Mechanisms that lead to yield loss after grazing across agro-ecological regions

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RESEARCH

Searching for answers

Location:
Minnipa Agricultural Centre, paddock South 7
Rainfall
Av. Annual: 325 mm
Av. GSR: 241 mm
2015 Total: 333 mm
2015 GSR: 258 mm
Yield
Potential: 2.96 t/ha (W)
Actual: 1.72 t/ha (W)
Paddock History
2014: Wheat
2013: Wheat
2012: Medic pasture
Soil Type
Red sandy loam
Soil Test
Organic C%: 0.6
Phosphorous: 2-22 mg/kg
Plot Size
20 m x 24 m x 3 reps
Yield Limiting Factors
Nil
Livestock
Simulated grazing

Key messages

- **The trials across agro-ecological zones have highlighted differences between varieties in their ability to respond to a range of production drivers over varied environments and seasons.**
- **There was no varietal difference between Mace and Trojan at Minnipa with both yielding an average of 1.7 t/ha, and the ungrazed treatment yielded 0.2 t/ha higher than the grazed. There was no difference in grazing response between cultivars.**
- **Nitrogen (N) can provide assistance in plant recovery through higher yields and grain quality with in-season application of N after grazing.**

Why do the trial?

Wheat varieties respond differently to stresses due to genetic and phenological variances. This can impact their production, including plant recovery after grazing. Grazing cereals to growth stage 30, then removing livestock and taking the crop through to yield, is a common practice in low rainfall mixed farming systems. However, with shorter and variable growing seasons the practice carries risk, and can impact negatively on the quantity and/or quality of grain produced from the crop.

An aspect of the Grain and Graze system that is yet to be explored is how different cultivars recover from a stress, such as grazing. Nitrogen (N) is a common yield limiting factor that can assist in the recovery of a crop after grazing, however the optimal N rate required for recovery and efficiency in this system requires further research.

In 2015 a trial was undertaken at the Minnipa Agricultural Centre to determine the ability and drivers of grain yield recovery of two different wheat varieties after grazing. The study also investigated whether N has the ability to assist in grazing recovery of yield and/or quality compensation.

Similar trials were conducted for the GRDC funded Grain and Graze 3 project in 2015 across other agro-ecological regions including Mid-North of South Australia, Wimmera Mallee region of Victoria and Southern Victoria to determine regional and seasonal differences.

How was it done?

The trial site was burnt on 15 April to remove stubble residue. Soil was sampled for pre-sowing soil water content and chemical analysis on 4 May. Sowing occurred on 8 May with a pre-emergent herbicide mix of 1.5 L/ha Roundup + 45 ml/ha Hammer + 1.5 L/ha Triflur X + 800 g/100 L SOA + 500 ml/100 L LI700 sprayed prior to sowing Trojan and Mace @ 50 kg/ha with 57 kg/ha DAP. Drier conditions at the time of sowing caused some unevenness in seeding depth; therefore the site was prickle-chained on 9 May. Plant counts were recorded on 30 June. Biomass cuts were taken prior to simulated grazing (mowing), which occurred on half of all plots on 24 July when plants were approaching GS30. To control grass weeds, 500 ml/ha 2-4-D Ester 680 was applied to wheat on 6 August.

Nitrogen treatments were imposed on the trial on the 10 August in the form of urea broadcast at rates of nil (control), 10, 25, 50 and 75 kg N/ha (equaling urea rates of nil, 22, 54, 109 and 163 kg/ha respectively) on the grazed and ungrazed sections of each plot, which was washed in by 26 mm of rainfall two days later. Yields and grain quality were recorded at harvest, which occurred on 11 November. Sampling for soil water content occurred on 21 December.

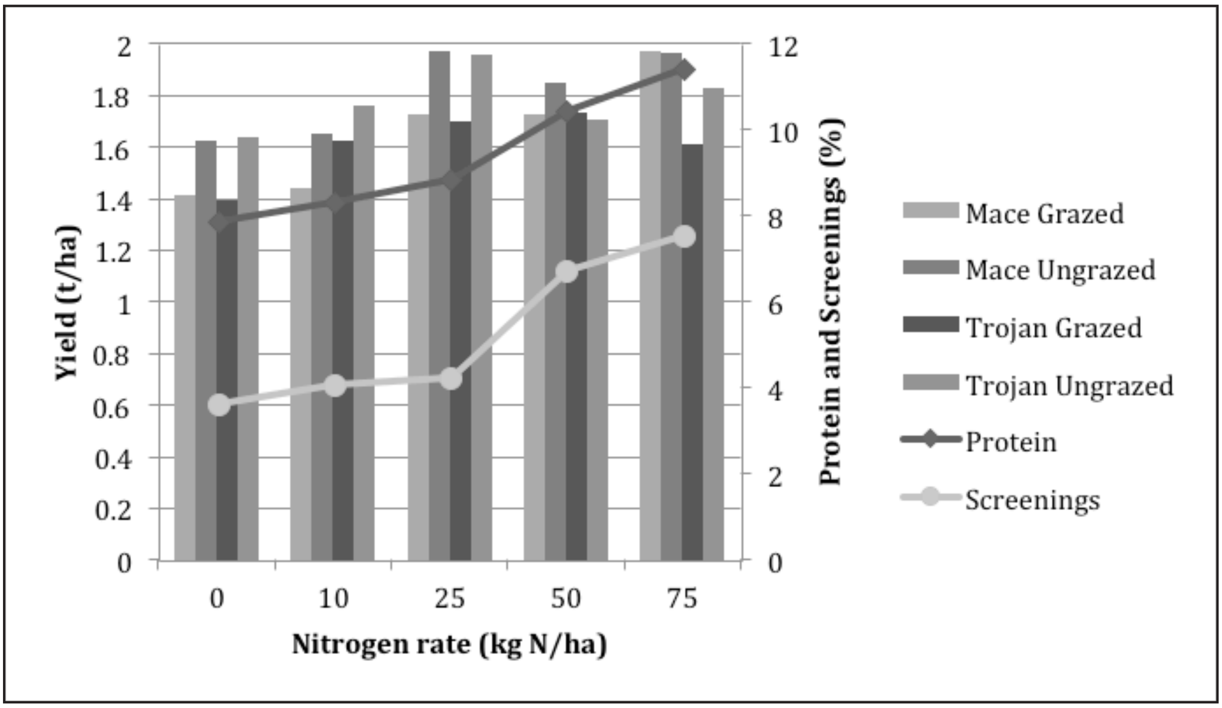

Figure 1 The response to N of grazed versus ungrazed Mace and Trojan in 2015, showing grain quality parameters of protein and screenings percentages.

What happened?

Eyre Peninsula, South Australia trial

Slow and staggered germination was observed due to prickle chaining, however there was no difference recorded in plant numbers after emergence.

At the time of simulated grazing there was on average 1.19 and 1.36 t/ha of biomass in the Trojan and Mace treatments respectively available for grazing. The biomass across the site ranged from 0.91 to 2.19 t/ha, with no varietal difference, and a useful quantity for a grazing opportunity.

Figure 1 presents the cultivar response to N of grazed versus ungrazed Mace and Trojan wheat. Similar to biomass results, there was no varietal difference with both Mace and Trojan yielding an average of 1.7 t/ha. Across varieties the ungrazed treatment yielded 0.2 t/ha higher than the grazed (P=0.003, LSD=0.105), with no difference in grazing treatment between cultivars. The N treatments of 25, 50 and 75 kg N/ha out-yielded the nil and 10 kg N/ha treatments by 0.2 t/ha on average (P=<0.001, LSD=0.166) with higher N application resulting in higher yields and better recovery from grazing as a trend, with the exception of grazed Trojan.

Results from grain quality testing measured no difference in protein percentage in wheat variety or grazing treatment. Figure 1 shows that there was a strong trend for higher protein as a result of higher N rate with averages of 7.8, 8.3, 8.9, 10.4 and 11.4% protein in the nil, 10, 25, 50 and 75 kg N/ha treatments respectively (P=<0.001, LSD=0.714).

Other quality parameters tested showed poorer results from higher N application with trends of lower grain weight, lower test weight and higher screenings regardless of cultivar or grazing treatment. Mace had a higher 1000 grain weight than Trojan in both grazed and ungrazed treatments (P=<0.001) however it had a lower test weight measuring 74.7 and 76.1 kg/hL in Mace and Trojan respectively (P=0.003). Test weight was lower in the higher N treatments (P=<0.001). Screenings were 1.1% higher in Trojan versus Mace (P=0.01) and the grazed treatments measured 0.9% higher screenings than ungrazed (P=0.03), with higher screenings in the higher N rate treatments (P=<0.001).

Mid-north of South Australia trial

The 2015 east SA trial looked at two varieties (Mace and Trojan), two times of sowing (11 and 24 April), seven N treatments (0 to 150 kg/ha N in 25 kg/ha N increments), grazed and ungrazed treatments and also imposed an irrigation treatment of 37.5 mm on 18 September just prior to anthesis. Yields were very high, as expected, as a result of good autumn/winter rains and some carry-over water from 2014.

Key outcomes:

- Grazed Mace out-yielded ungrazed Mace until very high N rates were applied, however the main driver of this response was likely frost of the ungrazed treatment.
- Grazing reduced the yield of Trojan, except at low N rates. High N rates induced haying off of the grazed treatments, but not for ungrazed Trojan.
- There was a yield loss associated with grazing Trojan but not Mace (until very high N rates) in the second time of sowing, however there is inconsistency in the response to N.
- Grazing changed the water use efficiency of applied irrigation (higher irrigation lowered WUE) and there were varietal differences in this response that warrants further investigation.

Wimmera Mallee Region of Victoria trial

The Birchip Cropping Group undertook a similar trial to investigate two varieties (Mace and Trojan), with five N treatments (0, 10, 25, 50 and 75 kg N/ha), and grazed and ungrazed treatments. A second trial imposed three irrigation treatments of 0, 25 or 50 mm/ha on 29 September. Urea was applied at 90 kg/ha on the irrigation trial only at GS25 on 27 July. The amount of biomass available for grazing was low due to the drier season and similar between varieties.

Key outcomes:

- Across grazing treatments Mace (1.03 t/ha) out-yielded Trojan (0.82 t/ha), a result reflective of the variety maturity and the season. Across varieties, grazed treatments yielded only marginally lower (0.90 t/ha) than ungrazed crops (0.95 t/ha).
- There was no significant grain yield effect of increasing rates of post-grazing N, nor were there any interactions between variety, grazing effect and N response.
- In the irrigation trial, Mace (1.30 t/ha) out-yielded longer season variety Trojan (1.07 t/ha). Grazing (average yield 1.1 t/ha) had no significant effect on grain yield compared with ungrazed (1.2 t/ha).
- The finishing rainfall applied at late flowering/early grain fill had a considerable effect on final grain yields, with grazed crops in particular responding to increasing rainfall.

Southern Victoria trial

Southern Farming Systems investigated the two wheat varieties Bolac (high yielding, mid-maturity) and Revenue (high yielding, late maturity, dual purpose), grazed and ungrazed treatments and a 50 mm irrigation treatment (on top of 210 GSR).

Key outcomes:

- There was a significant response between varieties with the irrigation treatment, but not between the unirrigated varieties with Revenue (4.59 t/ha) out-yielding Bolac (4.04 t/ha) in the modified soil water treatments. The irrigated treatments also out-yielded the unmodified soil water with a 1.18 and 0.48 t/ha yield difference in Revenue and Bolac respectively.
- There was no response to grazing treatments with variety or irrigation interactions and no significant difference between grazed and ungrazed treatments.

What does this mean?

Many farmers are unwilling to graze their grain crops due to the potential risks of grain quantity or quality reduction; however the value of feed to the livestock at this crucial period in the season is often left out in the cost-benefit ratio in the mixed farming systems equation. Previous Grain and Graze research has shown that crops have the ability to recover after grazing if grazed early, enough biomass is retained, and there is sufficient soil water and/or rainfall post-livestock removal. This trial shows that nitrogen can provide assistance in plant recovery through higher yields and quality with in-season application of N after grazing, which is a step towards making the practice more attractive to farmers in low rainfall mixed farming systems. Unfortunately, as there often is, there can be a trade-off between grain yield and quality, and the amount of N application required for optimum profitability. Yield results show that it is beneficial to apply at least 25 kg/ha of N in the 2015 season for the best yield of crops left ungrazed. However, to recuperate yields in the grazed crops more N may be required, which could pose a risk to decreasing grain quality, hence delivery grade, depending on the finish of the season.

These trials have highlighted differences between varieties in their ability to respond to a range of production drivers, including grazing, N application and irrigation over varied environments and seasons. Similar trials will be repeated in 2016 to broaden this database in order to gain a greater understanding of these interactions within the mixed farming system.

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