Solutions for sprouting in wheat?
sleepy wheat

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What I am talking about

- Background on sprouting and dormancy in wheat?
- How the environment during grain filling influences this?
- What does this mean for grain quality when it rains?
Background

- **Sprouting** = germination before grain is harvested

- **Caused by summer rain**
  - > 45% grain moisture for 3 days
Incidence of Sprouting in WA: ~1 in 4 years

Thunderstorms
- Geraldton
- Perth
- Katanning
- Merredin
- Esperance

Coastal Drizzle
What happens when grain sprouts?

- Sprouting = germination mobilisation of energy stores by enzymes
- $\alpha$-amylase problem as it breaks down starch to sugars during bread making.

$\alpha$-amylase
Starch $\rightarrow$ glucose + maltose
Sprouting = Germination

- Germination is controlled by embryo

Position of embryo

Coleoptile
Coleorhiza
Root

α-amylase
Falling Number (FN)*
- Prediction of the ability of the grain to make bread

FN is a measure of $\alpha$-amylase activity in first 20-30sec of stirring.

Ranges from 62 to >400 sec.

*Note: Low FN may occur due to factors other than rainfall (LMA, frost...).
Why is sprouting Bad?

- $\alpha$-amylase $\rightarrow$ decrease starch during bread making $\rightarrow$ poor flour
Germination: Seeds (water), 3 days

Germination of whole seeds over 7 days.

\[ GI = \frac{7 \times n_1 + 6 \times n_2 + 5 \times n_3 + \ldots + 2 \times n_6 + 1 \times n_7 \times 100}{(7 \times d) \times 50} \]

Max = 1.0 non-dormant    Min = 0.0 dormant
Wheat is cool

Except it makes me sneeze
How does the environment change this dormancy?

Can you make sleepy wheat get out of bed earlier, or make the early rises stay in bed?
AIM: Determine the effect of Water and Temperature stress during grain filling on sprouting tolerance in lines with different dormancy levels (sleepiness)
Environmental conditions

- Drought can induce dormancy in Cunderdin
- High temperature with lots of water can remove dormancy in DM 2001
- Also happens under field conditions
- eg DM 2001
  - Esp 2003 0.29 50mm late Nov mild finish
  - Esp 2004 0.09 dry finish
  - Esp 2005 0.04 mild finish

\[ \text{LSD}_{0.05} = 0.14 \]
But what is the most important........
temperature or water supply?

- Controlled environment and modelling literature suggests might be a period of sensitivity at 35-50 dpa where temperature can change dormancy, but no conclusive evidence

2005 season

± water stress anthesis to maturity

high temp. shocks, Temp. increased by 7°C

-20-30 dpa
-30-40 dpa
-40-50 dpa
Temperature shocks....

Environmental effects on dormancy

- Temp shocks from 30-50 dpa reduce dormancy
- But 40-50 dpa appears to be most sensitive period
- Greatest change in dormancy (sleepiness) is in partially dormant lines
Not just under artificial conditions, also in the field

For example, DH 45, partial dormancy influenced a lot by the season

- **Esp 2004**  GI = 0.86  Awake
- **KT  2005**  GI = 0.36
- **Esp 2005**  GI = 0.34  Sleepy
Environment changes dormancy / sleepiness and hence sprouting tolerance.

Who cares unless the GI thing or sleepiness is related to better grain quality (ie high FN) after rainfall
Breeding lines with a range of sleepiness

Relationship between GI and FN influenced by site, season and possibly maturity, especially in partially dormant lines

- lines with partial dormancy are less dormant (sleepy and less sprouting tolerant) in seasons or sites when sprouting is likely to be a problem and more dormant (sleepy and more sprouting tolerant) when sprouting is not a problem.

- So what does this mean for breeding work?
Major conclusions and implications for breeding work

- High temp. shocks at 30-50dpa reduces dormancy (awakens wheat) and hence sprouting tolerance
  - Consequently have to screen for sleepiness in target environment and avoid heat stress

- If using dormancy to select for sprouting tolerance need really sleepy wheat (GI<0.20) to get sprouting tolerance
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a) Esperance 2003/04
- •2003, 20mm reduced FN

b) Esperance 2004/05
- •2004, 20mm did not change FN

•2005, 70mm reduced FN in all but most dormant lines
- •Why do we get these differences???????
Grain was grown under natural rainfall conditions in Esperance (solid bars) or Ravensthorpe (open bars) 2003/04, harvested on 20 January 2004 after 23 mm and 47 mm post maturity.
Fig. 1. Falling number with successive harvests in Esperance (a) 2003, (b) 2004, (c) 2005, or Katanning (d) 2003 and (e) 2005 with rainfall. Hagberg falling number was determined using 7g flour adjusted to 15% moisture content in 25 mL DI water.

- 2003, 29mm no effect
- 2005, 75mm no effect
122mm = 70mm in Esp