# Integrated disease management for crown rot in bread wheat crops on upper Eyre Peninsula

RESEARCH

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**Location**
Mitchellville
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**Rainfall**
Av. Annual: 281 mm
Av. GSR: 192 mm
**Soil Type**
Light sandy clay loam
**Diseases**
Crown rot
**Plot Size**
1.8 m (6 row) x 12 m x 4 reps
**Yield Limiting Factors**
2015 - delayed sowing
2016 - frost and an extreme heat event in August
2017 - extremely low rainfall

## Key messages

- **Emu Rock (early maturing) is a good choice of variety for Upper Eyre Peninsula as it consistently yielded best in the presence and in the absence of crown rot when compared with Mace (early to mid maturing) and Trojan (mid maturing) at Mitchellville 2015-2017.**
- **Neither lower plant densities (significantly decreased yields in 2015) nor lower nitrogen application at sowing (results were limited and inconsistent) can be recommended for reducing crown rot expression or yield losses due to crown rot.**
- **Rancona® Dimension is unlikely to be an economic option for managing crown rot as it did not reduce crown rot incidence or severity, even though for Emu Rock it gave a slight yield improvement.**
- **Integrated disease management using pyramided treatments in-crop is unlikely to be economic and cannot be recommended unless more effective treatments (e.g. seed treatments with good activity on crown rot) become available.**
- **Many findings from this research challenge our understanding of how crown rot management affects crown rot expression and yield losses due to crown rot.**

## Why do the trials?

Management options available for in-crop reduction of yield loss due to crown rot have only a limited effect, but it is sometimes necessary to sow bread wheat into a paddock with medium to high risk of yield loss from crown rot. This work contributes to understanding the effects of crown rot management options used singly or in combination (integrated disease management or IDM) in-crop in the low rainfall environment of upper Eyre Peninsula.

PreDicta B results for the 2017 Mitchellville NVT trial site showed there were high levels of crown rot present at the site, as is common in this area. Andrew Ware and the Franklin Harbour Agricultural Bureau saw this as an opportunity to assess options for managing crown rot when bread wheat must be sown into a paddock with this disease.

Best management practice options were selected on the basis that they were suited to the area and its agricultural practices and were simple to implement. The practices assessed included nitrogen application, plant density, variety resistance, fungicide seed treatment, and time of sowing. Options were used alone or in combination, with the "control" being based on NVT trial protocols and district practice.

## How was it done?

Trials were undertaken in 2015, 2016 and 2017. All trials were co-located with the National Variety Trials at Mitchellville and provided a good opportunity for extension of information about crown rot to local growers and industry representatives. Treatments in 2015 (Table 1) were selected based on best management practice recommendations for crown rot. In 2016 and 2017 treatments were modified yearly on the basis of findings from previous year(s) and all treatments were sown with and without added crown rot.

Trials were undertaken in plots 12 m long x 6 rows wide using a completely randomised block design with 4 replicates. In 2015 (25 May) and 2016 (26 May) trials were sown late in the local sowing window to encourage crown rot expression. In 2017, the effects of time of sowing were examined.

The first time of sowing was early/mid (2 May 2017) in the local sowing window but the second time of sowing (planned for about 26 May), was extremely late (5 July 2017) due to lack of rain.

Treatments were selected to quantify the effects of current best-practice crown rot management recommendations on disease expression and yield on upper Eyre Peninsula:

- Variety selection - well adapted to local conditions, with a range of crown rot resistances and maturity categories. Mace as the "control" – susceptible to crown rot, early to mid season maturing; Emu Rock – moderately susceptible (MS) to crown rot, early maturing; Trojan - MS to crown rot, mid maturing.
- Fungicide seed treatment for crown rot suppression.
- Basal stem application of fungicide to suppress the rate of crown rot development.
- Lower plant density to reduce early crop bulk and moisture stress during grain fill.
- Lower nitrogen rates to reduce early crop bulk and moisture stress during grain fill.
- Sowing time - early in the local sowing window, later in the sowing window (to increase moisture and heat stress during grain fill).

Plant samples were collected at early grain fill for assessment of plant density, head density, whitehead expression and browning on main stem bases. Plot yield was recorded. Crown rot expression (extent of basal stem browning on main stems) was scored visually on a 0-5 scale:

0 = 0% - No yield loss

1 = 1-10% - Possibility of minor yield loss

2 = 10-25% - Possibility of some yield loss

3 = 25-50% - Probably some yield loss

4 = 50-75% - Significant yield loss likely

5 > 75% - High yield loss likely

## What happened?

Trials established well and weeds, other diseases and pests were adequately controlled. In 2015 rainfall was good early in the season, but during grain fill there was significant moisture stress. In 2016 there was adequate rainfall, but there were frosts and also extreme heat conditions in August. In 2017 rainfall was very low and resulted in yields being below average, particularly for the second time of sowing.



***Table 1 Treatments applied at Mitchellville in 2015, 2016 and 2017. Varieties assessed over that period: Mace - susceptible to crown rot, early-mid maturing; Emu Rock - moderately susceptible to crown rot (MS), early maturing; Trojan – MS, mid maturing.***

| | Treatment name | Seed dressing | Plant density (/m²) | N at seeding (kg/ha) | In-crop sprays | Time of sowing (ToS) |
|---|---|---|---|---|---|---|
| 2015 - Mace, Emu Rock | | | | | | |
| 1 | District practice | None | 180 | 14.4 | Nil | - |
| 2 | Low density | None | 90 | 14.4 | Nil | - |
| 3 | Low N | None | 180 | 7.3 | Nil | - |
| 4 | Rancona D[1] | Rancona D | 180 | 14.4 | Nil | - |
| 5 | Seed trt 1 and 2 | New products | 180 | 14.4 | Nil | - |
| 6 | Best CR[2] practice | Rancona D | 90 | 7.3 | Prosaro[3] | - |
| 2016 - Mace, Emu Rock. All treatments with and without added crown rot[4] | | | | | | |
| | | Rancona D | 180 | 14.4 | Nil | - |
| | | None | 180 | 14.4 | Nil | - |
| | | Rancona D | 180 | 7.3 | Nil | - |
| | | None | 180 | 7.3 | Nil | - |
| 2017 - Mace, Emu Rock, Trojan. All treatments with and without added crown rot | | | | | | |
| | | None | 180 | 14.4 | Nil | Early |
| | | None | 180 | 14.4 | Nil | Later |

*[1] Rancona® Dimension (registered for crown rot suppression) @ 320 ml/100 kg of seed.*
*[2] CR = crown rot.*
*[3] Prosaro® 420 SC @ 300 ml/ha to plant bases at early tillering and at anthesis.*
*[4] Crown rot inoculum applied at 2 g/m row of sterilised grain colonised with crown rot.*

***2015***

Detailed results and discussion for the 2015 trial can be found in the EPFS Summary 2015 (p 93-96). Crown rot incidence (19%-46% of main stems affected) and expression were low (basal stem browning score less than 0.7) and would have been unlikely to significantly affect yield. The main findings (Figure 1) were that, in the presence of very low levels of crown rot:

- Emu Rock yielded better than Mace.
- Pyramiding management options only resulted in a yield improvement over district practice for Mace.
- Seed treatment did not reduce crown rot incidence or severity, but did improve yields over IDM for Emu Rock. Note: other treatments had no fungicide applied to seed.
- Reducing plant densities resulted in reduced yields.
- Reducing nitrogen applied at sowing increased yields over district practice for Mace but not for Emu Rock.
- An unexpected result was that Mace (S) had lower crown rot expression than did Emu Rock (MS) - data not presented.

***2016***

Crown rot expression (basal stem browning score) was higher in plots with added crown rot inoculum than in plots without added inoculum (Table 2). This was reflected in a decrease in whitehead expression from 27% to 12% and an increase in yield from 1.63 t/ha to 2.00 t/ha, which translates to a 0.37 t/ha or 19% yield increase where crown rot was at low levels. Again, as was seen in 2015, Mace (S) unexpectedly had lower crown rot expression than did Emu Rock (MS), but only in plots where crown rot inoculum was added (Table 2). The lower nitrogen application rate at sowing decreased whitehead expression from 23% to 16% but did not increase yield.

***2017***

Crown rot expression (basal stem browning score) was highest in plots with added crown rot inoculum (Table 3) and this was reflected in whitehead expression at both times of sowing (Table 3) and in yields at the early time of sowing (Figure 2). At the early time of sowing, Emu rock yielded significantly better than the other varieties in the presence and the absence of crown rot. At the later time of sowing, Emu Rock and Mace yielded significantly better than Trojan in the presence of crown rot and Emu Rock yielded significantly better than Trojan in the absence of crown rot (Figure 2). At the early time of sowing, Trojan (63%) had the largest percentage yield loss from crown, followed by Mace (46%) and Emu Rock (30%). At the early time of sowing Trojan yielded worse than Mace in the presence of crown rot but as well as Mace in the absence of crown rot, which was unexpected given the relative maturities of these varieties.

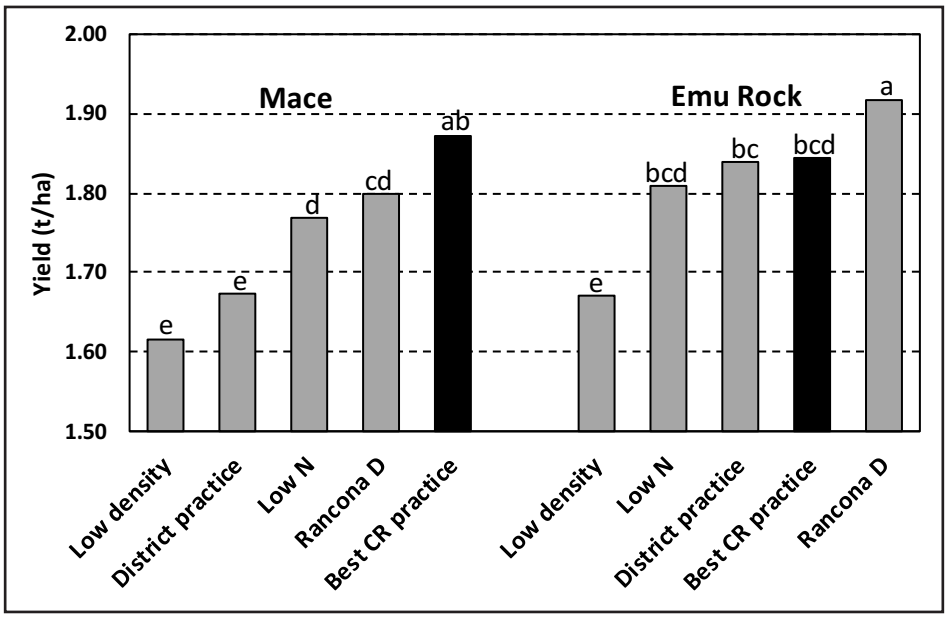


***Figure 1 Effects of crown rot management treatments (including varietal resistance) on yields of bread wheat, Mitchellville 2015. District practice – plant density 180, 14.4 kg N. Best crown rot practice – plant density 90, 7.3 kg N; Rancona® Dimension @ 320 ml/100 kg of seed; Prosaro® 420 SC @ 300 ml/ha to plant bases at early tillering and at anthesis.***

*Table 2 Effects of high and low crown rot levels on crown rot expression in Mace - susceptible to crown rot, early-mid maturing and Emu Rock - moderately susceptible to crown rot (MS) at Mitchellville in 2016*

| Treatment - variety and crown rot level | Crown rot score |
|---|---|
| Emu Rock – high crown rot | 2.41 a |
| Mace – high crown rot | 1.85 b |
| Emu Rock – low crown rot | 0.94 c |
| Mace – low crown rot | 0.81 c |

*Table 3 Effects of high and low crown rot levels on crown rot expression at two times of sowing (ToS1 - 2 May; ToS2 - 5 July) at Mitchellville in 2017*

| Treatment – time of sowing and crown rot level | Crown rot score | Whiteheads (%) |
|---|---|---|
| ToS1 – high crown rot | 1.80 a | 18.0 a |
| ToS1 – low crown rot | 0.08 c | 0.4 c |
| ToS2 – high crown rot | 1.08 b | 4.0 b |
| ToS2 – low crown rot | 0.05 c | 0.7 c |

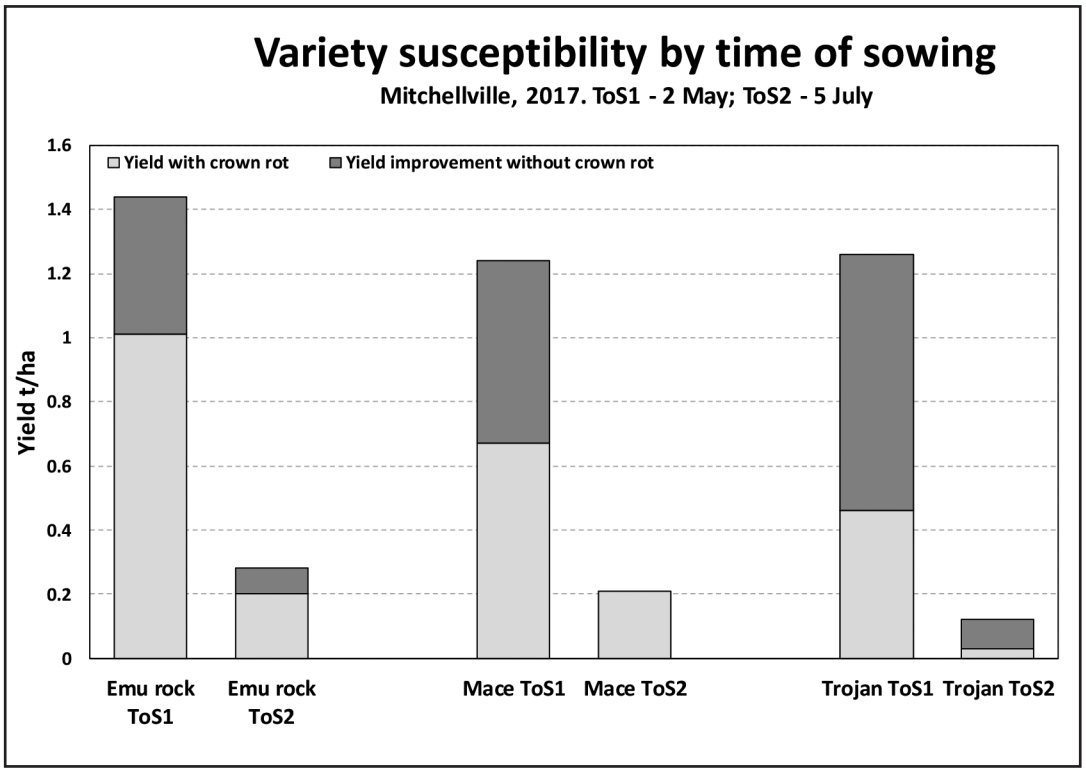


*Figure 2 Effects on yield of variety maturity and susceptibility to crown rot at two times of sowing at Mitchellville in 2017. Varieties had the following maturities and susceptibilities to crown rot Mace - early-mid, susceptible; Emu Rock – early, moderately susceptible; Trojan – mid, moderately susceptible.*

## What does it mean?

Seasonal conditions and times of sowing varied over the period of this research program, but Emu Rock (early maturing) consistently yielded best when compared with Mace (early to mid maturing) and Trojan (mid maturing). Of the management options assessed, variety choice had the most influence on yield in the presence of crown rot on upper Eyre Peninsula, with early maturity being critical for good performance whether or not crown rot was present. In this environment, early maturity (and good adaptation to the locality) is more important than crown rot resistance rating, although this might change if varieties with better levels of resistance to crown rot become available.

There were comparatively low levels of crown rot expression (≤0.70 in 2015, ≤1.80 in 2016 and ≤2.40 in 2017) in the trials undertaken at Mitchellville. In higher rainfall areas, these levels of crown rot would not be expected to result in significant yield losses. However, at Mitchellville in 2016 there was a 19% (0.37 t/ha) loss due to crown rot and in 2017 losses ranged from 30%-63% (0.43-0.80 t/ha) at the first time of sowing. Results from 2015 (where treatments all had crown rot present) also suggest low crown rot expression might have resulted in higher than expected yield losses.

This implies that comparison of varietal yield losses due to crown rot should be undertaken in low rainfall zones rather than assuming that findings from the medium rainfall zone will apply. It also has implications for interpretation of current PredictaB risk categories when applied to low rainfall zones. Further research is needed to quantify yield losses (including the relationship with rainfall during grain filling) due to crown rot and to assess whether PredictaB risk categories need modification for the low rainfall environment of upper Eyre Peninsula.

Even where crown rot inoculum was added to the plots, crown rot expression in-crop was relatively low, although it was associated with significant yield losses. If these low levels of expression occur widely and are related to significant yield loss, then visual identification of crops at risk will be difficult and may result in the magnitude of the crown rot issue being under-estimated in low rainfall zones.

Pyramiding crown rot management options (seed treatment, low plant density, low N application at seeding and two fungicide applications in-crop) reduced crown rot expression but provided limited yield benefits. It is unlikely that pyramiding these management options for crown rot control would be of economic or practical benefit on-farm. Neither lowering plant densities (which decreased yields in 2015) nor lowering nitrogen rates at seeding (which had limited yield benefits in 2015 and none in 2017) could be recommended as part of a crown rot management strategy in the low rainfall environment of upper Eyre Peninsula.

Using plots with and without added crown rot inoculum provided useful insights into performance of bread wheat varieties under crown rot pressure at different sowing times and with low or high nitrogen inputs at sowing. Interestingly, this methodology showed that in 2017 at the early time of sowing, Trojan yielded worse than Mace in the presence of crown rot, but as well as Mace in the absence of crown rot. This is unexpected given the relative maturities of these varieties and the expectation that Trojan would have yielded much less than Mace in both the presence and the absence of crown rot.

Unexpected results were obtained during this research program, including varietal yield responses to added crown rot and the relatively large yield losses in the presence of low crown rot expression. Whether these findings are due to the limited number of trials undertaken or to there being unique responses of crops to crown rot on upper Eyre Peninsula would require further research to clarify. Future research programs in low rainfall environments should include plots with and without added crown rot inoculum to more fully understand the effects of management options on crown rot expression and yield losses due to crown rot.


## Acknowledgements

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