Management of Grazing Crops to Reduce the Incidence of Frost in the Albany Port Zone

Steve Curtin and Ben Whisson, ConsultAg, Lake Grace WA.
In partial completion of SDI00007

Objectives

The objective of the ConsultAg trial was to simulate a range of grazing strategies in wheat to determine the delay in flowering with the aim of avoiding or reducing frost damage.
This was in response to the high priority of frost work for the Albany RCS Network in the 2012 season.

Methodology

A trial was set up in a farmer sown wheat crop south of Newdegate WA. Seven treatments with 3 replicates were trialled which looked at different levels and timing of grazing. The seven treatments were

1. Nil
2. Grazed late for 20 days
3. Grazed late for 10 days
4. Grazed early for 10 days
5. Grazed early for 20 days
6. Grazed early for 30 days
7. Grazed early for 40 days

The crop sown was Yitpi wheat on 14th May at 60kg/ha with 60kg/ha Megacrop + 12kg/ha Sulphate of Potash.

An area of wheat was divided into 7 treatments with 3 replicates and according to the treatments outlined above each plot was mown with a whipper snipper to simulate grazing. The crop was cut at 3-5cm above the ground to remove all available leaf area and simulate grazing. In this experiment and reference to grazing refers to the cutting of the crop with a whipper snipper. This resulted in the removal of between 65-70% of plant material in the first 4 cuts. After 24th July, the proportion of the plant cut was larger as growth rates increased considerably.

Mowing occurred at 10 day intervals from the first cut on the 14th June when plants were at 4 leaf and couldn't be pulled from the ground easily.
For example, treatment 4 was cut on the 14th June and then on the 25th June to simulate 10 days grazing. Treatment 5 was cut on the 14th June, 25th June and 4th July to simulate 20 days grazing.

The cutting procedure is outlined below.

		Date	Days
Week 1	Cut all plots except Treatments 1,2,3	14-Jun	
Week 2	Cut all plots except Treatments 1,2,3.	25/6	11
Week 3	Cut treatments 2,5,6,7	4/7	9
Week 4	Cut treatments 2,3,6,7	13/7	9

Week 5	Cut treatments 2,3,7	24/7	11

Dry matter cuts were taken each time to determine how much the crop had regrown and therefore how much feed was available.

Other counts that were carried out were head counts, head length, grains per head and crop height. Only the head counts were replicated samples while the other counts were sub samples from each plot. Results of each of these counts is detailed in the appendix.

A datalogger was installed to measure temperature at critical levels during a frost. Probes measured temperatures at screen height, head height, in crop canopy and ground level.

Treatments were harvested with a plot header to measure differences.

Treatments were observed during the flowering period to determine the point of flowering identified by 50% of heads with yellow pollen stems outside the head. In some plots this was calculated based on previous measurements from other plots.

Results

The results are in 4 sections
1. Dry matter measurements
2. Head Observations
3. Time to flowering
4. Yield results

1. Dry matter measurements

Treatment	Dry matter at end (6th August)	Total DM grazed (cut)	Grazing days	Growth Rate (Last period) kg/day
1. Nil	2330	0	0	93
2. Grazed late for 20 days	270	710	20	
3. Grazed late for 10 days	283	668	10	
4. Grazed early for 10 days	1257	122	10	96
5. Grazed early for 20 days	797	244	20	62
6. Grazed early for 30 days	552	425	30	43
7. Grazed early for 40 days	267	692	40	21

The dry matter cuts show that there is a considerable loss in dry matter from grazing of any period. Even the short grazing for 10 days only managed to have 54% of the bulk of the ungrazed. Of interest was the fact that the growth rates for this short grazing were back to the same level as the ungrazed 42 days after grazing was stopped.

Grazing for extended periods affects the potential growth rate of the plants. There is less green plant material present at a time when plants need it most and it is hard to see how long grazing periods cannot seriously affect yield. For example, grazing for 20 days instead of 10 days reduced the growth rate by 36%, while 40 days reduced growth rates by nearly 80%.

The amount of dry matter grazed is a factor of stocking rate and time on the crop. This experiment showed that there was considerable DM available for longer and later periods of grazing. Stocking rates can be worked out by allowing for sheep to eat 1kg DM/hd/day. So for the 10 day grazing period with 122 kg DM cut per hectare, 120 sheep can be grazed for 1 day or 12 sheep/ha for 10 days. For the long grazing period of 40 days a stocking rate of 17 sheep/ha will consume the dry matter available. The later grazing (13th July) is interesting because the

crop has more time to build up bulk and a short period of 10-20 days has the same amount of bulk available as a crop which was grazed for 40 days from an early time of 4 leaf (4th July).

2. Head Observations

Treatment	Crop height cm	Head length cm	Potential grains per head.	Head Counts (heads/m2)	% of Ungrazed
1. Nil	75	66.5	39.7	249	
2. Grazed late for 20 days	61	60.3	32.5	228	92%
3. Grazed late for 10 days	59	52.9	30.2	233	94%
4. Grazed early for 10 days	72.5	70	37.3	231	93%
5. Grazed early for 20 days	67.5	71.2	39.6	208	84%
6. Grazed early for 30 days	61	71.9	38.2	210	84%
7. Grazed early for 40 days	53	64.5	32.5	182	73%

Grazing has a big impact on crop and head parameters. The following points are noted.

- Extended grazing resulted in a shorter crop and all grazing treatments resulted in less head density.
- It was observed that there was a larger variation in head height and development with longer grazing. This means that there was a larger variation in head development than for the ungrazed which was more even in height and development.
- The shorter grazing periods had less reduction in head numbers (6-7%) and 40 days had a large reduction (27%)
- Grazing later had a big effect on potential grains per head with a 24% reduction with the latest timing (treatment 3)
- Head length was increased for the three timings of early grazing compared to the ungrazed but grains per head was similar.
- A short period of grazing early in the life of the plant (4 leaf) has the least impact on head and crop parameters.

3. Time to Flowering

Treatments were monitored and flowering dates recorded so the delay in flowering time compared to the ungrazed treatment could be found. The estimated flowering dates are shown below. Flowering was calculated as the time when 50% of the anthers were emerged from the head and is estimated from the middle of the head on the oldest tillers.

Treatment	Flowering date	Days delay
1. Nil	14th Sept	
2. Grazed late for 20 days	26th Sept	12
3. Grazed late for 10 days	24th Sept	10
4. Grazed early for 10 days	18th Sept	4
5. Grazed early for 20 days	24th Sept	10
6. Grazed early for 30 days	27th Sept	13
7. Grazed early for 40 days	29th Sept	15

Grazing has successfully delayed flowering date and for the early grazing treatments it would appear that there is roughly a 1 day delay in flowering for 2 days grazing. This rule did not

apply for a later start to grazing. Plants were taken from treatments and dissected so head development could be compared. The photos below show the differences in development stage for each treatment. Photos are from the 6th August and the 29th August

Plant characteristics on 6th August

Plant characteristics on 29th August

There were a number of frosts during the flowering period. The most serious frosts were on the 13th, 23rd and 28th of September. Notice that these dates correspond to the flowering dates of some of the treatments. As a result the site was severely frosted and the frequency of the frost means that all treatments were frosted either before, after or during the frosts. The temperatures at head height as recorded by the dataloggers are shown below.

12th September	-2.6°C
13th September	-4.3°C
14th September	-1.0°C
23rd September	-2.5°C
28th September	-2.0°C

4. Yield Results

Despite the severity and frequency of the frost the yield results still showed a difference between treatments. The most severe frost on the 13th Sept was when the Nil was most susceptible and some of the delayed plots were not flowering yet. There could have been some frost induced sterility pre flowering in these plots, however, this was not determined.
The average yield for each of the treatments is shown in the table below.

Treatment	Yield (kg/ha)	% of ungrazed
1. Nil (ungrazed)	200	
2. Grazed late for 20 days	380	190%
3. Grazed late for 10 days	333	166%
4. Grazed early for 10 days	360	180%
5. Grazed early for 20 days	491	245%
6. Grazed early for 30 days	519	259%
7. Grazed early for 40 days	420	210%
LSD (95%)	125	

Discussion of Results

From the original objectives of this project it has been shown that grazing can have the desired effect of delaying flowering and for the early and shorter grazing periods there is a rough rule of thumb which says flowering will be delayed for half the time the crop is grazed. For example, grazing for 20 days delays flowering for 10 days.

However, the trial was unable to achieve the objective of preventing frost due to the severity and frequency of frost on this highly frost prone soil type. All treatments were frosted to some degree. With further funding it would have been ideal to replicate the trial in a non frosted area to see what yield loss would be caused by each treatment. Further research is needed to give this answer. The unfrosted area in this paddock yielded around 2.2t/ha which means the ungrazed area only yielded 9% of potential.

Implications

The implications of this research could have a big impact on how farmers utilise frost prone areas for both cropping and sheep enterprises.
The benefits of grazing crops in frost prone areas means farmers can

- Sow early when crop moisture is available.
- Sow dry with confidence flowering date can be manipulated once germination date is known.
- Delay flowering by varying the grazing length and push flowering outside the frost window.
- Fill an early season feed gap.
- Defer pastures early in the season so they produce more later in the season.

In this trial the benefits just in yield difference alone for the early grazed treatments ranged from $46/ha up to $93/ha. If we add in the value of the feed that was available to consume we can use the values in the table below. The real value depends whether the feed available is valued at equivalent grain prices or agistment value. Because feed is not usually desperately short at this time of year and grain feeding is reduced from usual levels then agistment values have been used.

Treatment	Yield value ($/ha)	Agistment value ($/ha)	Total value above Nil ($/ha)
1. Nil	$58		

2. Grazed early for 10 days	$104	$12	$58
3. Grazed early for 20 days	$142	$23	$107
4. Grazed early for 30 days	$151	$32	$125
5. Grazed early for 40 days	$122	$49	$113

Yield is valued at $290/t net in the bank price. Agistment 50c/hd/wk.

Recommendations

This work was an investigative look at the potential to manipulate crop flowering time to avoid or lessen the impact of frost. Further work is needed to

1. Validate the rule of thumb developed and
2. Determine the yield decrease from various grazing pressures in the absence of frost.

Appendices

1. *Communication and extension activities (numbers attending in brackets)*
    - Presentation and publication at Crop updates in February 2013 (100)
    - Presentation to LIFT farming group at Lake Grace (15)
    - Presentation to Albany RCS network – progress report. (15)
    - Presentation to Climate champions at Lake Grace (20)
    - 3 presentations at ConsultAg client workshops at Lake King, Kulin and Narrogin. (80)
    - Presentation to AAAC Consultants at Autumn Update (30)
    - Publication report to GRDC.

2. *Head counts.*

Treatment	Rep	Counts – Heads/0.5m of row						Average	Mean	Mean (hd/m2)
1	1	24	42	25	28	25	33	29.5		236
	2	27	28	29	35	31	42	32.0		256
	3	32	29	29	38	26	38	32.0		256
									31.2	**249**
2	1	20	32	19	35	30	29	27.5		220
	2	30	32	35	22	25	30	29.0		232
	3	21	42	24	35	24	29	29.2		233
									28.6	**228**
3	1	35	40	50	35	28	22	35.0		280
	2	25	25	19	26	15	32	23.7		189
	3	38	29	30	26	26	24	28.8		231
									29.2	**233**
4	1	35	26	37	32	38	24	32.0		256
	2	20	26	28	28	39	30	28.5		228
	3	19	31	26	26	22	32	26.0		208
									28.8	**231**
5	1	25	14	28	28	27	25	24.5		196
	2	19	19	31	23	30	28	25.0		200
	3	32	29	32	32	22	25	28.7		229

									26.1	**208**
6	1	20	22	26	23	32	25	24.7		197
	2	25	28	26	27	18	30	25.7		205
	3	32	30	20	27	31	31	28.5		228
									26.3	**210**
7	1	20	18	24	27	17	18	20.7		165
	2	23	25	23	21	28	27	24.5		196
	3	16	22	27	25	25	24	23.2		185
									22.8	**182**

3. Yield results

Wheat Grazing Trial		Rep 1	Rep 2	Rep 3	Average
Nil	1	0.23	0.15	0.22	0.200
Late grazing 2 weeks	2	0.37	0.32	0.44	0.380
Late grazing 1 week	3	0.43	0.19	0.37	0.333
Graze early, 1 week.	4	0.31	0.34	0.43	0.360
Graze early, 2 weeks	5	0.61	0.42	0.45	0.491
Graze early, 3 weeks	6	0.56	0.42	0.58	0.519
Graze early, 4 weeks	7	0.36	0.42	0.48	0.420
LSD (95%)					.125

4. Flowering dates

	Treatment	Flower date	Days difference	Days grazing
1	Nil	14-Sep	0	0
2	20 days (Late)	26-Sep	12	20
3	10 days (Late)	24-Sep	10	10
4	10 days (Early)	18-Sep	4	10
5	20 days (Early)	24-Sep	10	20
6	30 days (Early)	27-Sep	13	30
7	40 days (Early)	29-Sep	15	40

Flowering Date (oldest tiller middle of head)

5. Crop parameters

Grazing	Head Counts	Crop Height	Head length	Potential Grains
Nil	249	75	66.5	39.7
40 days	182	53	64.5	32.5
30 days	210	61	71.9	38.2
20 days	208	67.5	71.2	39.6
10 days	231	72.5	70	37.3