The mechanisms that lead to yield loss after grazing across agro-ecological zones

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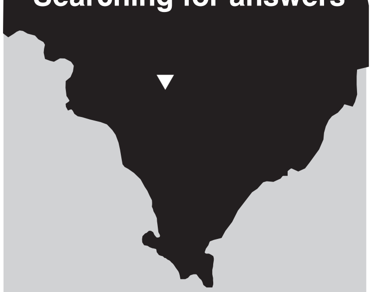
RESEARCH

Searching for answers



Location: Minnipa Agricultural Centre, paddock North 5 South
Rainfall
Av Annual: 325 mm
Av GSR: 241 mm
2016 Total: 391 mm
2016 GSR: 268 mm
Yield
Potential: 3.6 t/ha (W)
Actual: 3.7 t/ha (W)
Potential: 4.0 t/ha (B)
Actual: 4.1 t/ha (B)
Paddock History
2015: Medic pasture
2014: Barley
2013: Wheat
Soil Type
Red sandy loam
Soil Test
Organic C%: 0.7
Phosphorous: 2 - 19 mg/kg
Nitrogen: 5 - 48 mg/kg
Plot Size
20 m x 24 m x 3 reps
Livestock
Simulated grazing

Key messages

- **Ideal growing season conditions in 2016 provided an example of how grazing winter crops can be utilised as a tool, without significant consequence, as an early feed source for livestock in mixed farming systems of southern Australia.**
- **The value of grazing crops to the whole mixed farming system is important, as the combination of grazing and grain production may increase overall farm profitability through more productive use of farming land for both enterprises, however other flow on effects to the system can be challenging to quantify.**

Why do the trial?

The practice of grazing winter crops is often used in mixed farming systems as an opportunistic feed source rather than a regular annual feed supply, thus suitable cereal varieties have habitually been referred to as 'dual purpose', signifying their fit for both grazing and grain uses. Varieties that have been bred to remain in a vegetative stage for a long period after sowing and that have a vernalization requirement (need for exposure to cold temperatures to trigger commencement of head development, described as having a 'winter habit'), are commonly labelled as dual purpose due to their longer growth habit, facilitating the successful recovery of the crop after grazing. Long season spring wheats, which do not have a vernalisation requirement, but mature later anyway, have also commonly been used for grazing.

However, because of the progress towards earlier sowing in our modern farming systems, with longer season wheat and barley varieties being bred to adjust to this expansion in the growing season, cultivars that have not traditionally been considered as dual purpose are proving their suitability for grazing over winter, and allowed to recover for hay, silage or grain production. This development is significant for growers in southern Australia, as research into the dual purpose fit of common grain varieties in the region's mixed farming systems is proving the potential. Just because a plant does not have winter habit does not mean it cannot be grazed and then recover successfully, though the opportunity to graze is usually reduced and the time when the plant changes from vegetative growth is less predictable depending on its innate 'earliness' and the presence of photoperiod or minor vernalisation genes.

Regardless of vernalisation requirement, wheat and barley varieties respond differently to stresses (such as grazing) due to genetic and phenological variances. Grazing has five main impacts on a growing crop being; a reduction in crop biomass, later phenological development, reduced photosynthetic area, changed leaf architecture and canopy development and changed root system. In addition, there can be impacts on foliar disease by ingesting leaf material. For this reason, a trial was undertaken at the Minnipa Agricultural Centre to determine the grain yield recovery potential of common wheat and barley varieties and if there are genetic differences in the way varieties respond after grazing, other than simple phenology. Whether nitrogen is able to assist in grazing recovery because it is highly correlated to biomass production will be investigated through yield and/or protein of grain as the determinants.

Similar trials, with some variations including irrigation and drought simulation treatments, have been undertaken as part of the Grain and Graze 3 project in 2015 (EPFS Summary 2015, p 43-45) and 2016 across three other sites in the mid-north region of South Australia, near Birchip in the mallee region of Victoria and in Southern Victoria to determine regional and seasonal differences.

How was it done?

Soil was sampled for pre-sowing soil water content and chemical analysis on 4 May. The trial was sown on 16 May after 20 mm of rain with a pre-emergent herbicide mix of 1.5 L/ha DST + 60 ml/ha Hammer + 1.6 L/ha Avadex Xtra + 25 L/ha Boxer Gold + 800 g/100 L SOA + 500 ml/100 LI 700 sprayed prior to sowing. Wheat varieties Mace, Trojan and new AGT variety RAC2341, in addition to barley varieties Spartacus CL and Compass were sown @ 50 kg/ha with 57 kg/ha DAP (18:20:0:0). An insecticide and fungicide treatment of 350 ml/ha LeMat + 400 ml/ha Prosaro was applied for red-legged earth mite, aphids and leaf rust on 7 June and 1 L/ha Broadstrike was applied on 27 June to control broadleaved plants. Plant counts were recorded on 14 June. Biomass cuts were taken prior to a single simulated grazing (one mowing), which occurred on half of all plots on 15 July when plants were approaching GS30.

Nitrogen treatments were applied to the trial on the 9 August just prior to 8 mm of rain as 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 un-grazed sections of each plot. Flowering scores were recorded on 22 and 27 September. Yields and grain quality were recorded at harvest, which occurred on 18 and 23 November for the barley and wheat respectively.

What happened?

Growing conditions were very favorable leading up to the simulated grazing with 113 mm of rainfall since sowing, producing 1.45 t/ha and 0.85 t/ha of biomass available for grazing in the barley and wheat respectively (Table 1).

Barley (Compass and Spartacus comparison)

The percentage of protein in the barley sample increased with the greater nitrogen (N) treatment with an average of 0.8% higher protein content in the 50 and 75 kg N/ha treatments compared to the lower N treatments ($P < 0.001$, LSD=0.43, results not presented). Spartacus CL had higher protein and test weight, while Compass recorded an average of 6.4% higher 1000 grain weight across all treatments (Table 1). Screenings were higher in the grazed compared to the un-grazed barley at 3.8% and 2.6% respectively ($P < 0.001$, LSD=0.6, results not presented). Figure 1 shows that Compass had 0.3 t/ha greater yield after grazing, compared to Spartacus CL, which lost 0.1 t/ha on average after grazing (P=0.004, LSD=0.21), with no yield differences between N treatments. All grazed and un-grazed grain from both barley varieties were classified as Feed 1 under the Viterra Classification system.

Wheat (Mace, Trojan and RAC2341 comparison)

There was a greater percentage of protein in un-grazed (12.0%) compared to grazed (11.8%) wheat across all varieties (P=0.008, LSD=0.11) and a trend of increasing protein with increasing rates of N applied after grazing, with an average of 11.7% (0, 10 and 25 kg/ha N), 11.9% (50 kg N/ha) and 12.2% (75 kg N/ha) ($P < 0.001$, LSD=0.18, results not presented). Grazing resulted in higher screenings compared to the un-grazed treatments with 1.9% and 1.7% respectively (P=0.004, LSD=0.1). Trojan wheat recovered best after grazing, yielding 0.15 t/ha higher than the un-grazed treatment, followed by RAC2341 yielding 0.05 t/ha higher and Mace lost 0.29 t/ha on average due to grazing (P=0.004, LSD=0.19). Figure 1 shows yields for Trojan and Mace were higher than that of RAC2341, regardless of grazing or N treatment.

Table 1 Biomass, yield and grain quality results for the wheat and barley varieties

	Biomass (t/ha)	Yield (t/ha)	Protein (%)	Screenings (%)	Test weight (kg/hL)	1000 grain weight (g)
Compass	1.6	4.2	12.5	2.7	66	32.1
Spartacus CL	1.3	4.1	13.3	3.6	68	25.7
LSD (P<0.05)	*0.14*	*ns*	*0.27*	*0.60*	*0.72*	*4.02*
Mace	0.9	3.8	11.2	1.9	79	35.7
Trojan	0.9	4.0	11.8	1.9	81	38.5
RAC2341	0.7	3.3	12.8	1.6	76	35.2
LSD (P<0.05)	*0.08*	*0.13*	*0.14*	*0.13*	*0.52*	*1.11*

**LSDs presented are for varietal comparisons between barley cultivars and wheat cultivars as displayed*

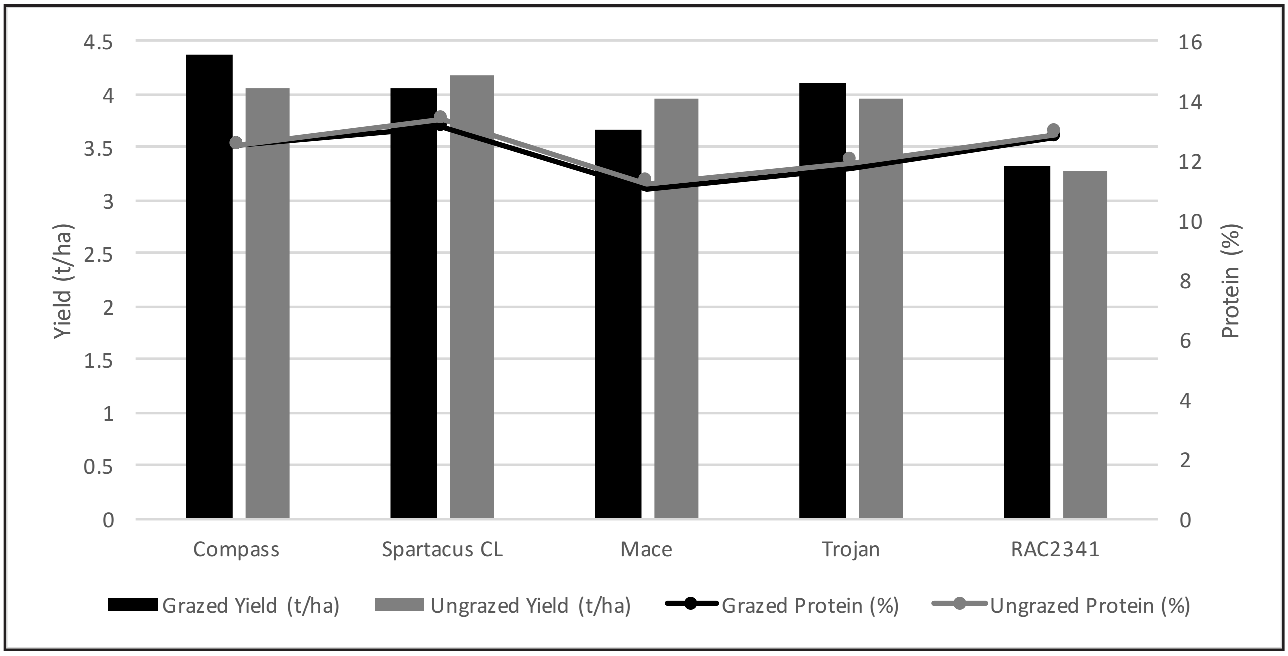


Figure 1 Yield (t/ha) and protein (%) response to grazing across two barley and three wheat varieties in 2016

What does this mean?

Ideal growing season conditions in 2016 proved that grazing winter cereal crops can be utilised as an early feed source for livestock in mixed farming systems of southern Australia, without significant grain yield loss. Good seasonal conditions meant yield penalties were minimal or that yield actually increased due to grazing and there was no significant downgrading of grain quality in this trial.

In a highly productive year such as 2016, grazing crops can have a multitude of benefits to the cropping system that may not be realised until harvest. Benefits to the cropping system can include; enabling excessive crop canopies to be managed, reducing possible lodging, incidence of disease and future stubble loads, conserving soil moisture to be utilized by the crop later in the year and delaying maturity which may avoid frosts. Winter crops can offer high quality feed which is equivalent or higher than typical pastures at the same time of year, in particular, the early vegetative stage of crop growth offers superior digestibility, metabolisable energy and protein when compared to grazing cereals later in the season. Autumn sown cereals produce high quantities of dry matter very soon after establishment when compared to many other pasture species.

There are also potential downsides and risks of grazing crops, including; the possibility of reducing grain yield and grain quality, uneven grazing which may lead to variable crop maturity, possibility of increased weed populations, delayed maturity which may expose the crop to heat stress and reduction of stubble remaining after harvest.

Reducing crop canopy can manipulate cereal production by changing the phenology and physiology of the crop, in particular delaying flowering, which may reduce the risk of the cropping program to the threat of frost. Newer varieties such as Trojan and RAC2341 that have been bred to remain in a vegetative stage for a longer period after sowing, have opened up an opportunity for growers to sow earlier with the possibility of an early graze if conditions are favourable. Understanding crop development, and how different varieties respond to stress plays a key role in the success or failure of utilising cereal crops as a dual purpose option. Unfortunately for ease of analysis in replicated trials across regions and across years, recommended sowing and grazing times are not always achievable for every variety in a trial. Knowing that grazing is planned provides the opportunity to sow commercial varieties earlier than would otherwise be normal practice.

The practice of grazing crops should be utilised as another tool for farmers to manage risk in mixed farming systems, as good growing seasons cannot be predicted. The combination of large amounts of early biomass production and the ability to fill feed gaps and still leave an opportunity to harvest grain can increase whole farm profit. Our limited research has shown that a moderate application of nitrogen after grazing should assist in crop recovery after grazing, however more investigation is required to determine the optimal amount due to variable responses in grain yield and quality across regions, seasons, cereal varieties and treatments. We aim to undertake an across-site and across-year analysis of the Grain and Graze 3 project data in order to gain a clearer understanding of varietal response to grazing and the impact of nitrogen in crop recovery.

The value of grazing crops to the whole mixed farming system is important, as the combination of grazing and grain production may increase overall farm profitability. Flow on effects or system impacts can be challenging to quantify, as they are not immediate, enterprise specific or necessarily measureable from either a production or economic perspective. Often system benefits, and downsides, need to be considered for individual farms to help calculate the financial implications to the whole system. Previous articles about grazing crops have highlighted the outcomes of grazing at a time of year when there may be a feed gap and have shown how this strategically benefits the livestock enterprise. It is important to note that grain yield loss doesn't always occur, and that the value of grazing should be valued, both economically and in a systems context in the cropping portion of a mixed farming system.

Acknowledgements

I gratefully acknowledge the technical assistance, support and site management of Leigh Davis and Brenton Spriggs. Thanks to John Kelsh for assistance with site management also. I appreciate AGT for allowing the use of their new wheat variety RAC2341 in the trial before official release. Thanks to Alison Frischke (Birchip Cropping Group), Mick Faulkner (Agrilink Agricultural Consultants Pty Ltd) and Zoe Creelman (Southern Farming Systems) for their guidance and support through trial development and analysis. The Eyre Peninsula Grain and Graze 3 project is funded by GRDC (SFS00028).

References

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