The impact of livestock on paddock health

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RESEARCH

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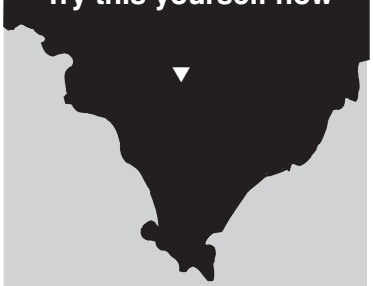

Location: Minnipa Ag Centre

Rainfall
Av. Annual: 324 mm
Av. GSR: 241 mm
2013 Total: 334 mm
2013 GSR: 237 mm
Yield
Potential: 2.5 t/ha (W)
Actual: 2.1 t/ha
Paddock History
2012: Medic pasture
2011: Wheat
2010: Medic pasture
2009: Wheat
2008: Wheat
2007: Wheat
Soil Type
Red sandy loam
Soil Test
Organic C%: 1.2
Phosphorus: 18 - 34 mg/kg
Plot Size
3.5 ha
Yield Limiting Factors
Nil
Livestock
Enterprise type: Self replacing merinos
Stocking rate: Rotational grazing and district practice
Environmental Impacts
Soil Health
Soil structure: Stable
Compaction risk: Plus and minus grazing treatments
Ground cover or plants/m^2: Grazed to 1 t/ha pasture residue
Perennial or annual plants: Annual
Grazing Pressure: High (1.5 DSE/winter grazed ha) and medium (0.75 DSE/winter grazed ha)
Water Use
Runoff potential: Low
Resource Efficiency
Energy/fuel use: Standard practice
Greenhouse gas emmisions (CO_2, NO_2, methane): Cropping & livestock

Key messages

- **There has been no measured grain production or soil health decline associated with grazing sheep on pastures and crop stubbles over a 4 year pasture-wheat rotation.**
- **Grain yields were higher as a result of increased wheat seed and fertiliser rates in 2013.**
- **Higher applied crop seed and fertiliser rates with an improved medic pasture increased estimated gross margins by $16/ha/annum over a 6 year wheat-wheat-pasture-wheat-pasture-wheat rotation.**

Why do the trial?

A trial was established on Minnipa Agricultural Centre in 2008 to test whether soil fertility and health could be improved under a higher input system (e.g. higher fertiliser and seeding rates, establishment of improved pasture) compared to a lower input and more traditional system (district practice seed and fertiliser inputs, volunteer pasture). The six year (2008-2013) rotation of: wheat, wheat, pasture (volunteer and sown annual medic), wheat, pasture (annual medic – self regenerating) and wheat, was also split into grazed and un-grazed treatments in both the high and low input systems to establish the relative impact of grazing.

How was it done?

In 2008, a 14 ha red sandy loam (pH_{CaCl} 8) portion of a paddock on MAC was divided into four 3.5 ha sections. Each section represented a system treatment: Traditional - grazed, Traditional – un-grazed, High input – grazed and High input – un-grazed. The pasture and grazing treatments were not imposed until 2010. Four sampling points were selected and marked as permanent sampling points in each section. Data presented for each treatment are a mean of the four selected permanent points in each section.

In 2013 the trial was sown to Mace wheat on 5 May at 50 kg/ha with 7 kg N/ha and 8 kg P/ha (45 kg/ha DAP) and 70 kg/ha with 13 kg N/ha and 15 kg P/ha (75 kg/ha DAP) for the traditional and high input treatments respectively. See EP Farming Systems Summary 2012 p 92 for 2012, pasture performance and 2011, p 113 for 2008 - 2011 crop and pasture inputs. Weed control was imposed on all treatments as required in both summer and during the growing season.

Sampling for pre-seeding soil water content and chemical analysis was completed on 16 April. Plant establishment counts were taken on 25 June followed by a biomass sampling, both from 3 x 1 m rows (1 m^2), taken prior to grain harvest on 4 November. Post harvest soil water contents were collected on 5 November.

What happened?

Soil fertility was estimated prior to seeding in each year of the study. Table 1 presents the 2011, 2012 and 2013 phosphorous, total organic nitrogen and soil organic carbon results. Residual Colwell P levels were similar or trended lower following annual medic in 2012 when no P was applied. 2013 residual mineral N figures suggest there was a greater increase from the 2012 annual medic phase of the rotation in response to grazing compared to not grazing. Soil organic carbon contents are showing no evidence of a separation as a result of high or low inputs, grazing or not grazing.

Social/Practice
Time (hrs): No extra
Clash with other farming operations: Standard practice
Labour requirements: Livestock may require supplementary feeding and regular checking
Economic
Infrastructure/operating inputs: High input system has higher input costs
Cost of adoption risk: Low

An accurate assessment of the soil chemical and organic carbon response to the treatments imposed requires a statistical analysis with time (years) as a third factor, with treatment and replicate, at the completion of study.

To measure grain production in 2013 an experimental plot harvester reapt four 1.8 x 9 m plots at the four permanent points in each section. Table 2 presents the 2013 grain data and the estimated water use efficiency figures.

The two high input treatments produced similar biomass, similar or more plants, more wheat heads and higher grain yields than the un-grazed traditional treatment. The high input grazed treatment produced higher protein content than both the low input traditional treatments, screening percentages were similar.

Table 1 Colwell P (mg/kg 0-10 cm), total mineral nitrogen (kg N/ha 0-60 cm) and soil organic carbon (%, 0-10 cm) in April 2011, 2012 and 2013 following annual medic, wheat and annual medic respectively

System	Colwell P (mg/kg)			Total mineral nitrogen (kg/ha)			Soil organic carbon (%)		
	2011	2012	2013	2011	2012	2013	2011	2012	2013
Traditional - grazed	41	34	34	134	64	111	1.2	1.3	1.3
Traditional - un-grazed	29	30	27	99	59	84	1.1	1.0	1.2
High input - grazed	23	23	18	119	72	118	1.1	1.2	1.2
High input - un-grazed	34	30	22	84	60	74	1.1	1.2	1.1

Table 2 Plant establishment (PE, plants/m^2), biomass yield (DM, t/ha), grain heads (numbers/m^2), grain yield (t/ha), protein content (%), screenings (%) and water use efficiency (WUE, kg/ha/mm of plant available water)

System	PE (plts/m^2)	DM (t/ha)	Heads (#/m^2)	Yield (t/ha)	Protein (%)	Screenings (%)	WUE (kg/ha/mm)
Traditional - grazed	127	5.3	208	1.9	10.3	5.6	15
Traditional - un-grazed	124	5.4	221	1.8	10.3	4.7	14
High input - grazed	175	6.3	262	2.1	11.2	6.3	16
High input - un-grazed	158	6.1	256	2.1	10.8	5.6	16
LSD (P=0.05)	*33.7*	*ns*	*35.7*	*0.24*	*0.66*	*ns*	

Estimated water use efficiency in 2013 was correlated with yields with each treatment having similar available water.

What does this mean?

In 2011 there was a wheat yield benefit as a result of the grazing of both the sown and self-regenerated traditional medic based pastures in 2010, when compared to the un-grazed sown and self-regenerated medics. This may have been due to the higher total soil N levels measured pre-seeding in 2011. There was also a yield benefit in response to the high input treatments (high seed and fertiliser inputs, improved pasture, EPFS Summary 2011, p 113). In 2012 the self-regenerating, 2010 sown high input medic pasture reduced competing annual grass, increased biomass production and carried double the stocking rate, compared to a volunteer self-regenerating medic pasture (EPFS Summary 2012, p 92).

In 2013 the higher grain yields from the high input treatments, compared to the un-grazed traditional system, can only be credited to the 2013 inputs. Neither the grazing nor the observed increased N levels or reduced grass populations resulting from the grazing in 2012 had any yield or protein content response, as was the case in 2011.

The soil organic carbon % may be trending higher but even if this is shown to be correct in the fullness of time, this may only be a response to seasonal conditions and best practice agronomic and livestock management. If the trial continues in a new phase of Grain and Graze a heavier grazing regime on both stubbles and pastures may provide some insights into the soil organic carbon content movements in response to more intensive mixed farming systems.

Economically the high crop and pasture input treatments have produced an extra 1 t/ha of wheat from 4 crops in 6 years, irrespective of being grazed or un-grazed. The value of the extra grazing is reliant on the stocking rate and available growing season pasture area, i.e. there is no benefit unless there is a feed deficit under the current stocking rate requiring handfeeding in the winter/spring period when annual medic is productive. The cost/ha has been an extra 120 kg of DAP ($80), 80 kg of seed wheat ($20) plus the pasture establishment ($40) giving a 6 year increased gross margin of approximately $100/ha plus any increased livestock returns (assuming a wheat price of $240/t).

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