Delaying wheat flowering time through grazing to avoid frost damage (Part 1: Time of cutting)

Steve Curtin and **Ben Whisson**, ConsultAg Lake Grace.

Key messages

- Crash grazing will delay flowering of wheat. The delay in flowering is half the period of grazing. This rule of thumb applies to other wheat varieties as validated in Part 2.
- With early sown crops and early grazing, up to 20 days crash grazing is possible without reduction in yield. Part 2 suggests yield penalties with crops sown in late May and in higher rainfall areas when sown mid to late May in 2013.

Aims

- To investigate whether grazing will delay flowering of wheat so the crop can be sown early and grazed to a set period which will put it outside the frost window.
- To validate the rule of thumb developed in the previous year - graze for twice as long as the period you want to delay flowering for.
- To determine the effect on yield from different lengths of grazing.

Method

Two identical trials were conducted in different parts of the same paddock. One was in a low frost prone area and the other in a safe area higher in the landscape. Yitpi wheat was sown on the 9th May and once the crop was at 4 leaf (11th June) the first cuts were applied. Treatments were Nil, 10 days, 20 days and 30 days of cutting. The appropriate plot was cut every 10 days. For example the 10 days treatment was cut on 11th June and on the 21st June. The 20 day treatment was cut on 11th and 21st June and 1st July. Plants were cut to 3-5cm above the ground with a whipper snipper to simulate crash grazing by sheep. Dry matter cuts and growth stages were taken at each stage of cutting to measure comparative growth rates.

Results

There was no significant yield loss from up to 20 days simulated grazing at both sites. There was a significant yield loss from the 30 day treatment of around 14% for both sites. The Nil treatments for the low and high sites yielded 2.03 and 2.2 t/ha respectively.

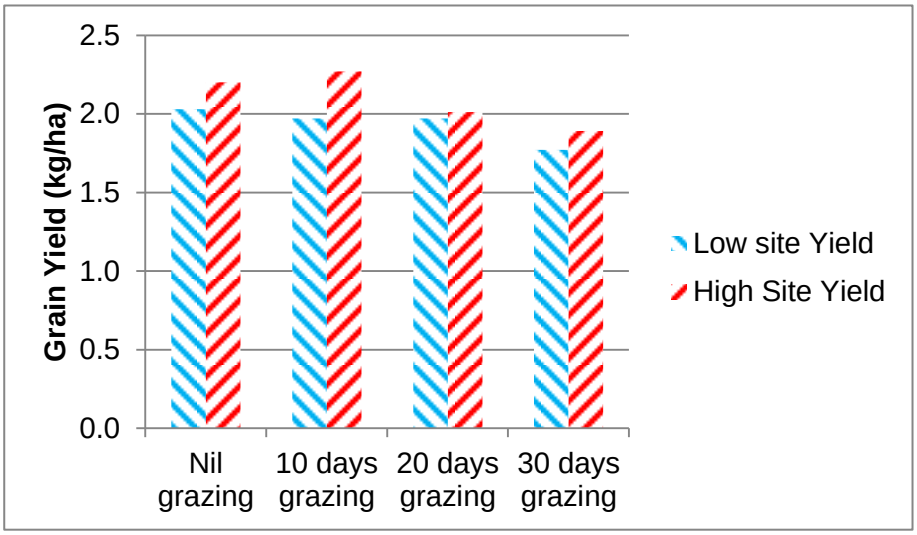

Figure 1 Shows the grain yield response for the different treatments at the frost prone site and the high safe site.

There was no significant frost during the critical flowering period of the crop. The recorded frosts were on 6th September, 1st October and 13th October. The 13th October frost damaged some grains in the treatments on the frost prone site but the results were not significant despite the 30 day treatment being more affected with the largest delay in flowering. The flowering dates (50% flowering) recorded on the low site are shown in Table 1.

Table 1 Days delay in flowering of Yitpi from respective simulated grazing treatments.

Treatment	Flowering Date	Days delay from Nil
Nil	16th September	
10 days grazing	22nd September	6
20 days grazing	27th September	11
30 days grazing	30th September	14

The delay in flowering time validates the 2:1 rule of thumb developed from a similar trial in 2012 by Curtin and Whisson. Two days of crash grazing will delay flowering by 1 day. This rule of thumb was further supported by trials in Part 2 of this paper where a 14 days crash grazing treatment on twelve wheat varieties and at two different sowing times showed a similar result.

The dry matter cuts show that there was a significant amount of feed on offer for sheep grazing and it is surprising that there is not a larger reduction in yield with the low biomass the grazed plots have to recover from after cutting. The last cut was done on 11th July before the plants were at the critical first node stage (Z31) so the head had not yet extended above the 3-5cm cutting level. The final dry matter cuts taken 14 days after the final cut are summarised in Table 2. As an example of the time taken to recover, the 10 day grazing treatment has had 20 days to recover but is still only growing at 58% of the Nil

Table 2 Dry matter cuts and growth rates from 11th July to 25th July, 14 days after the final cut.

Treatment	Dry matter (kg/ha)	% of Nil	Growth Rates (kg/ha/day)
Nil	2521		92
10 days grazing	1492	59%	53
20 days grazing	857	34%	38
30 days grazing	451	18%	10

Conclusion

The trials in 2013 confirmed the results of 2012 and showed that crash grazing has the potential to delay flowering according to the 2:1 rule of thumb. Unfortunately, there was no major frost during the critical flowering stage of Sept 16th to September 30th to test the effectiveness of the delay. The ability of the plant to recover most of the yield with up to 20 days grazing is confirmation that crash grazing can have minimal reduction on yield.

The recommendations from this work and that carried out in 2012 are summarised below.

- Only graze early sown crops.
- Graze early from 4 leaf of the crop or 4-5 weeks after seeding.
- Crash graze for up to three weeks. Two weeks is safe.
- Stop grazing before plants are at the first node stage (Z31).
- Use “Flower” to predict flowering date and work out the required flowering delay.
- Crash graze for twice as long as the required delay in flowering to avoid a high risk frost period.

The work has shown the advantages of crop grazing and has benefits for both crop and sheep programs. They are:

1. The avoidance of the main frost period.
2. Possible reduction of major yield loss from frost.
3. The opportunity to sow early (or dry) knowing flowering date can be manipulated in crop. This is the only “in crop” manipulation after sowing which can lower frost risk.
4. Provision of valuable sheep feed during a critical feed gap period.

Key words

Crop grazing, frost, grazing, flowering

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Delaying wheat flowering time through grazing to avoid frost damage (Part 2: Incorporating varieties and sowing time)

Brenda Shackley and **Rod Bowey,** DAFWA Katanning

Key messages

- Simulated crash grazing can delay flowering of wheat where the rule of thumb established in Part 1 is 1 day delay in flowering for every 2 days of grazing, when sown mid to late May. Choice of variety still gives the biggest spread of flowering to avoid frost.
- The twelve varieties tested did not respond differently to the simulated crash grazing treatment.
- Effect of crash grazing on yield can vary with environment and sowing time. Yields were reduced with crash grazing when sown mid to late May in a high rainfall environment or with a late May sowing in a low rainfall environment. There was no yield penalty with a mid May sowing in the low rainfall environment.

Aims

- To investigate whether crash grazing can be used to delay flowering of wheat as a mitigation tool to avoid frost.
- To examine if current and potentially new varieties vary in their response to grazing in low and high rainfall environments.

Method

This paper is presented in two parts. Part 1 helped to establish the "best bet" crash grazing treatment in Part 2, enabling the research work to examine a wider range of varieties at different sowing times.

Similar trials were sown at Newdegate and Qualeup to represent low and high rainfall environments. Newdegate receiving approximately 210 mm for the growing season (May to October) while Qualeup received 400mm.

The trial at Newdegate was sown in the same paddock adjacent to the trials in Part 1. The small plot trials were sown as a latinised split plot with sowing times (May 15 and May 28, for Newdegate or May 11 and May 27, for Qualeup) as the main plot, varieties (12) as the sub plot and grazing (nil and plus) as the sub sub plots. Varieties included Mace$^{\phi}$, Yitpi, Magenta$^{\phi}$, Estoc$^{\phi}$ and a number of potential long season varieties including the newly released Harper$^{\phi}$ and Trojan$^{\phi}$. Site specific varieties included Wyalkatchem$^{\phi}$, Scout$^{\phi}$ and Young$^{\phi}$ at Newdegate or Envoy$^{\phi}$ and Calingiri at Qualeup.

Plus grazing was a crash graze (3-5 cm above ground) with a whipper snipper at 6 or 7 weeks after sowing or roughly 4-5 leaf stage followed by another crash graze 14 days after. This treatment was nominated as the "best bet" treatment from previous results in Part 1. The critical stage of Z30 was reached after all cutting had been completed.

Results

The "low" rainfall site at Newdegate was sown six days after the bulk crop. Grower experience suggested the paddock was "frost prone" and frost events or temperature below 2°C were recorded before flowering (September 6) and well into grain fill (October 10 and 13). Hence there was very little frost damaged observed in the trial. There were some non wetting issues at the site and the establishment was lower than expected at approximately 100 plants/m² for the mid May sowing or 110 plants/m² for the late May sowing.

The average yield for the mid May sowing time was 2.5 t/ha at Newdegate, similar to the surrounding bulk crop of Yitpi. Mace(Þ) was the highest yielding variety at 2.8 t/ha which was not significantly higher Magenta(Þ), Wyalkatchem(Þ) or Trojan(Þ) - a new mid-long season variety (Figure 1). Although most varieties showed a slight yield penalty with a delay in sowing of thirteen days, the decline was not significant. The average yield decline with sowing at this site was 7 kg/ha/day, well below average yield penalties from previous trials of 25 kg/ha/day.

There was a significant interaction between sowing time and grazing at Newdegate. Simulated grazing had no significant effect on grain yield of the varieties sown in mid May, similar results also occurring in Part 1. However, at the later sowing time the grazing treatment showed an averaged yield penalty of 0.4 t/ha at Newdegate. There were no interactions with varieties indicating that the varieties responded similar to the range of sowing times and grazing treatments in this trial.

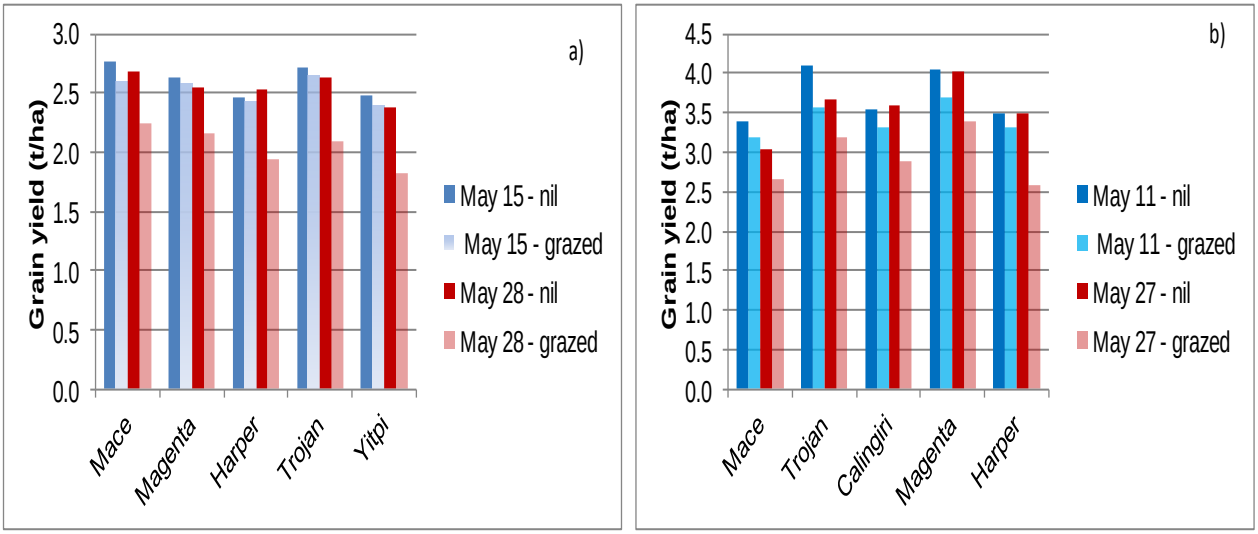

Figure 1 The grain yield response of five wheat varieties to simulated crash grazing and sowing time a) Newdegate and b) Qualeup in 2013. The "grazed" treatment was cut 3-5 cm above ground at 6 to 7 weeks after sowing and then 14 days later.

The penalty of a simulated crash graze in a higher rainfall environment at Qualeup is higher than the low rainfall site at Newdegate (Figure 1). The average yield for the mid May sowing was 1 t/ha higher than Newdegate at 3.5 t/ha. Trojan(Þ) was the highest yielding variety at Qualeup but not significantly different to Magenta(Þ) and Estoc(Þ) (results not shown). There was no significant difference in yield between the sowing times at Qualeup, but simulated grazing reduced yields by an average of 0.3 t/ha in mid May and 0.6 t/ha at the late May sowing.

Studies in the Eastern States suggests that the penalty of grazing is related to the residual biomass and the time to recovery or the amount of biomass left to drive yield (Kirkeguard pers comm.). The Qualeup site had a higher yield potential hence a bigger requirement for biomass to develop grain. To avoid this yield penalty with grazing it is suggested that earlier sowing are required to provide additional biomass.

One of the main outcomes of this trial was to assess how crash grazing delays flowering as a potential management technique to spread flowering in order to avoid frost. Crash grazing did delay flowering by an average of six days at Newdegate (varying from 4 – 7 days in the mid May sowing) or 7 days at Qualeup (5 – 8 days). This supports the rule of thumb of 1 day delay in flowering for 2 days of crash grazing, developed by Curtin and Whisson in 2012 and 2013 (Part 1).

The question remains as to whether the 6 day delay in flowering with the simulated crash graze would adequately spread the risk of frost at Newdegate. Choice of variety has the potential to spread the risk by 11 days at this site in 2013, while the delay in sowing of a variety of nearly two weeks led to an average delay in flowering of 9 days (Figure 2). Note that due to the complex interaction between temperature and a variety's response to cold or daylength, these relationships

can vary from season to season. Variety choice still offers the largest spread in flowering but other factors such as yield will also need to be considered.

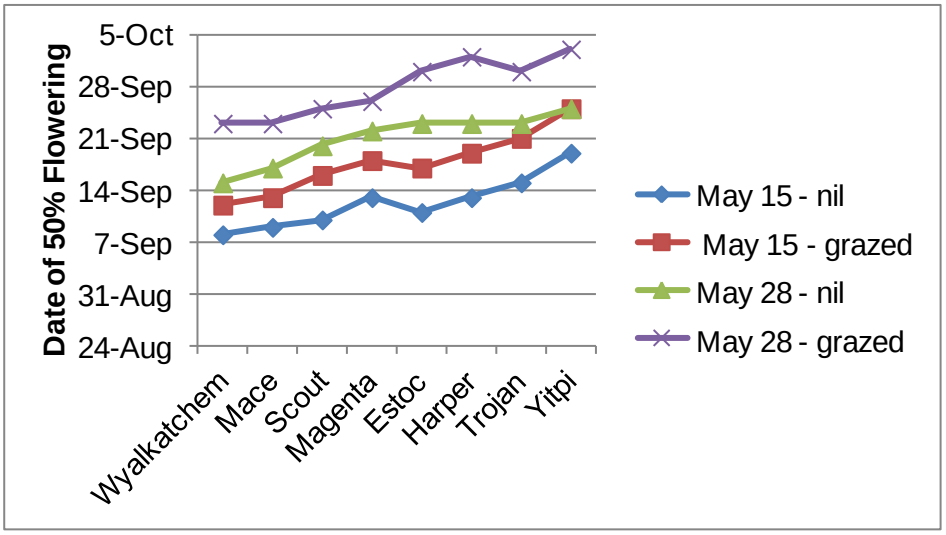

Figure 2 The effect of time of sowing and simulated crash grazing on the flowering date of eight varieties, Newdegate 2014. Varieties shown in order of flowering. The "grazed" treatment was cut 3-5 cm above ground at 6 to 7 weeks after sowing and then 14 days later.

Conclusion

The grain yield response of twelve current main stream varieties and potential Yitpi replacements to environment (high and low rainfall), sowing time and grazing were examined. Varieties had similar grain yield responses to sowing time and grazing treatments specific to the trials in 2013. Rankings of varieties however varied between the environments with Magenta$^{\phi}$ and Trojan$^{\phi}$ among the highest yielding varieties at both sites.

In 2013 there was non significant yield penalty between mid and late May sowing as a result of the favourable grain filling conditions for the sowing times at the two locations.

Both the low and high rainfall sites had a significant interaction between sowing and grazing. But at the low rainfall site (Newdegate), simulated crash grazing had no significant effect on yield when sown mid May. Crash grazing had a significant effect on yield (0.4 t/ha) if the crop was sown late May at the low rainfall site and at the high rainfall site (Qualeup) there was a yield penalty of 0.3 and 0.6 t/ha when sown mid or late May. These results suggest that the crash grazing treatment in the high rainfall/high potential environment should only be carried out at sowing before mid May in order to establish a higher biomass for recovery. Repetition of this research with an early May sowing may highlight varietal differences.

Simulated crash grazing can be used to delay flowering where the rule of thumb of 1 day delay in flowering for 2 days of grazing is still applicable for a mid to late May sowing. However, variety choice still offers the largest spread in flowering as a tool for the mitigation of frost.

Key words

Wheat varieties, grazing, sowing time, flowering

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