Grazing wheat and barley – impacts on crop canopy management, lodging and grain yield

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Take home messages

1. Sow cereals intended for grazing or dual purpose as early as practical (April-1st week May) to maximise opportunity to accumulate biomass for winter grazing.
2. Increasing plant population can be used to increase dry matter production for grazing.
3. Grazing cereals early will minimise impact on grain yield but reduce livestock production, whereas, grazing late will have a more negative impact on grain yield but more than double Dry Matter (DM) available for grazing.
4. Grazing can effectively be used to reduce the severity of lodging of susceptible cereals such as barley, particularly when grazing is later (closer to stem elongation).
5. Livestock **must** be removed by the end of tillering (GS30) to minimise any grain yield penalties associated with grazing.

Background

The grazing of winter cereal crops has been widely adopted, especially in southern NSW. The use of dual purpose cereal crops in mixed farming systems provides supplementary grazing during winter when pasture growth is limited by low temperatures. Well managed dual purpose cereals provide producers with an opportunity for increased profitability and flexibility in mixed farming systems, by enabling increased winter stocking rates and generating income from forage and grain. Typically these crops are earlier sown, longer season varieties that provide greater dry matter production for grazing. Barley with its vigorous early growth generally produces more dry matter for grazing and greater grain yield compared to grazed wheat. Research has shown that to avoid grain yield penalties stock must be removed from cereals before the end of tillering (GS30). However, the timing and intensity of grazing during the season can incur yield penalties, particularly when grazing pressure is high and late in the grazing period. In some circumstances grazing can be beneficial to grain production by reducing lodging or in seasons with dry springs grazing can increase grain yields due to reduced water use in the vegetative stages leaving more soil water for grain fill. The challenge for growers is to find the balance between optimising dry matter (DM) removal without compromising grain production.

The aim of this paper is to collate the results from a number of research trials conducted at Tamworth from 2007 to 2010, with specific focus on what management strategies can be used to manipulate the balance between DM removal and grain production. All trials were conducted at the Tamworth Agricultural Institute research station. The 2007 grazing trial compared the performance of 8 barley and 2 wheat varieties that were planted either early (11th May) or during the main sowing window (25th June). The 2009 grazing trial investigated the interaction between variety (3 barley varieties - Urambie, Commander and Fitzroy) and plant population (100 and 200 plants/m^2). In

2010 two barley varieties (Commander and VB0611 – an experimental line) and one wheat; EGA Gregory; were grazed either early (at GS25), late (at GS30) or both early and late. All trials were overlayed with plus or minus grazing treatments, where grazing was simulated with the use of a slasher.

Results

Time of sowing

To fully maximise the accumulation of biomass for winter grazing it is important to ensure that cereal crops intended for grazing are sown early (April – 1st week May). Sowing early in the 2007 grazing trial resulted in significantly greater DM yields at GS30 and grain yield for all barley and wheat varieties. On average for barley and wheat there was 40 and 42 %, respectively, greater DM production for the early plant compared to the main season plant (6 weeks later). Similarly, there was an average 1.59 t/ha (P<0.05) grain yield penalty across barley and wheat varieties for delaying sowing from the early to the main season plant. The severe grain yield penalty observed from grazing main season planted cereals is associated with grazing delaying maturity, which means flowering occurs later when conditions are hotter and drier. In the 2007 trial grazing delayed flowering of barley and wheat by 6 – 11 days depending on variety.

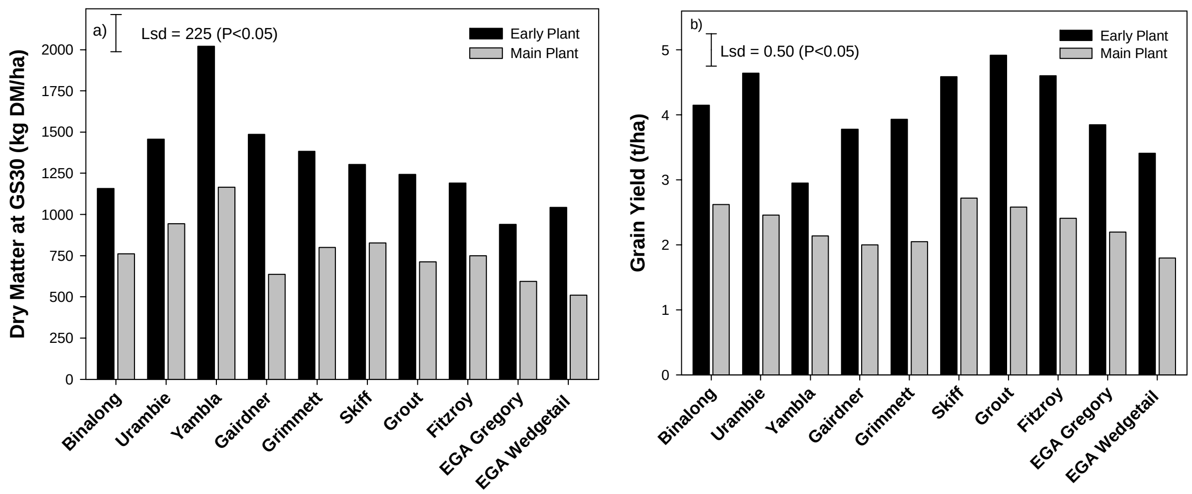

Figure 1: a) Dry matter yield at GS30 and **b)** grain yield for 8 barley and 2 wheat varieties that were planted either early (11th May) or in the main season window (25th June).

To get an indication of the additional value that grazing can add the grazing days (Dry Sheep Equivalent (DSE) days/ha) were calculated based on a pregnant merino ewe (1.5 DSE rating). Therefore DSE.days/ha is calculated by the available DM – 300 (amount DM remaining after grazing) * 70% (assumes that only 70% of available DM is utilised) divided by DSE rating of animals used. The DSE rating for different livestock are listed in Table 1. The DSE days/ha can be used by producers to calculate stocking rate or days on feed by dividing the DSE.days/ha by number of days on feed or by stocking rate, respectively. The DSE.days/ha for early plant (681 DSE.days/ha) was more than double that of the late planting (313 DSE.days/ha).

Plant population

Manipulating plant population is a simple management option that can have a significant impact on DM production for grazing and grain yield. Increasing plant populations from 100 to 200 plants/m^2 (doubling sowing rate from 60 to 120 kg/ha) for the 3 barley varieties Fitzroy, Urambie and

Commander significantly (P<0.05) increased DM yield by 710, 335 and 407 kg DM/ha, respectively. Two DM cuts were able to be taken from Fitzroy and Urambie treatments compared to only 1 from the Commander treatment, which produced approximately half the DM biomass. Increasing plant population significantly (P<0.05) increased grain yield for Fitzroy and Commander by 0.36 and 0.44 t/ha when no grazing was implemented. Under grazing treatments Urambie was the only variety to have a higher yield (0.33 t/ha) at the higher plant population. At the 200 plants/m^2 population grazing significantly reduced the grain yield of all varieties, whereas, at 100 plants/m^2 population a grain yield penalty was only observed for Urambie. Therefore, using higher plant populations to increase DM yield for grazing is achievable but for increasing grain yield may be less reliable.

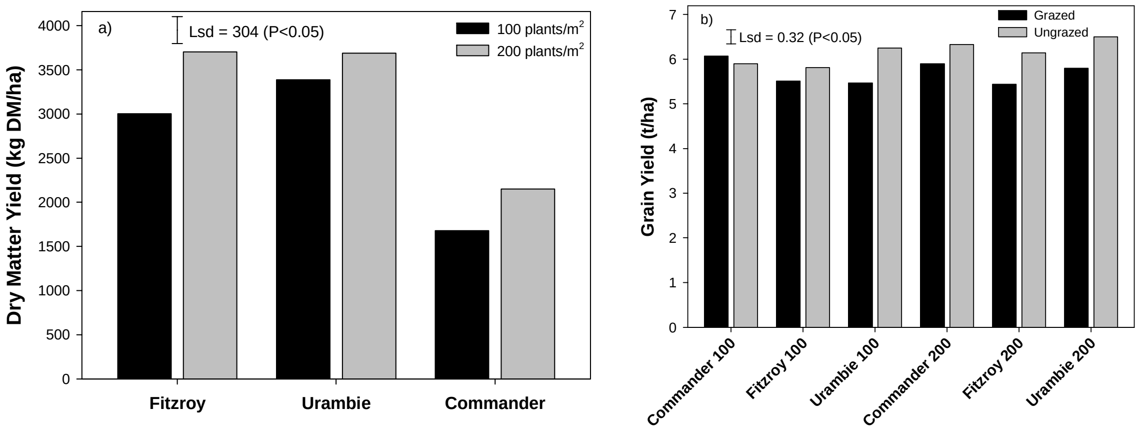

Figure 2: a) Dry matter yield for grazing from 3 barley varieties at either 100 or 200 plants/m^2 and, **b)** grain yield for 3 barley varieties grown at 100 or 200 plants/m^2 and either grazed or ungrazed.

Increasing plant population from 100 to 200 plants/m^2 resulted in an average increase of 20% in DSE.days/ha. Therefore if the barley was grazed for 40 days the stocking rate could potentially be increased from 33 to 39-40 merino ewes/ha.

Table 2: Estimates of Grazing days (DSE.days/ha) for Commander, Fitzroy and Urambie grown at either populations of 100 or 200 plants/m^2

Variety	Population	
	100 Plants/m^2	**200 Plants/m^2**
Commander	643	943
Fitzroy	1267	1589
Urambie	1418	1581

*Estimates of DSE.days/ha based on a pregnant merino ewe (1.5 DSE/ha)

Timing of grazing

Although removing livestock before GS30 minimises grain yield penalties, the timing of grazing between GS13-GS30 can also have a significant influence on DM yield and grain yield. Across 2 barley varieties Commander and VB0611 (advanced breeder line) and EGA Gregory grazing early significantly (P<0.05) limited DM yield by 74 and 62 % compared to the late and early + late grazing systems, respectively. The early + late grazing system also yielded approximately 750 kg DM/ha less (P<0.05) than the late grazing system. The additional, DM yield achieved under the late and early + late grazing systems came at the expense of grain yield. Grain yield for the late and early + late grazing systems was similar regardless of variety but had approximate reductions of 0.6, 1.0 and 0.4 t/ha of grain for Commander, VB0611 and EGA Gregory, respectively. The early grazing had no significant effect on grain yield compared to the ungrazed control.

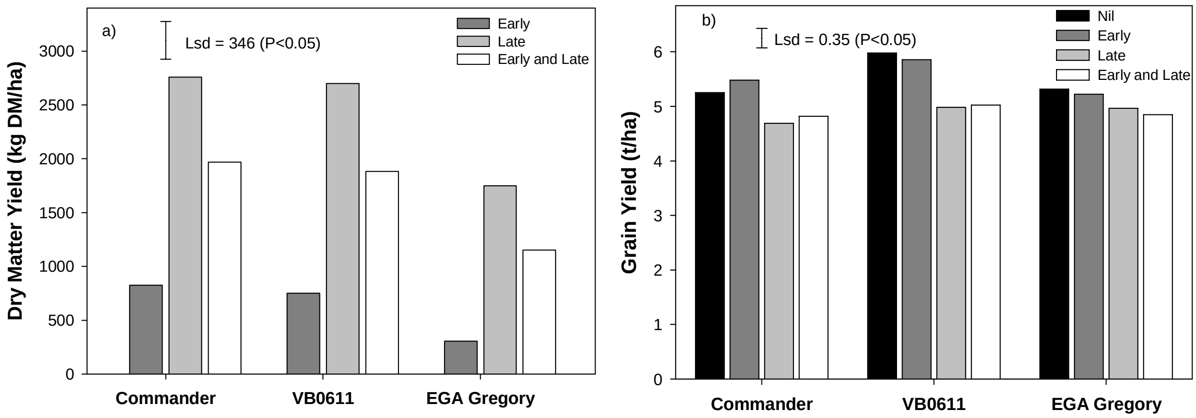

Figure 3: a) Dry matter yield for Commander, VB0611 and EGA Gregory under either early, late or a combination of early and late grazing systems and **b)** grain yield for Commander, VB0611 and EGA Gregory under either ungrazed, early, late or a combination of early and late grazing systems

Grazing late enabled an additional 84 and 35 % greater DSE.days/ha in comparison to the early and early + late grazing systems. Dry matter production for EGA Gregory for the early grazing system was insufficient to support grazing.

Table 3: Estimates of Grazing days (DSE.days/ha) for Commander, VB0611 and EGA Gregory under either ungrazed, early, late or a combination of early and late grazing systems.

Variety	**Timing of Grazing**		
	Early	**Early + Late**	**Late**
Commander	246	779	1147
VB0611	211	739	1120
EGA Gregory	2	397	676

***** Estimates of DSE.days/ha based on a pregnant merino ewe (1.5 DSE/ha)

Lodging

Grazing can be used to limit early canopy growth and therefore is a management tool to reduce the incidence of lodging. Lodging remains a significant problem in barley and has been estimated to cause yield losses of up to 40 %. In the 2010 grazing trial it was observed that grazing late had the greatest potential to reduce lodging scores, particularly in the 2 barley varieties. The early + late grazing system reduced lodging to a similar extent to late grazing, whereas early grazing only reduced the lodging scores slightly. These results are directly related to the quantity of DM removed (Figure 3a).

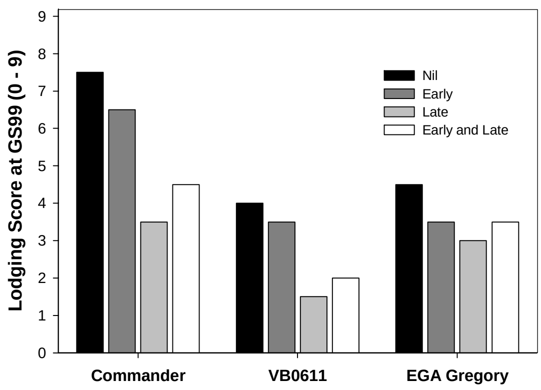

Figure 4: Influence of ungrazed, early, late and early + late grazing systems on lodging scores (0 = standing, 9 = flat)

Conclusion

When trying to optimise the balance between DM production and grain yield for grazing cereals growers have a number of management options available including sowing time, plant population, species/variety and grazing timing, among others. Ensuring that grazing cereal crops are sown early (April – 1st week in May) is pivotal to allow sufficient time for biomass to accumulate for winter grazing and flowering to still occur within the optimum window. Grazing crops planted in the main season sowing window are likely to suffer large yield penalties as flowering will occur later when conditions are hotter and drier. Increasing plant populations is an effective means of increasing DM yield for grazing, however, has limited capacity to increase grain yields after grazing. Increases in DM yield ranged from 335 to 710 kg DM/ha when moving from 100 to 200 plants/m^2. In comparison, the timing of grazing can have a greater influence on DM yield, with late grazing systems offering an additional 74 and 45 % DM yield compared to early and early + late grazing systems. Despite the additional DM yield under the late grazing system it has the greatest risk as grazing occurs closer to GS30 and there are greater grain yield penalties. However, late grazing has the potential to reduce lodging severity, particularly in susceptible varieties such as Commander. When considering the farming system as a whole the late grazing system may be the most suitable as it offsets grain yield losses with reduced lodging and increased livestock production from additional DM yield. The emphasis on either DM yield or grain yield will be grower specific and a range of management options may need to be implemented to get the balance right.

Determining the economic benefit of grazing cereals is difficult. If yield penalties from grazing are avoided then the gross margin obtained from a dual purpose system is greater than that obtained from grain only. In particular the greatest benefits would be obtained where the grazing cereals complement existing livestock enterprises by filling the winter feed gap and livestock don’t have to be purchased to utilise additional feed from grazing cereals. Furthermore, grazing cereals during the winter period allows for the potential to spell pastures, which could lead to substantial increases in available feed to the whole system. Grazing cereals also provide flexibility and risk management to make decisions about weather and commodity prices throughout the season. It may be more profitable to focus more on livestock weight gains and sacrifice grain recovery but this decision will vary from season to season.

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