Minnipa farming systems competition - grain and graze barley

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RESEARCH

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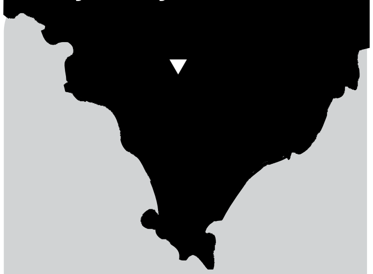

Location:
Minnipa Ag Centre
Rainfall
Av. Annual: 325 mm
Av. GSR: 241 mm
2011 Total: 404 mm
2011 GSR: 252 mm
Yield
Potential: 4.05 t/ha (B)
Paddock History
2010: Canola
Pre - 2010: Varied
Soil Type
Red sandy loam
Soil Test
Organic C%: 0.4-1
Plot Size
2.7 ha (split in half for grazed versus ungrazed treatments)
Yield Limiting Factors
Grazing
Livestock
Enterprise type: Self replacing merinos
Stocking rate: High (37 DSE/ha), low (27 DSE/ha)
Environmental Impacts
Soil Health
Soil structure: Stable
Compaction risk: Plus and minus grazing treatments
Perennial or annual plants: annual
Water Use
Runoff potential: Low
Resource Efficency
Energy/fuel use: Standard
Greenhouse gas emmisions (CO_2, NO_2, methane): Cropping and livestock
Social/Practice
Time (hrs): No extra
Clash with other farming operations: Standard practice
Labour requirements: Livestock may require supplementary feeding and regular checking
Economic
Cost of adoption risk: Low

Key messages

- **Depending on seasonal influence, stored soil moisture, soil nutrition, stocking rate management and correct timing (early tillering at growth stage (GS) 18-22, rather than later tillering at GS 24-28), grazing can be done with no detriment to crop yield.**
- **However, preceding paddock history had a significant impact on subsequent crop success and needs to be considered when planning future rotations.**

Why do the trial?

The Farming Systems Competition began in 2000 to compare the impact of four different management strategies on production, profitability and sustainability at the Minnipa Agricultural Centre. Comparative production and profitability were measured annually (EPFS Summary 2009, pg 120) and the soil health and sustainability after 10 years of competition were reported last year (EPFS Summary 2010, pg 103) at the completion of management from the 4 teams including; farmers, farm consultants, MAC research staff and district practice, each group being responsible for one paddock.

In 2010 we commenced the restoration of the competition paddocks to a common nutrition and disease level by sowing canola across all 4 paddocks. In 2011 barley was sown for the same purpose, which also provided the opportunity to measure the impact of early grazing with livestock as opposed to previous studies that have simulated grazing by mowing (EPFS Summary 2010, pg 136). This decision was based on comparing feed and sacrificial grain and graze opportunities (see below) of a 'dual purpose' crop with solely a grain crop that had no intent to introduce livestock for grazing.

- FEED: Sowing the cereal early as a pasture with the potential to remove stock and harvest grain if late winter and spring conditions are favourable (grazing is the main paddock use, grain harvest is the bonus) or;
- DUAL PURPOSE: Sowing the cereal with the full intention of harvesting grain but utilising it for livestock during early growth stages. The crop can put extra growth into its reproductive phase as there is reduced plant canopy during vegetative growth, reducing the impact of grazing (grain harvest is the main paddock use, grazing is the bonus) or;
- SACRIFICIAL: During the mid to late reproductive phase of the crop where there is a decreased likelihood of reaping a significant yield, the crop is grazed after maturity to fill the feed gap or short supply over summer.

How was it done?

Each 2.7 ha paddock was sown with Hindmarsh barley on 3 May 2011 @ 55 kg/ha with 60 kg/ha DAP. Each paddock had a grazed versus ungrazed section and a 'high' and 'low' stocking rate treatment was imposed on the grazed section with 2 replicates for each.

Figure 1 presents the trial design which shows the treatments and previous managers of the paddocks for reference to management history. For previous management histories see EPFS Summary 2009, pg 120. In this report, paddocks will be referred to as their corresponding letter i.e. A, B, C and D.

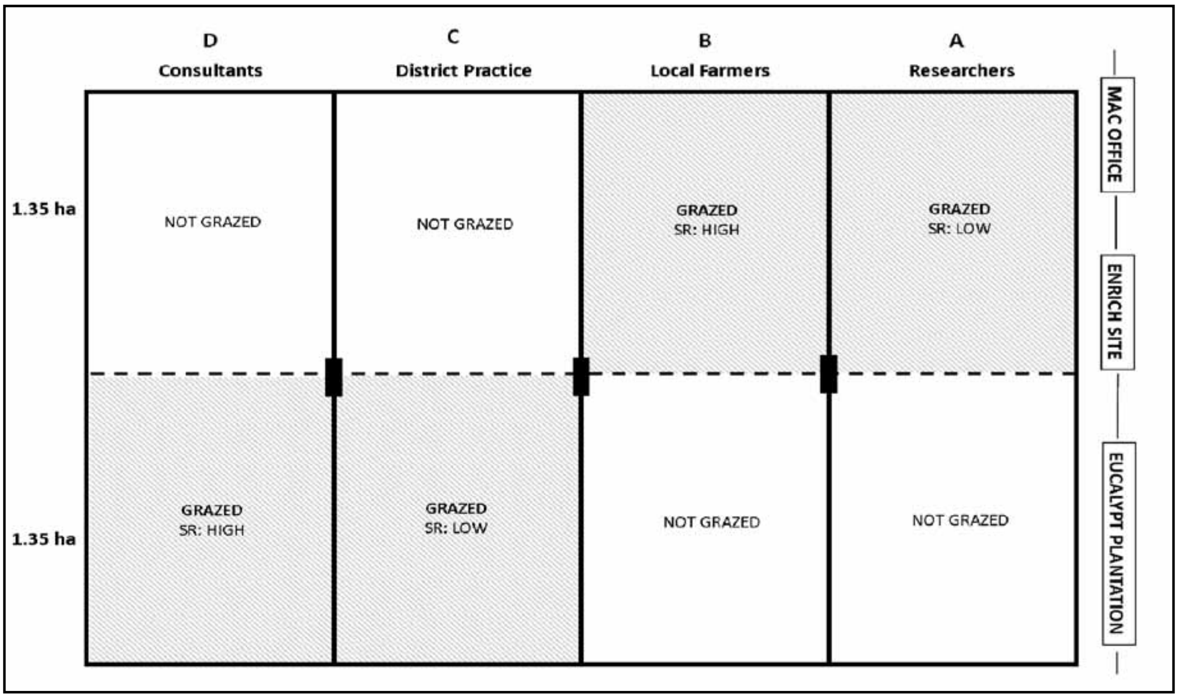

Figure 1 Competition paddock trial design for 2011 with names of the previous managers for paddock history

Plant counts and biomass samples (dry matter, DM) were taken from 12 x 0.1 m^2 quadrats across each section and dried at 70°C for 48 hours on 6 June and biomass was also measured on 28 June, just prior to the commencement of grazing. From the second biomass measurement, a feed test was taken to assist with calculating stocking rates for grazing. Ground cover measurements using a 1 x 1 m^2 quadrat were also conducted prior to grazing.

On the 28 June approximately 1 year old ewe hoggets began grazing the 1.35 ha section of each paddock that was split in half using an electric fence, as shown in Figure 1, at a 'high' stocking rate of 37 DSE/ha and at a 'low' stocking rate of 27 DSE/ha. To clarify, the 'high' and 'low' stocking rate treatments in the grazed sections of the paddock were thus named to simplify the treatment titles; it needs to be noted that both stocking rates are high for the Minnipa district.

These stocking rates were calculated according to feed on offer, crop growth rate, feed allowance for the stock class and crop to be left at the end of grazing using the MLA Stocking Rate Calculator http://www.mla.com.au/Publications-tools-and-events/Tools-and-calculators/Stocking-rate-calculator which is presented in Table 2 along with the total grazing days for each section. Sheep were removed from the paddock after approximately a week of grazing on 6 July and post-grazing ground cover and biomass measurements were taken.

Harvest occurred on 10 November and 10 x 0.1 m^2 cuts were taken in each section to measure dry matter, harvest index and a variety of grain properties including yield, test weight, screenings, protein, moisture and 1000 grain weight at each sampling point.

What happened?

The feed test reported acceptable levels for grazing young ewe hoggets with 14% dry matter, 34.2% crude protein (target is 16% for growing lambs), 38.3% neutral detergent fibre (target over 30%), 75% DOMD (digestibility) (75% required for production feeding) and 13.4 MJ ME/kg DM (11 MJ ME/kg DM required for young, quick growing lambs).

During the week of grazing, Minnipa had 17 mm of rain, which caused some slight damage in the paddocks with a high stocking rate as the sheep were trampling some of the crop. After grazing, Minnipa had 158 mm of growing season rainfall, which helped in the recovery of the barley. No fertiliser was applied post-grazing.

Table 2 Grazing calculations for high and low stocking rates in competition paddocks 2011

Treatment	HIGH	LOW
Paddock size	1.35 ha (2.7 ha split by electric fence x 4)	1.35 ha (2.7 ha split by electric fence x 4)
Crop daily growth rate	10 kg DM/ha/day	10 kg DM/ha/day
Feed allowance	1 kg DM/hd/day (10 MJ ME/kg DM)	1 kg DM/hd/day (10 MJ ME/kg DM)
Grazing period (15% spoilage)	7.04 (retaining 800 kg DM/ha)	9.65 (retaining 800 kg DM/ha)
Stock class and number	50 x 1 year old ewe hoggets	37 x 1 year old ewe hoggets
Stocking rate	37 DSE/ha	27 DSE/ha
Number of actual grazed days	7 days	8 days

ME = metabolisable energy

Table 3 Dry matter (DM kg/ha) for the competition paddock throughout the 2011 season

	Early DM	Pre-grazing DM	Post-grazing DM	Harvest DM
A (grazed)	562	1667	1211	7905
A (ungrazed)	423	1194	2042	8223
B (grazed)	398	1250	376	3414
B (ungrazed)	482	1083	1791	6159
C (grazed)	894	1146	748	7280
C (ungrazed)	786	832	1475	5794
D (grazed)	631	1079	558	4803
D (ungrazed)	697	1096	1946	6309

The biomass measurements that were taken throughout the period of crop growth are presented in Table 3. Paddock C had 2 sowing times due to a missed seeder width, which resulted in higher early biomass measurements, therefore grazing occurred at an earlier growth stage. The differences between the grazed and ungrazed sections were measureable at harvest with the grazed sections in paddocks A, B and D measuring less biomass than the ungrazed sections. Paddock C had an increase in biomass at harvest time in the grazed section, which is directly related to the yield results for the paddock also.

The previous variation in management strategies became a catalyst for diverse results between the paddocks after deciding to plant barley in the 2011 season. It soon became obvious that previous paddock history prevented the comparison between paddocks, therefore each of the four paddocks have been analysed separately.

Paddock A

Paddock yield in the grazed section measured only 0.5 t/ha lower than the ungrazed with the test weight also measuring slightly lower. Screenings were over 5% higher in the grazed section and protein was 0.2% higher.

Paddock B

The high stocking rate during grazing had a detrimental effect on yield and there was a 1.5 t/ha loss in yield in the grazed versus ungrazed section. Test weight was lower by over 4 kg/hL, screenings were almost 7% higher and protein was 0.3% lower in the ungrazed section.

Paddock C

Grazing at a 'low' stocking rate was favourable for paddock C, measuring a 1 t/ha higher yield in the grazed compared to the ungrazed section. Test weight was 2.4 kg/hL higher and there was 1.6% less screenings in the grazed section. The only unfavourable result from the grain sample in the grazed area was a 1% decline in protein.

Paddock D

There was a 0.7 t/ha yield loss in the grazed compared to the ungrazed section in paddock D from the high stocking rate. Test weight was 0.8 kg/hL lower and protein was 0.4% lower after grazing, with screenings 0.8% higher in the ungrazed area.

What does this mean?

Paddock history had a big impact on yield differences across paddocks and was a contributing factor to treating each paddock as a separate trial.

Paddock A

This paddock has a history of good soil nutrition due to both sown and self-regenerating medic in 3 out of the past 6 years of rotation, resulting in higher levels of soil N. This is represented in the higher protein percentage in the sample than other paddocks and may have contributed to lower grain weight and higher screenings. The reasonable levels of N in the soil assisted plant recovery after grazing, resulting in minimal yield loss in the grazed section of the paddock. The 'low' stocking rate and even grazing minimised crop damage and allowed the barley to compete well against emerging weeds.

Lodging in the ungrazed section was a major issue at harvest time and resulted in significant loss of barley heads; visually the grazing helped overcome this problem and the barley was standing more upright in the grazed section of the paddock.

Table 4 Grain sample figures for the competition paddock in the 2011 season

	Yield (t/ha)	Test weight (kg/hL)	Screenings (%)	Protein (%)	1000 Grain weight (g)
A (grazed)	3.2	62.3	16	12.8	34.0
A (ungrazed)	3.7	64.5	10.9	12.6	36.4
B (grazed)	1.7	62.7	7.6	10.4	36.1
B (ungrazed)	3.2	66.9	0.7	10.1	43.1
C (grazed)	3.9	67.4	3.6	10.3	39.0
C (ungrazed)	2.9	65.0	5.2	11.3	39.0
D (grazed)	2.7	66.6	1.3	9.8	40.6
D (ungrazed)	3.4	67.4	2.1	10.2	41.9

Paddock B

After a cereal rotation in this paddock in 4 out of the last 5 years, the grass weed burden became a significant issue in the 2011 crop. A wet period during the week of grazing exacerbated the problem due to the 'high' stocking rate on the grazed section of the paddock, which led to vast crop damage caused by sheep trampling the crop. Following grazing, the competition from the weeds impacted considerably on plant growth, resulting in a substantial yield penalty. The size and weight of the grain was also negatively impacted by the grazing and weed burden. Again, lodging was an issue for the ungrazed section of the crop.

Paddock C

The dissimilar results from the grazed section of Paddock C compared to the other paddocks were due to a combination of grazing at an earlier crop stage due to a missed pass at sowing time, a lower stocking rate and a conservative rotation history. Unlike the other paddocks, the grain yield was higher in the grazed section and test weight and screenings were also more favourable after grazing. Almost half of the crop (the missed seeder pass) was grazed at a more recommended growth stage during early tillering with the other half of the barley and other paddocks closer to late tillering. The 'low' stocking rate of the paddock caused less trampling than the higher stocking rate and allowed time for a vigorous crop recovery before weeds could become an issue. A conservative approach in 'district practice' rotations created a catalyst for sound soil nutrition. The lodging issue in the ungrazed section of the paddock added to the lower yield in the ungrazed section of the paddock.

Paddock D

The loss in yield in the grazed section of Paddock D can be attributed such a high stocking rate and grazing at a later growth stage than originally anticipated. Competition from weeds after grazing also caused the barley to struggle during recovery. A variety of past paddock rotations meant that soil nutrition was stable, resulting in an average yield in the ungrazed section with lodging again presenting itself as an issue with the loss of grain heads on the ground, especially at harvest.

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