Dryland Legume Pasture Systems: Grazing trial

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Location
Minnipa Agricultural Centre, paddock S8
Rainfall
Av. Annual: 324 mm
Av. GSR: 241 mm
2019 Total: 254 mm
2019 GSR: 234 mm
Paddock history
2018: Various legume species or Scepter wheat
2017: Scepter wheat
2016: Medic pasture
Soil type
Red sandy loam
Soil test
$pH_{(H20)}$ (0-10 cm) 8.4
Plot size
2 hs x 3 reps

Key messages

- **Pasture legumes sown in 2018 were allowed to regenerate in 2019 and were grazed with ewe hoggets.**
- **Sheep live-weight increased on average by 13.8 kg (+26%, ~180 g/day) and was similar for all legume treatments, but differences between the sown legumes may have been masked by volunteer pasture species in the plots.**
- **Sown legume intake ranged from 401 kg/ha (*Trigonella balansae*) to 1461 kg/ha (Harbinger medic). Sheep showed some grazing preference for medic over trigonella.**
- **The site will be sown with wheat in 2020. Crop growth, grain yield and quality will be measured. Stubbles will be grazed. It will return to pasture in 2021.**

Why do the trial?

In southern Australian mixed farming systems, there are many opportunities for pasture improvement. The Dryland Legume Pasture Systems (DLPS) project aims to boost profit and reduce risk in medium and low rainfall areas by developing pasture legumes that benefit animal and crop production systems. A component of the DLPS project aims to quantify the impacts of different pasture legume species on livestock production and health. Included are widely grown legumes (strand medics and vetch) and legumes with reasonable prospects of commercialisation (trigonella).

A five-year grazing system trial was established at the Minnipa Agricultural Centre (MAC) in 2018. It is the main livestock field site for the DLPS program in southern Australia.

How was it done?

The large-scale (36 ha) grazing system experiment was established in paddock South 8 at MAC in July 2018. The trial, which consists of six treatments, is arranged in a randomised block design with three replications. The treatments are: Scepter wheat (Control 1; wheat measurements not until 2020); Volga vetch (Control 2), locally sourced harbinger strand medic; PM-250 strand medic with powdery mildew resistance and SU herbicide tolerance; SARDI rose clover; and *Trigonella balansae*, a new aerial-seeded legume closely related to medic. Each 'plot' is 2 ha in size, to allow grazing during pasture phases and on stubbles after harvest in cropping years. Four set sampling points are located within each plot to facilitate consistent pasture measurement over time. Because poor seasonal conditions limited legume growth and the priority was to optimise legume seed set, the plots were not grazed in 2018. Legume dry-matter (DM) production, seed set, nitrogen (N)-fixation and nutritive value (at maximum biomass) were measured.

The pasture treatments were allowed to regenerate in 2019. The trial was rolled with a light steel roller a week after a 10 mm rainfall event on 30 April 2019 to ensure sufficient seed to soil contact, which was followed up by 15.8 mm in the 24 hours following rolling. The vetch and cereal treatments were re-sown on 4 and 16 May respectively, in line with the planned rotation sequence below:

- 2018 pasture establishment year (aim to maximise seed set)
- 2019 pasture allowed to regenerate (monitor regeneration, graze, measure livestock production)
- 2020 wheat (measure crop yield and quality, graze stubbles)
- 2021 pasture allowed to regenerate (monitor regeneration, graze, measure livestock production)
- 2022 assessment of pasture regeneration.

Soil sampling for water content, basic nutrition, nitrogen and soil borne disease tests was completed on 4 May.

Total rainfall received for April at Minnipa was 11 mm, with May recording 57 mm and June 56 mm, providing a good start to the 2019 season. Plant emergence counts were completed between 21 and 29 May 2019.

On 29 July, eight 1-year-old ewe hoggets (equivalent to current district practice of 7 DSE/ha) were introduced into each treatment paddock after weighing and condition scoring. Four grazing exclusion cages (1 m x 1 m) were placed in each 2 ha plot (treatment) area. Pasture biomass cuts were taken within and outside the cages to enable the estimation of feed on offer (FOO), pasture DM production and composition (sown legume content and volunteer species, the latter comprising mostly naturalised medic). Pasture intake by the sheep was calculated as the difference in DM within and outside the exclusion cages. Livestock weights and pasture production were measured when the sheep were introduced (29 July) and then on 26-27 August and 3 October. Legume samples are still being processed to determine nutritive value, N-fixation level and seed production for 2019.

What happened?

2018

Legume production, N-fixation and nutritional results for the 2018 season are shown in Table 1. Vetch was the most productive legume. It produced double the DM of PM-250 medic and SARDI rose clover. Rose clover fixed the least N (10%) and had the lowest DMD and crude protein. Vetch had the highest N-fixation percentage (72%) and fixed most shoot N (21 kg/ha).

Despite a late start to the season and below average rainfall (150 mm GSR), each of the pasture species set a large number of seed/m^2 in the absence of grazing (Table 1).

The legume treatments did not significantly affect volumetric soil water content at the end of the season. Soil N results are pending.

2019

The pasture legumes differed in their regeneration density (295 to 757 plants/m^2), but were generally satisfactory (>500 plants/m^2) (Table 2). Vetch density was lower, but adequate for this larger seeded legume.

No significant differences were measured for FOO, pasture production or intake. At the commencement of grazing, FOO ranged between 1963 kg DM/ha (PM-250 medic treatment) and 1086 kg DM/ha (rose clover treatment) with volunteer pasture components (mainly naturalised medic) comprising on average 24% of the total DM (data not shown). All legume treatments had flowered by mid-August, with growth noticeably slowing due to low rainfall in that month (19 mm). Total pasture production to 3 October ranged between (3153 kg/ha, 73% vetch) and (1920 kg DM/ha, 95% Harbinger medic) (Table 2). Intake of the sown legume component ranged between 1461 kg DM/ha (Harbinger medic) and 401 kg DM/ha (*Trigonella balansae*).

No significant (P=0.3) treatment differences in livestock performance were measured. Sheep weight increased by between 26% and 30% (Table 2) and condition scores remained stable (data not shown).

Pastures

Table 1. Pasture herbage and seed production, N-fixation, nutritive value for five legumes grown at Minnipa in 2018.

Legume	DM Prod'n (kg/ha)	Seed Prod'n (#/m^2)	Nitrogen fixation (%)	Nitrogen fixed (kg/ha)	DMD (%)	Crude protein (%)
Volga vetch	1297	9	72	21	68	14
Trigonella balansae	744	8208	49	11	67	19
SARDI Rose clover	541	6621	10	1	63	14
Harbinger medic	822	7639	45	9	66	18
PM-250 medic	514	4177	54	8	69	20
LSD (P=0.05)	*134*	*237*	*12*	*2*	*1.3*	*1.1*

Table 2. Legume regeneration density, total and sown legume DM production, total and sown legume intake and sheep live-weight, for five legume treatments at Minnipa in 2019.

Treatment	Sown legume density (plants/m^2)	Total production (kg/ha)	Sown legume production (kg/ha)	Total Intake (kg/ha)	Sown legume intake (kg/ha)	Sheep weight 29 July (kg)	Sheep weight 10 Oct. (kg)	Weight change kg (% gain)
Volga vetch	95	3153	2315	2014	1295	50.4	65.0	14.6 (30)
Trigonella balansae	551	2375	1572	941	401	51.5	66.0	14.5 (29)
SARDI Rose clover	295	2584	1466	1917	1116	50.3	63.3	13.0 (26)
Harbinger medic	635	1920	1902	1474	1461	49.3	63.2	13.8 (28)
PM-250 medic	757	2065	1721	1469	1398	50.4	63.5	13.1 (27)
LSD (P=0.05)	*93*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*

What does this mean?

Sheep weight increased in all treatments, with an average gain of 14 kg/head at the end of the 73 day grazing period. A good quantity and quality of feed supported rapid growth as the animals matured as hoggets. No adverse effects of the different legume treatments on sheep performance were measured or observed. Vetch was the most productive legume in both years and fixed most N in 2018. It is the best option where a sown legume of one year duration is preferred, but comes with a higher input cost as it needs to be sown each season, whereas ley pasture species self-regenerate.

Observation of the standing feed in late September indicated limited grazing of trigonella after flowering and overall the intake of this species was least (401 kg/ha) and final FOO highest (1434 kg/ha) compared to the other legumes. However, this was not reflected in sheep performance, probably because volunteer pasture species, mainly naturalised medics, contributed significantly to total pasture production (34% of DM in the trigonella treatment) and provided the sheep with an alternative feed source. The avoidance of mature trigonella by sheep may allow it to achieve higher seed yields under grazing, but in a pure sward this aspect may equally limit sheep production.

A benefit of medic PM-250, which is scheduled for commercial release in 2021, is its powdery mildew tolerance. Powdery mildew was not observed in 2019. Reports suggest that where susceptible medics are affected by powdery mildew, grazing by sheep is reduced. In the presence of powdery mildew, the production of PM-250 has previously been found to be up to 49% greater, compared to susceptible medics. PM-250 is also expected to be more palatable to sheep in years where conditions are conducive to the development of powdery mildew. PM-250 is also tolerant of SU and Intervix herbicide residues whereas the other legume cultivars are not.

The site will be cropped with wheat in 2020. If differences in N-fixation measured in 2018 were similar in 2019 (results pending), then effects on crop performance are anticipated. The site will be allowed to regenerate to pasture in 2021. This will provide critical information on the persistence of the sown legumes through the cereal crop and provide the opportunity for further grazing studies.

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