Managing early sown wheat crops

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KEY MESSAGES

- Early sown (10th April) SQP Revenue was significantly more responsive than Manning to a programme of agrichemicals for foliar disease and Barley Yellow Dwarf Virus control (BYDV)
- Ungrazed SQP Revenue gave a significant 0.66 t/ha response to a two spray fungicide programme and a further 0.28 t/ha response to an additional insecticide programme for BYDV control, compared to a maximum response of 0.39 t/ha for both fungicide and insecticide for Manning
- Simulated grazing did not significantly reduce yield with either cultivar and gave an average dry matter benefit of 1.89 t/ha with lax grazing at GS16 & GS30 and 2.39 t/ha with laxed grazed followed by a hard grazing at the GS30
- Leaf rust Puccinia triticina which was the principal disease in the trial was at significantly higher levels in SQP Revenue than Manning and required two foliar fungicides to give control
- In SQP Revenue grazing was not an effective control measure for leaf rust control compared to an early GS31 fungicide when assessed at flag leaf
- At the Westmere site, simulated grazing reduced grain yield by 0.2-0.5 t/ha compared to 1.7 t/ha dry matter removed by grazing
- Low levels of disease at this site did not allow the hypothesis that grazing reduces disease pressure to be tested.

Keywords: Septoria tritici blotch (*Zymoseptoria tritici*), Leaf rust (*Puccinia triticina*), BYDV

BACKGROUND

Where an early autumn break allows sowing dates of wheat to be brought forward into early – mid April it is not only important to ensure that cultivar choice is based on winter wheat cultivars, but that crops are managed to take account of higher disease and aphid pressure. Over the last five seasons Septoria tritici blotch (STB, *Zymoseptoria tritici*) and Barley Yellow Dwarf Virus (BYDV) have been noted at higher levels when crops are sown in April. In some cases the level of STB and BYDV have been high enough to significantly reduce yield and with it, remove the advantage of sowing early. The winter wheat cultivars Manning and SQP Revenue offer the opportunity to sow early in April, although the BYDV tolerance and STB resistance is greater with Manning than with SQP Revenue. The research reported here looks at the significance of the cultivar difference with regard to management strategy.

METHOD

Inverleigh Trial

For the third year of this CSIRO lead GRDC funded project (CSP00178) the research team looked at the management of wheat sown in the first half of April in the southern HRZ. The principal trial at Inverleigh was established on the 10th April on the duplex soil consisting of sandy loam over heavy sodic clay. The trial which emerged without the need for irrigation followed a pea crop.

The trial was established as a split plot design, with eight different management treatments as the main plot and cultivar either Manning or SQP Revenue as the sub plot.

Management treatments in the trial incorporated insecticide programmes, and disease management strategies including, seed treatment with fungicide, grazing, and foliar application of fungicide.

Grazing treatments

Manning and SQP Revenue were subject to two levels of simulated grazing (lawn mower - biomass removed) compared to ungrazed crops:

1. Lax grazing – Lax graze at the 6 leaf stage (GS16) on 12th June followed by lax grazing at pseudo stem erect (GS30) on 31st July.
2. Hard grazing - Lax graze at the 6 leaf stage (GS16) followed by hard grazing (GS30).
3. Ungrazed

Fungicide applications

Fungicides were applied at one of three timings: Flutriafol at sowing (200 g/ha ai), Prosaro 300 mL/ha at GS31 on 31st August and at GS39 on 29th September. These timings were combined in treatments as follows and compared to an untreated control:

1. Untreated
2. 1 Foliar Spray at GS39
3. 2 Foliar Spray at GS31 and GS39
4. Flutriafol at sowing plus GS39

The seed treatment fungicide was Raxil (100 mL/100kg seed).

Insecticide applications for BYDV control

There were two levels of insecticide management:

1. Untreated
2. Treated (Raxil + Gaucho 240 mL/100kg seed), Transform 100 mL/ha at 3 leaf (GS13) on 22nd May and Karate applied 18 mL/ha at tillering stage on 17th June.

The different grazing, fungicide and insecticide managements were combined into eight management approaches (table 1).

Table 1. Management strategies applied to Manning and SQP Revenue

Trt No.	Defoliation	Fungicide	Insecticide for BYDV control
1.	Ungrazed	Untreated	Untreated
2.	Ungrazed	2 Foliar Spray (2F) at GS31 & GS39	Untreated
3.	Ungrazed	Untreated	Treated
4.	Ungrazed	2 Foliar Spray at (2F) GS31 & GS39	Treated
5.	Hard grazing	2 Foliar Spray at (2F) GS31 & GS39	Treated
6.	Hard grazing	1 Foliar Spray (1F) at GS39	Treated
7.	Lax grazing	1 Foliar Spray (1F) at GS39	Treated
8.	Ungrazed	Flutriafol at sowing plus GS39	Treated

Westmere Trials

To complement the CSIRO project, SFS ran two smaller trials at the Westmere trial site sown 16th April looking at the impact of grazing and fungicide application for disease control.

RESULTS

INVERLEIGH RESULTS

Dry matter removed by defoliation

The early lax grazing at GS16 removed an average of 0.46t DM/ha from the Manning and SQP Revenue plots, with the GS30 lax grazing removing a further 1.42t DM/ha on average across the two cultivars and the hard grazing 1.92t DM/ha. At 5 c/kg dry matter for sheep feed, the total value of dry matter with lax grazing was $94/ha and $119/ha with hard grazing.

Crop reflectance (NDVI) measurements

The different management approaches were "visualised" in terms of crop canopy greenness readings by the Greenseeker®, which measures crop reflectance at particular wavelengths of light. In this case Normalised Difference Vegetative Index (NDVI) was used to compare management strategies for their effect on the crop canopy (Figure 1). The significant differences in NDVI were observed where crops were grazed (green and blue lines) the lower NDVI's being apparent at the assessment timings following defoliation.

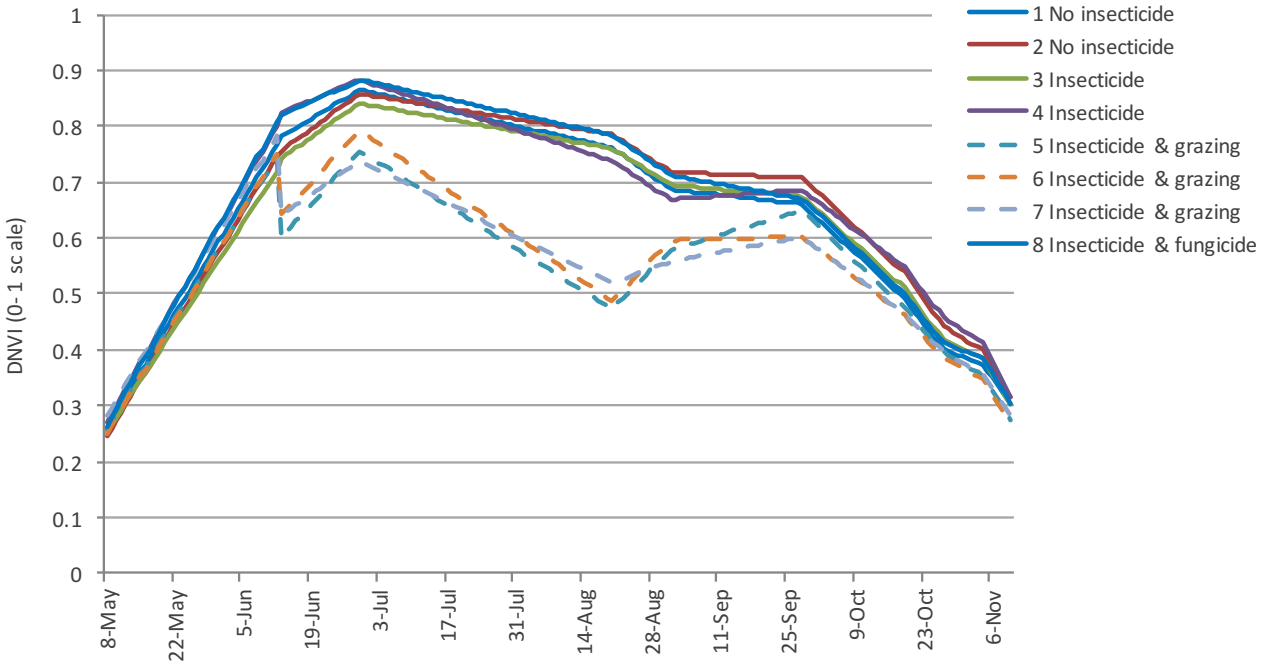


Figure 1. Influence of management strategies on NDVI (crop canopy greenness) – mean of SQP Revenue and Manning assessed through the course of the season. (NB dashed lines are where crops were grazed).

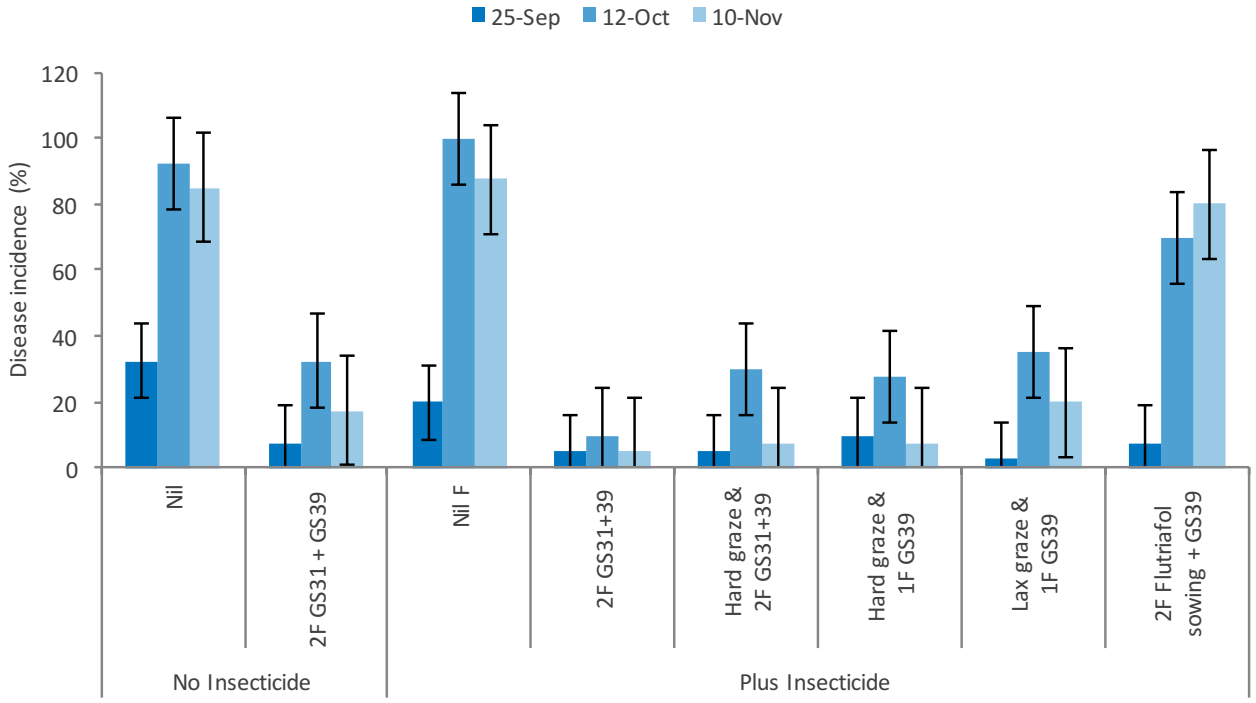
Disease control

August 20 disease assessments conducted on the lower leaves (Flag leaf – 5 (F-5) newest emerged leaf showing infection) at early stem elongation (GS31-32) showed more leaf rust Puccinia triticina than STB. There was 78% incidence of leaf rust on the F-5 compared to 15% incidence of STB on the same leaf, with severity respectively at 2.6% and 0.6% of the leaf area infected.

Leaf rust remained the dominant disease throughout the season, STB infection on F-2 reached a maximum of 2.2% severity and 31% incidence in the untreated control on the 12th October at flowering (GS61-69).

In all circumstances where there was a significant difference in disease severity and incidence as a result of cultivar, Revenue was inferior to Manning. Management strategy had a significant influence on disease levels and differed in effect between Manning and SQP Revenue. The levels of leaf rust in Manning were significantly lower than with SQP Revenue (figure 2a and 2b). Although the initial observations were positive shortly after grazing, it was not possible to demonstrate that grazing could successfully reduce leaf rust infection with the more susceptible cultivar SQP Revenue. At flag leaf emergence leaf rust control was clearly superior where two foliar sprays were applied compared to hard or lax grazing. With Manning, grazing plus one fungicide gave similar levels of leaf rust control to two foliar fungicides since the overall incidence of infection was much lower.

a) Manning



b) SQP Revenue

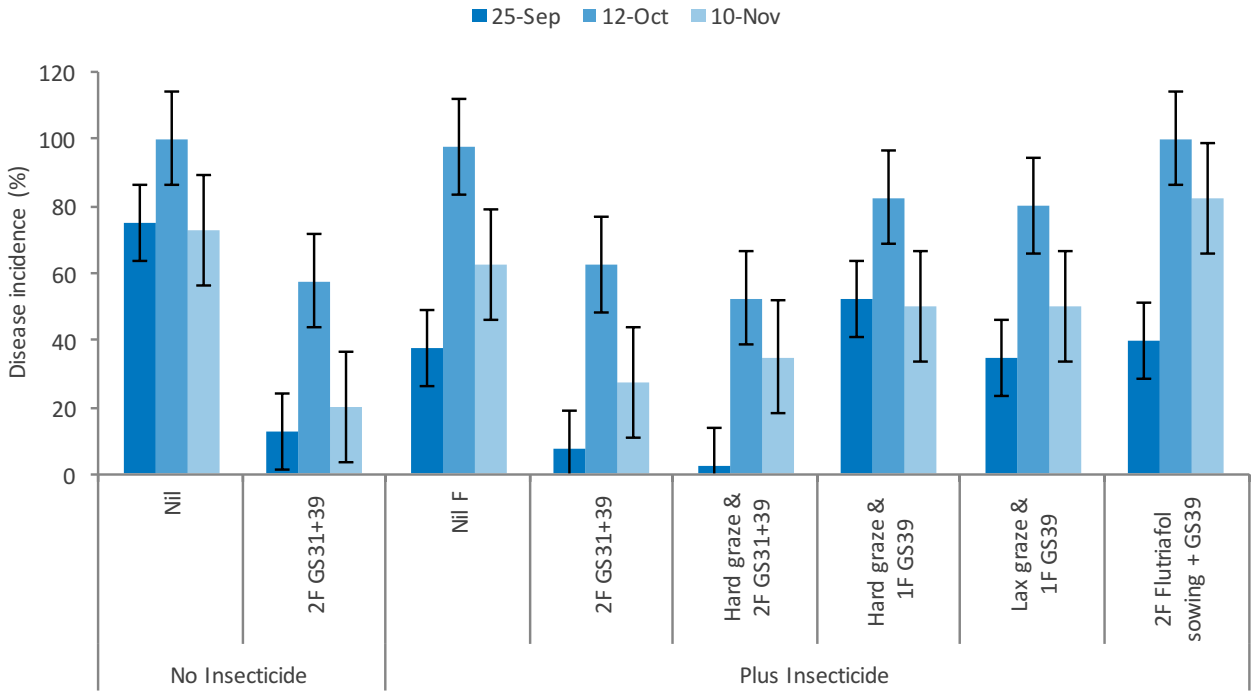


Figure 2a and 2b. Influence of management approach on incidence of leaf rust infection – cv Manning and SQP Revenue assessed on 25th September at flag leaf emergence (GS37-39), 12th October at flowering (GS61-69) and 10th November at early dough (GS83).

BYDV control

Unfortunately, with some variation in the plots due to other issues it was not possible to conclude that BYDV infection was higher in SQP Revenue than Manning, since it is known that the latter is more tolerant of BYDV damage.

Yield and Quality

Influence of cultivar on yield

The trial was harvested on January 8th 2016 (table 2). SQP Revenue was significantly higher yielding than Manning, SQP Revenue out yielding Manning by 1.35 t/ha when averaged over all the management strategies.

Influence of fungicide and insecticide

There was a significant interaction (p=0.0017) between cultivar and management strategy indicating that when left ungrazed SQP Revenue gave significant yield responses to a full fungicide programme and insecticide programme for BYDV control. In contrast Manning showed there was a significant effect of a two spray fungicide programme or BYDV control insecticide programme. When the effect of a full 2 spray fungicide programme and an insecticide programme were combined, SQP Revenue yield was maximised with a yield advantage of 0.94 t/ha over the ungrazed untreated control. With ungrazed Manning the combination of insecticide and a full fungicide programme did give a significant yield increase over the untreated control but the increase was only 0.39 t/ha. Managing disease in the ungrazed crop with flutriafol at sowing followed by a foliar fungicide was not as effective as applying two foliar fungicides with SQP Revenue or Manning, a result that correlates to lack of leaf rust control with the flutriafol option.

Influence of defoliation (simulated grazing) on yield

Provided a BYDV control programme and full fungicide cover was maintained with SQP Revenue, neither lax nor hard grazing reduced yield relative to the equivalent ungrazed crop, although there was a trend for yields to be lower. With Manning, grazing significantly improved yield when fungicide and insecticide cover were maintained. There were no significant effects of management strategy on grain protein only cultivar effects presumably associated with the yield advantage of SQP Revenue.

Table 2. Grain yield (t/ha) and grain protein (%)

Manning										SQP Revenue	
No.	Management Strategy			Yield		Protein		Yield		Protein	
	Defoliation	Fungicide	BYDV control	(t/ha)		(%)		(t/ha)		(%)	
1	Ungrazed	Untreated	Untreated	2.0	i	13.0	a	3.2	de	12.1	a
2	Ungrazed	2F at GS31 & 39	Untreated	1.9	i	13.6	a	3.8	abc	12.4	a
3	Ungrazed	Untreated	Treated	2.1	hi	13.0	a	3.7	bc	11.1	a
4	Ungrazed	2F GS31 & GS39	Treated	2.4	gh	12.5	a	4.1	a	11.8	a
5	Hard graze	2F GS31 & GS39	Treated	2.9	ef	11.6	a	3.9	ab	10.6	a
6	Hard graze	1F at GS39	Treated	2.6	fg	12.0	a	3.7	bc	10.5	a
7	Lax graze	1F at GS39	Treated	3.1	e	11.7	a	3.9	abc	10.7	a
8	Ungrazed	Flutriafol at sow plus 1F GS39	Treated	2.0	hi	13.0	a	3.5	cd	12.0	a
	Mean			**2.4**		**12.6**		**3.7**		**11.4**	
	LSD (p=0.05) management			0.3							
	LSD (p=0.05) cultivar			0.1							
	LSD (p=0.05) management x cultivar			0.4							
	P value (interaction)			0.0017							
	CV			8.9%							

WESTMERE RESULTS

To complement the Inverleigh work done under the Early Sown Wheat project, SFS set up two smaller trials at the Westmere trial site. They were based around the hypothesis which first arose in 2013 that grazing reduces STB infection, and ongoing work to combat the level of disease seen in SQP Revenue, the most commonly grown winter wheat in the western district.

Winter wheat often presents a grazing opportunity when sown early, and the thought that grazing can decrease disease pressure or even cut out a fungicide was the focus of the first trial sown to SQP Revenue at Westmere on the 16th April.

Disease scoring of STB at GS37 suggested that grazing caused a reduction in disease, however these differences were not

evident in the later season scores – which were primarily an assessment of the top three leaves (Flag, Flag-1 and Flag-2). The differing disease pressure seen early in the season did not correlate to yield, as shown in figure 3.

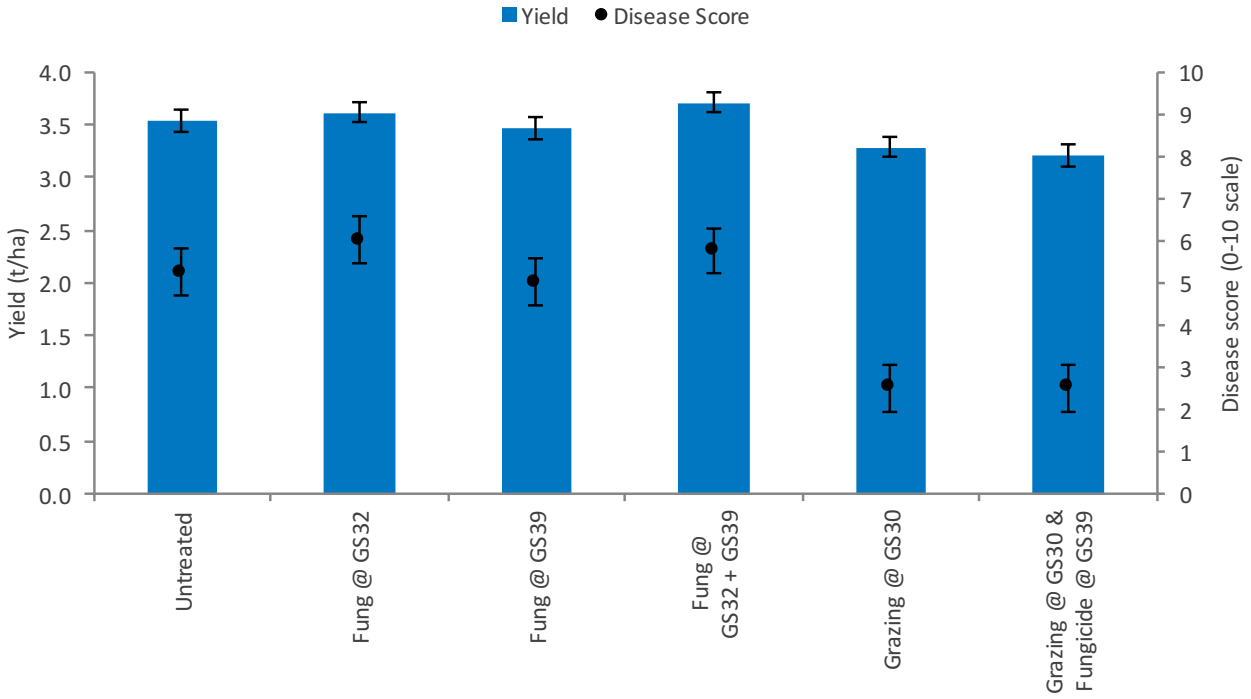


Figure 3. Yield and disease scores across the treatments. Yield: $p<0.001$, LSD ($p=0.05$) = 0.2 t/ha, Disease score: $p<0.001$, LSD ($p=0.05$) = 1.1.

Grazing resulted in a yield and protein penalty. With the hot and dry spring, the grazed crops were unable to recover the removed biomass by flowering (Figure 4), when compared to the ungrazed crop. The reduction in protein, albeit inconsequential given that SQP Revenue is classified a feed wheat, is thought to be the result of N removal in the grazed biomass which was not replaced with extra fertiliser N after grazing, although reduced root growth and N uptake following defoliation may have been a factor.

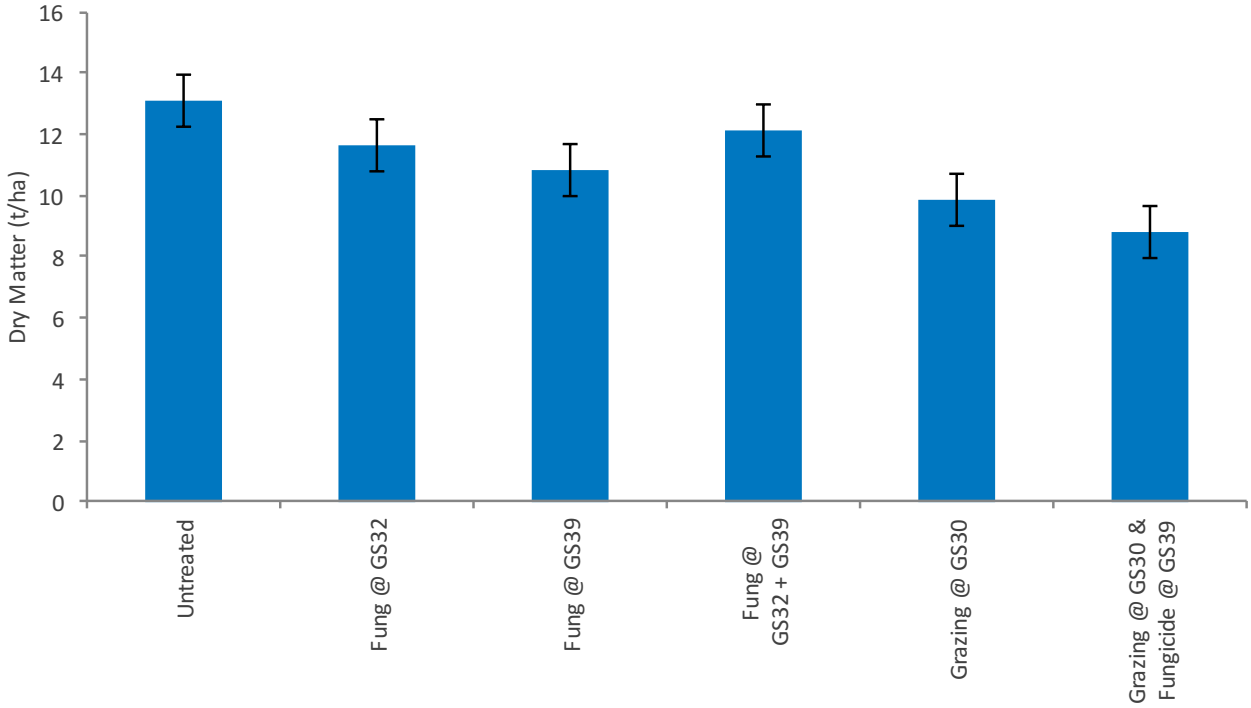


Figure 4. Influence of grazing and fungicide treatment on biomass recorded at anthesis $p=0.0008$, LSD ($p=0.05$) = 1.7 t/ha

Figure 5. Photo showing the degree of grazing conducted at GS30.

The grain yield penalty from grazing was 0.2 – 0.5 t/ha, however dry matter removed at grazing was in excess of 1.7 t/ha, at 5 c/kg dry matter, the total value of the dry matter grazed was $85/ha. With higher disease pressure, the STB control given by grazing may have been more significant.

CONCLUSION

Sowing true winter wheat cultivars in early April gives good grazing options pre GS30 (1.7-2.4 t/ha dry matter in 2015 trials), although there may be yield reductions if the post grazing period is dry (however it should be noted that in 2015 at the Inverleigh site grazing significantly increased the grain yield of Manning). Previous CSIRO/FAR/SFS research work has recorded benefits in STB control from grazing, in 2015 when leaf rust was more prevalent disease grazing was less effective at reducing disease levels and the need for an early foliar fungicide at GS31.

Sowing wheat early increases both disease pressure (STB and leaf rust) and the potential for BYDV infection caused by aphids. Results in 2015 illustrated that management of these two issues is an essential ingredient of success when sowing pre ANZAC day, particularly with SQP Revenue which is more susceptible to both STB and the leaf rust and less tolerant of BYDV infection than Manning. Although grazing has been observed to reduce disease pressure the effect cannot be relied upon when there is early leaf rust infection.

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