The impact of livestock on paddock health

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RESEARCH

Searching for answers

Location: Minnipa Ag Centre
Rainfall
Av. Annual: 325 mm
Av. GSR: 241 mm
2011 Total: 404 mm
2011 GSR: 252 mm
Yield
Potential: 3.65 t/ha (W)
Actual: 2.04 t/ha (B)
Paddock History
2010: Medic pasture
2009: Wheat
2008: Wheat
2007: Wheat
Soil Type
Red sandy loam
Soil Test
Organic C%: 0.77
Phosphorus: 12.54 mg/kg
Plot Size
8 sowing widths across paddock
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 2 t/ha pasture residue
Perennial or annual plants: Annual
Grazing Pressure: High (8 DSE/ha) and medium (3 DSE/ha)
Water use
Runoff potential: Low
Resource Efficiency
Energy/fuel use: Standard
Greenhouse gas emissions (CO_2,NO_2, Methane): Cropping and livestock

Key messages

- **Grain yields increased with higher crop inputs and following grazing, they were further improved following a sown legume pasture and a more intensive grazing system.**
- **There has been no measured change in soil organic carbon over the 4 year project as a result of varying crop and pasture inputs or grazing compared to not grazing crop stubbles or pastures.**

Why do the trial?

A well run mixed farming enterprise of cropping and livestock can be as profitable as a continuous cropping business for most districts across Eyre Peninsula, but carries less risk, as shown by a profitability analysis in the Eyre Peninsula Grain & Graze and Farming Systems projects. However, as livestock graze they remove plant biomass which would otherwise have been ground cover, then decomposed into the soil and thus contributed to the carbon pool.

In high rainfall areas the benefits of retaining stubble have been shown to improve soil carbon levels and microbial health. In low rainfall areas stubble retention helps reduce erosion and can help plant establishment in poor moisture conditions at sowing. However, in an environment where biomass production, soil moisture and microbial activity levels are lower, a clear relationship between stubble retention and soil health is still to be established. Value adding to stubbles by grazing is usually regarded to be of greater economic value.

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 compared to a lower input and more traditional system. The four year (2008-2011) wheat, wheat, pasture (annual medic), wheat rotation was also split for plus and minus grazing in both the high and low input systems to establish the impact of grazing between the two treatments.

How was it done?

In 2008 a 14 ha, red sandy loam (pH 7.7, CaCl) portion of a paddock on Minnipa Agricultural Centre was divided into 4 x 3.5 ha sections. Each section represented a system treatment:

- Traditional - grazed
- Traditional - ungrazed
- High input - ungrazed
- High input - grazed

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. Table 1 presents the seed and fertiliser inputs over the 4 years. Weed control was imposed on all treatments as required in both summer and during growing season; broad-leaved weed control in the wheat, selective grass control in the medic.

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

What happened?

Soil for chemical analysis by CSBP soil testing laboratory was collected prior to seeding at five sites surrounding the four selected permanent points in each section. Table 2 presents the initial 2008 and subsequent 2010 and 2011 phosphorous, total nitrogen and soil organic carbon results.

2010 soil analysis figures indicate there has been a declining trend in residual P or N contents over the 2008 and 2009 seasons. However the 2011 results suggest increased total N contents in response to the 2010 medic pasture, with increased additions in response to the 2010 high input grazed medic treatment. Soil organic carbon levels have remained constant in study to date.

Table 1 Crop and pasture variety, seeding rate (kg/ha), phosphorus and nitrogen (units N & P/ha) applied to the traditional and high input systems, sowing dates and annual and growing season rainfall totals (mm) over the 4 year rotation

Variable	Systems	2008	2009	2010	2011
Crop variety		Wyalkatchem wheat	Angel medic	Wyalkatchem wheat	Wyalkatchem wheat
Rainfall (mm)	Annual	251	421	410	402
	Growing season	139	333	346	252
Sowing date	All treatments	19 May	7 May	22 April	9 May
Seeding rate (kg/ha)	Traditional	50	50	0	50
	High Input	70	70	5	70
N & P (kg/ha)	Traditional	7N, 8P	7N, 8P	0	7N, 8P
	High Input	25N, 12P	25N, 12P	6N, 7P	13N, 15P

Table 2 Colwell P (mg/kg 0-10 cm), total mineral nitrogen (kg N/ha 0-60 cm) and soil organic carbon (SOC%, 0-10 cm) in 2008, 2010 and 2011

System	Colwell (mg/kg)			Total mineral nitrogen (kg/ha)			Soil organic carbon (%)		
	2008	2010	2011	2008	2010	2011	2008	2010	2011
Traditional - grazed	32	25	41	83	93	134	1.2	1.1	1.2
Traditional - ungrazed	32	25	29	109	51	99	1.2	1.0	1.1
High input - ungrazed	29	25	34	107	50	84	1.2	1.0	1.1
High input - grazed	22	17	23	92	54	119	1.1	1.2	1.1

Table 3 Grain yield (t/ha) in the cereal phases of the wheat-wheat-pasture-wheat rotation and water use efficiency (kg/ha/mm of plant available water) in 2011

	Grain Yield* (t/ha)			WUE (kg/ha/mm of H_20)
System	2008	2009	2011	2011
Traditional - grazed	0.2	4.0	2.0[b]	13.5
Traditional - ungrazed	0.2	4.1	1.7[c]	11.9
High input - ungrazed	0.3	4.4	2.1[b]	14.4
High input - grazed	0.3	4.5	2.4[a*]	16.2
LSD (P=0.05)			*0.24*	

**Different letters indicate significant differences LSD P=0.05*

In 2008 and 2009 grain yields were collected by yield monitor data from a 9 m commercial harvester at the four selected points in each section. In 2011 an experimental plot harvester harvested two 1.8 x 9 m plots at the four permanent points in each section. Table 3 presents the grain yield data for the 2008, 2009 and 2011 wheat crops and the estimated water use efficiency figures for 2011.

Grain yields were higher in response to increased seeding rates and/or fertiliser inputs in 2008, 2009 and 2011, grazing in 2010 also increased 2011 yields. Estimated water use efficiency in 2011 was directly correlated with higher yields with each treatment having similar available water. Wheat grain protein content did not differ significantly between treatments; the averages were 14.3, 9.7 and 10.2% respectively in 2008, 2009 and 2011.

Pasture biomass was collected in 2010 from 5 x 0.1 m^2 quadrats sited at each of the 4 permanent points in each section. Table 4 presents the annual pasture biomass, grazing pressure and stocking rate on the 2010 medic pasture.

Table 4 Annual pasture biomass in September following August grazing, grazing days imposed in March, August and November and total annual stocking rate (DSE/ha) in 2010

System	Biomass (t DM/ha)	March (DSE)	August (DSE)	November (DSE)	Annual DSE/ha
Traditional - grazed	1.8	200[1]	120[3]	750[5]	3
Traditional - ungrazed	3.9				
High input - ungrazed	4.9				
High input - grazed	3.8	200[2]	1200[4]	1500[6]	8

[1]40 days grazing with 5 sheep @ 1 DSE, [2]7 days grazing with 28 sheep @ 1DSE, [3]14 days grazing with 7 sheep @ 1.2 DSE, [4]14 days grazing with 70 sheep @ 1.2 DSE, [5]21 days grazing with 24 sheep @ 1.5 DSE and [6]21 days grazing with 48 sheep @ 1.5 DSE

The food on offer in September represents the utilisation through grazing and the comparative recovery capability of the volunteer self-regenerating (traditional) and sown (high input) medic pastures. The sown medic pasture carried more than double the stocking rate of the volunteer self-regenerating medic pasture.

What does this mean?

Higher grain yields were measured in 2008 and 2009 in response to a higher seeding rate and phosphorus and nitrogen applications. In 2011 there was a wheat yield benefit measured as a result of the grazing of both the sown and self regenerated medic based pastures in 2010, when compared to their ungrazed sown and self regenerated medics. This benefit was considered to be due to the increased total soil N levels measured pre-seeding in 2011. It could not be attributed to increased water access as soil water content measurements taken before seeding were similar in each section. There has been no measured change across sections in soil organic carbon levels after 3 seasons of below (1 year) and above (2 years) average growing season and annual rainfall.

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