Stress Stages in Oat Australia

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Australian Oat Production

- 1.5 million t. – grain
- 850,000 t – export hay
- Demand increasing 10 to 15% per annum
- Growers receiving competitive prices for grain and hay
Top Five Oat Producing Countries 2010-2013

- Russian Federation: 4.38 million tonnes
- Canada: 3.04 million tonnes
- Poland: 1.34 million tonnes
- Australia: 1.22 million tonnes
- Finland: 1.03 million tonnes

FAO Statistics, 2015
Australian Agricultural Zones

Figure 1.1 Agro-ecological regions of Australia

1. North-west wet/dry tropics
2. North wet/dry tropics
3. North-east wet/dry tropics
4. Wet tropical coasts
5. Semi-arid tropical/subtropical plains
6. Subtropical slopes and plains
7. Wet subtropical coast
8. Wet temperate coast
9. Temperate highlands
10. Temperate slopes and plains
11. Arid interior

Source:

- Non-traditional oat growing regions
- Inconsistent rain events yearly
- Factors highlight importance of understanding stress stages in oat
Literature – Critical Periods

- Established for many crops - maize, sunflowers, soybean, chickpea . . .
- Wheat and barley differ in critical period
- Important to establish for oat
Creating Controlled Stress

- Shade plants for a period of time through all developmental stages
- Shade reduces photosynthesis — similar to effects of water or nutrient stress
Materials and Methods

Trial design—3 rep split plot, variety main plot, shade subplot
Shade treatment 11 2-week periods consecutively through crop cycle
Materials and Methods

- Shade treatment imposed by PVC frames 1 x 1.3 m
- Frame covered with black nylon net
- Shade cloth intercepted 90% solar radiation
Weekly Phenology

- Notes were taken weekly for plant phenology—seedling emergence to senescence
- Plant growth stage related to yield reduction due to shaded treatment
Data Collection and Analysis

- Grain yield, yield components—grain number, grain weight, number of tillers m$^{-2}$
- Data analysed ANOVA
- Significance of unshaded control compared to shaded treatment—Fisher’s partial least square differences
Results - Pinery 2013

• Annual rainfall 406 mm
• Growing season rainfall, April to November 353 mm
• Higher than average rain, May to August
• Only 15 mm in October (38% lower than long term)
• 5.4 mm in November compared to average 28.1 mm
• Average grain yield 3.25 t/ha (1.0 on y axis)
• Anthesis is 0 on the x axis
• Thermal time scale = daily mean temperature
• Closed symbols are significantly different to the control
Pinery, South Australia

-1200 -900 -600 -300 0 300 600 900 1200

Normalised Grain Number

• 1.0 = 10,000 grains m$^{-2}$
Pinery, South Australia

- WIN
- WIL
- MIT

Normalised Grain Weight

Thermal time relative to anthesis (°Cd)

- 1 = 33mg
Conclusions

- Critical period for stress was between 84 to 125 days after sowing
- Greatest effect near Z40 to Z60, booting to panicle emergence
- Grain yield reduction significant for three varieties during window
- Grain number m\(^{-2}\) accounted for yield response
- Grain weight largely unresponsive to stress except in Williams
- Number of heads m\(^{-2}\) not significant
Critical Period of Stress in the Breeding Program

- Successful crop management – avoids critical periods of stresses such as drought and frost
- Improve management options to increase grain yield
- Develop more effective evaluation procedures for stress tolerance—drought
Thank You