or areas more prone to moisture deficits.

TABLE 1. Yield losses in cereals due to crown rot 1998–2008 at three SA sites

Cereal type	Yield loss (%)		No. of trials
	Average	Range	
Durum	34	4–100	12
Triticale	20	13–26	5
Oat	16	8–25	2
Bread wheat	12	0–38	11
Barley	7	0–23	8
Rye	7	0–14	2

Note: trials had very high crown rot levels

FIGURE 2. Effects of high crown rot levels (seed inoculated with crown rot pathogen) on a range of cereal types and varieties during 2014



Stubble management: Stubble from last season is best left standing if it is infected with crown rot and a cereal is being sown into it. Slashing, chaining, cultivating and grazing all spread infected residues across the paddock, which will increase infection rates in the next crop.

Moisture stress: Conserve soil moisture by controlling summer weeds and reducing cultivation to reduce moisture stress during flowering and grain fill.

Sowing time: Sow early within the recommended sowing window to encourage earlier grain fill and to reduce the probability of moisture and temperature stress. Early sowing also increases root growth, improving crop access to deeper soil water during flowering and grain fill.

Inter-row sowing: Inter-row sowing between standing stubble using accurate <2 cm differential GPS auto-steer can decrease the number of infected plants by up to 50%. In the Upper North, crown rot inoculum levels in the inter-row were only 4–25% of those in the cereal stubble row. This may result in a yield increase of 5–10% if the stubble is standing and inter-row sowing is accurate.

Crop nutrition: Avoid excessive early growth by reducing nitrogen applied before or at sowing, and by matching nitrogen rates and timing of application to stored soil moisture and targeted yields. Ensure adequate zinc nutrition as zinc-deficient crops tend to have higher levels of white heads.

Seed protection: Seed treatments registered for the suppression of crown rot are becoming available, but these products are unlikely to result in significant yield improvements by themselves. They are most likely to help control crown rot as part of an overall management program.

Reducing crown rot levels

Rotation: All winter cereals increase levels of crown rot inoculum, with durum wheat and barley the worst. A grass-free break (choose the break most suited to your farming system) from winter cereals will reduce crown rot inoculum. Warm, damp conditions under the canopy of the grass-free break from cereal will increase the rate of breakdown of infected cereal residues. With high crown rot inoculum levels and low rainfall, it may take two years or more for infected plant residues to break down enough for very susceptible crops (durum) to be grown.

Cultivation: Cultivation to incorporate infected plant residues into the soil can increase the rate of breakdown, but complete breakdown may still take several years depending on biological activity, soil moisture and nutrient availability.

Stubble management: Baling and burning to reduce residues will remove some inoculum but there can still be significant levels below the ground. Most crown rot inoculum (76%) is in the bottom 7cm of the stem, including the crown.

Levels of crown rot inoculum (PreDicta™ B risk rating in soil pre-sowing) in one of the Upper North paddocks sampled in 2014. Photo: Dr Margaret Evans, SARDI

Putting it into practice — farmer feedback on crown rot

Trevor and Matt Nottle, Booleroo Centre

The Nottles have had poor-performing patches in their wheat crops for a number of years and thought the crops hayed off early due to the shallow clay soils in these areas.

During 2013, this problem was identified as being caused by crown rot and they have started putting in place management strategies to reduce yield losses from the disease.

Single-year break crops do not appear to be sufficient to reduce crown rot and two-year breaks are needed where crown rot levels are high.

The Nottles have used PreDicta™ B soil testing to determine crown rot levels in high-risk paddocks and are using a crop rotation of either vetch followed by canola or field peas followed by canola where levels are high.

Matt is also collaborating with the UNFS and SARDI researcher Dr Margaret Evans to assess the effectiveness of vetch as a single-year break for crown rot.

Matt Nottle (pictured) is investigating a range of management strategies to address wheat yield losses due to crown rot including the use of vetch (inset) as a single-year break crop. Photo supplied by Matt Nottle.

Further information

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References

» Crown rot in cereals GRDC Fact sheet (2009) *Understanding the disease underpins effective management.* Southern Region version
» Evans, M (2014) *Soil-borne disease risk in Upper North paddocks, 2014*, UNFS Annual Trial Results Compendium, 2014

Acknowledgements

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