Increased carbon-dioxide affects crown rot incidence, severity and pathogen colonisation in wheat, reducing potential grain yield.

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Crown rot (CR)

- Predominantly caused by *Fusarium pseudograminearum*
- Stubble borne disease
- Saprophytic life-stage
- Pathogenic life-stage
- Yield limiting
Plant pathogens and Climate change

Climate change

• Elevated atmospheric CO$_2$
  - Today ~400ppm  
  - 2050 ~700ppm

• Warmer temperatures
  - An average global increase of approximately 2°C by 2050

• Expected changes in rainfall
  - Future trends extremely difficult to predict
  - Increasing extreme weather events
Previous work – AGFACE 2007, 2008

- Elevated CO$_2$ increased Fusarium colonisation in wheat plants sampled at maturity.
  - At what point in the host lifecycle does CO$_2$ impact on crown rot?

- The extent of colonised Fusarium under elevated CO$_2$ is dependant on growing season
  - Is the effect of CO$_2$ on crown rot dependant on growing temperature

- Wheat genotype mediated the effect of elevated CO$_2$ on crown rot
  - By studying a larger range of wheat genotypes can we identify some genotypes which show durable resistance at elevated CO$_2$

- Irrigation treatment did not interact with the effect of CO$_2$ on crown rot

Increased crown rot incidence was dependent on:

- Glasshouse environment
- Sampling stage
- Wheat genotype x sampling stage

**Glasshouse study – 16 genotypes, 4 growth stages**

**Environment one**
- Cool growing temperatures
- Ambient CO$_2$ (~390ppm)

**Environment two**
- Cool growing temperatures
- Elevated O$_2$ (~690ppm)

**Environment three**
- Warm growing temperatures
- Elevated O$_2$ (~690ppm)
2010, 2011 AGFACE
Sixteen genotypes, two sampling stages

Ambient

Elevated CO₂ treatment
An increase in Crown rot incidence at elevated CO₂ was dependant on genotype and sampling stage
Arrow indicates the direction change in crown rot incidence at elevated CO₂ compared to ambient

<table>
<thead>
<tr>
<th>Genotype</th>
<th>Glasshouse †</th>
<th>AGFACE field trial *</th>
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† Excluding elevated CO₂ and warm temperature environment * Wheat genotype response regardless of season
CR severity relative to Fusarium colonisation

- At elevated CO$_2$ there is greater CR severity per unit of relative Fusarium biomass ($P = 0.045$)
- adjusted R-squared value = 0.4867

Ambient CO$_2$ (~380ppm)

Elevated CO$_2$ (~800ppm)
Lower crown rot tolerance under elevated CO$_2$

- 2011 Crop mature plants

- Higher grain weight in plants grown under at elevated CO$_2$

- Greater loss in grain weight due to CR severity at elevated CO$_2$ ($P = 0.049$)
Key points

• Change in CR incidence under elevated CO$_2$ can be dependant on genotype

• The effect of elevated CO$_2$ on plant disease is also dependant on temperature or season

• Elevated CO$_2$ may cause enhanced symptom expression per unit of infected host tissue

• Elevated CO$_2$ may cause a reduction in host tolerance leading to lower crop productivity in infected plants
Thank you!

CSIRO
- Dr Sukumar Chakraborty
- Dr Friday Obanor
- Ross Perrott
- Rhyannyn Westecott
- Anca Rusu
- Rosalie Sabburg
- Cassandra Guilinfoyle

Victorian DPI
- Rebecca Van de Geer
- Dr Piotr Trębicki
- Dr Glenn Fitzgerald

The University of Queensland
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