GRAZING SHEEP ON STUBBLES – CONDOBOLIN RESULTS 2009-10

Neil Fettell[1,2] and Ian Menz[1]
[1]Industry & Investment NSW, Condobolin Agricultural Research & Advisory Station, PO Box 300, Condobolin NSW 2877
[2]Agronomy and Soil Science, University of New England, Armidale NSW 2351

Key words
Grazing, stubble, soil water, infiltration, yield

Take home messages

- Grazing livestock can compact surface soil and reduce infiltration rates, but their biggest impact on fallow efficiency is through stubble removal.
- Stubble improves summer fallow efficiency primarily by increasing infiltration; it slows but does not stop evaporation, and this is only beneficial where rainfall events occur close together or if it aids crop establishment.
- Despite high rainfall during the 2009-10 fallow period at Condobolin, there was little response in soil water storage to the grazing and stubble treatments.
- Wheat yield in 2010 was reduced by very heavy grazing but not by moderate (more typical) grazing.

Background

Crop yields can be increased in low rainfall areas if more 'out of season' (fallow) rainfall is stored prior to seeding. No-till, controlled traffic systems are expected to improve water storage by increasing infiltration, reducing run-off and slowing evaporation. However, for mixed farmers, grazing crop stubbles can add to animal production and with the current high prices for lamb and mutton, livestock can be a major contributor to farm income. Grazing can also assist with summer weed control, which can be difficult and costly with herbicides when weeds are under water stress. In more intensive systems, grazing of winter crops is also economically attractive. Therefore, a key management decision for mixed farmers is whether to graze crops and crop stubbles and if so for how long and how intensively.

Past research has shown that stock apply similar pressures on the soil to unloaded vehicles. Treading by livestock can reduce soil porosity and infiltration rate, and increase soil bulk density and soil strength, although these effects are mainly in the soil surface (top 5-10 cm). Despite these effects, rarely have reductions in crop performance following grazing been reported in the literature, possibly because effects are too small in magnitude or depth to influence plant growth significantly. The risk of compaction can be reduced by removing stock during wet conditions and maintaining soil organic matter. Because compaction from livestock is shallow it may not be long-lasting and can be rectified by natural processes or tillage. However, tillage operations on soils compacted by livestock may require extra draught, which will increase fuel consumption.

A field trial have been established at Condobolin as part of the GRDC-supported Water Use Efficiency initiative to measure the impact of grazing within cropping systems on soil properties, water dynamics and crop yield.

Condobolin Trial

Methods

Eight treatments were imposed after the 2009 harvest on a paddock which carried just under 3 t/ha of wheat stubble. The soil is a typical clay loam and the site is relatively flat. There are eight treatments, each replicated four times, and the variables are;

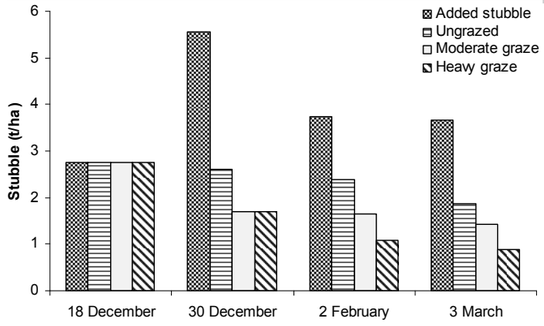
1. Grazing intensity, using adult sheep (nil, moderate, or heavy)
2. Stubble amount (as is, or added or removed depending on the season)
3. Weed control (all herbicide, or partly reliant on grazing).

Plots are relatively large and individually fenced. Fences are removed prior to seeding and all operations are conducted using commercial equipment and +/- 2 cm GPS guidance and controlled traffic. Treatments will be imposed on the same plots over four seasons. Regular measurements include stubble cover, soil water to 1.4 m (64 neutron tubes), infiltration capacity (drip infiltrometer), bulk density, soil strength, soil mineral nitrogen and crop growth and yield.

Results to date

Initial grazing treatments were imposed in December 2009, prior to any rain. Subsequent summer rainfall was well above average, and reduced the palatability and feed value of stubble after the first grazing. Weeds were controlled by herbicides in all treatments, following district practice in 2009-10. The amount of stubble remaining on the soil surface at each measurement date is shown in Figure 1. Additional stubble was added to one treatment to give over 5 t/ha. In the ungrazed plots, stubble levels declined slowly as a result of rainfall and subsequent breakdown, reaching 1.9 t/ha in early March. Grazing reduced stubble levels to 1.7 t/ha at the end of December and to 1.4 t/ha in March with moderate grazing and 0.9 t/ha for heavy grazing. The sheep flattened the remaining stubble and loosened the soil surface.

Figure 1. Changes in stubble cover during the 2009-10 summer at Condobolin



Soil water has been measured regularly using a neutron moisture meter and Table 1 shows the amount of water stored over the fallow period for each treatment. Rainfall over this period totalled almost 350 mm, well above average, resulting in significant water storage. While storage under the high stubble, ungrazed treatment appeared higher, none of the treatment differences were significant. Fallow efficiency averaged 36%, above common values, and likely a result of the rainfall being received in large falls. It is also possible that some water moved below the root zone as the 130-140 cm depth was close to the drained upper limit for an extended period. If so, this would have minimised treatment differences in soil water storage.

Table 1. Fallow water storage to 140 cm depth and grain yield responses to stubble level and grazing at Condobolin, 2009-2010

Treatment	Available water	Yield
	4 May 2010 (mm)	(t/ha)
Ungrazed, (2.6 t/ha stubble)	127	4.62
Ungrazed, (5.6 t/ha stubble)	135	4.72
Moderate graze (1.7 t/ha stubble)	123	4.69
Heavy graze (1.0 t/ha stubble)	122	4.40
LSD (P=0.05)	NS	0.16

The site was sown to Livingston wheat using a tined seeder with presswheels, and crop growth, water use and grain yield were measured. There was no yield difference between the two ungrazed stubble levels or from light grazing, where yield averaged 4.67 t/ha (Table 1). However, the heavily grazed treatment was significantly lower yielding at 4.40 t/ha. It also had a lower biomass but ear numbers and harvest index values were similar. The reason for the yield depression is not readily apparent. Crop establishment was similar (86 plants/m^2) for all treatments as was crop water use. Soil tests and grain protein measurements will be examined for possible nutritional effects.

Conclusions

These results support earlier research findings that light-moderate grazing of stubble by sheep is unlikely to be detrimental. Stubble can be beneficial for water storage, particularly where summer rainfall intensity is high, unstable soil surface structure results in low infiltration rates, and slopes are sufficient to encourage run-off. The minimum amount of cereal stubble required to minimise run-off (and hence water erosion) is thought to be around 2 t/ha or 70% cover. The moderate graze treatments in this trials had close to this level, whereas heavy grazing reduced the level to less than 1 t/ha for much of the fallow period. Stubble grazing should be managed to retain at least 2 t/ha of stubble, and can provide useful feed to stock while maintaining fallow efficiency and subsequent crop yields.

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