Dryland Legume Pasture Systems: pasture demonstration sites

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Location
Lock
Rainfall
Av. Annual: 340 mm
2020 Total: 322 mm
2020 GSR: 277 mm
Paddock history
2019: Medic
2018: Wheat
Soil type
Sandy loam
Plot size
2 m x 25 m x 2 reps

Location
Wirrulla
Rainfall
Av. Annual: 375 mm
2020 Total: 315 mm
2020 GSR: 293 mm
Paddock history
2019: Medic
2018: Wheat
Soil type
Calcareous grey sandy loam
Plot size
2 m x 25 m x 2 reps

Key messages

- **Grain protein, but not grain yield was significantly affected by the type of pasture legume previously grown.**
- **The findings will be used to prioritise further research and development of novel pasture species on sandy soils.**

Why do the trial?

Over the past three decades there has been a shift from integrated crop-livestock production to intensive cropping in dry areas, which has significantly reduced the resilience of farms in low to medium rainfall areas. Intensive cropping is prone to herbicide resistant weeds, large nitrogen fertiliser requirements, and major financial shocks due to frost, drought or low grain prices.

A pilot project with MLA and AWI in WA and southern NSW has demonstrated how novel pasture legumes such as serradella, biserrula and bladder clover can improve livestock production while reducing nitrogen requirements, weeds and diseases for following crops. The extent to which these new legumes establish, grow and persist on South Australia's alkaline sandy soils requires clarification.

The demonstration sites are primarily an extension tool, unlike research trials requiring detailed data collection. The purpose of these sites is to gather information on regional legume performance, including benefits to the crops that follow.

How was it done?

The demonstration trials were designed after discussions with local farmers at the Minnipa Agricultural Centre 2018/19 harvest meetings in several locations across upper Eyre Peninsula. It was decided that the two sites chosen should target challenging soil types (particularly sandy soil) for establishing and successfully growing legume pastures in the mixed farming environment. Cultivars were chosen based on recommendations from low to medium rainfall pasture experts, site locality and soil profile information, including recent soil tests undertaken.

Site 1

Lock, SA, (Kerran 'Gus' Glover)
Treatments established in 2019: Best bet variety demonstration - 2 reps x 10 treatments, 2 m x 25 m plots. The pastures were managed for maximum seed set, fenced off from grazing over summer and sown to Spartacus barley in 2020. Pasture treatments were:

- Casbah biserrula sown @ 5 kg/ha
- Toreador disc medic sown @ 7.5 kg/ha
- PM-250 strand medic sown @ 7.5 kg/ha
- Sultan-SU barrel medic 2.5 sown @ 2.5 kg/ha
- Sultan-SU barrel medic 10 sown @ 10 kg/ha
- Scimitar spineless burr medic sown @ 7.5 kg/ha
- Volga vetch sown @ 40 kg/ha
- SARDI rose clover & Bartolo bladder clover mix sown @ 3.75 kg/ha
- Volga (40 kg/ha) & Sultan-SU (10 kg/ha) mix
- Margurita French serradella sown @ 7.5 kg/ha

In 2020 on 8 May, the site was sown to Spartacus barley @ 60 kg/ha, with DAP @ 70 kg/ha and 1.8 L/ha glyphosate, 100 ml/ha oxyfluorfen, 2 L/ha trifluralin applied pre-sowing. Soil sampling for soil nitrogen and soil borne diseases occurred on 4 April. GreenSeeker and weed assessments were conducted on 18 August. The site was harvested on 17 November. Lock received a total of 322 mm rainfall for the year with 277 mm falling within the growing season.

Site 2

Wirrulla, SA, (Dion Trezona)

Treatments applied in 2019: Best bet variety demonstration - 2 reps x 10 treatments, 2 m x 25 m plots. The pastures were managed for maximum seed set, were fenced off from grazing over summer and sown to Scepter wheat in 2020. Pasture treatments were:

- Casbah biserrula sown @ 5 kg/ha
- Toreador disc medic sown @ 7.5 kg/ha
- Scimitar spineless burr medic sown @ 7.5 kg/ha
- SARDI rose clover & Bartolo bladder clover mix sown @ 3.75 kg/ha
- Margurita French serradella sown @ 7.5 kg/ha
- Boron tolerant DL11 sown @ 7.5 kg/ha
- PM-250 strand medic sown @ 7.5 kg/ha
- Sultan-SU barrel medic 2.5 sown @ 2.5k g/ha
- Volga (40 kg/ha) & Sultan-SU (10 kg/ha) sown @ 10 kg/ha
- Sultan-SU barrel medic 10 sown @ 10 kg/ha
- Volga vetch sown @ 40 kg/ha

On 21 May 2020, the site was sown to Scepter wheat with Granuloc Zinc DAP applied @ 60 kg/ha. Soil sampling for soil nitrogen and soil borne diseases occurred on 4 April. GreenSeeker, Canopeo (determines % area green) and weed assessments were conducted on 17 August. The site was harvested on 9 November. Wirrulla received a good amount of rainfall with an annual total of 315 mm and 293 mm of that falling within the growing season.

What happened?

In 2019, Volga vetch produced the greatest biomass on both soil types (calcareous grey sandy loam at Wirrulla and sandy loam at Lock). Pasture production at Wirrulla in general was low in 2019, with the biomass ranging from 0.80 t/ha Margurita French serradella to 3.23 t/ha Volga vetch. Seed pod set was noticeably low at the Wirrulla site due to a dry finish compared to the Lock site, where the PM-250 strand medic, Scimitar spineless burr medic and Casbah biserrula set the most pods. Overall, the majority of species at both sites produced adequate seed set for regeneration in 2021, following a cereal crop. At both sites in 2020 measurements including soil nitrogen, soil disease assessment and GreenSeeker analysis conducted throughout the growing season showed no differences between the treatments (data not shown).

The wheat and barley at Wirrulla and Lock showed consistent emergence (mean plants/m^2) across all pasture treatments, with no significant treatment differences observed. Cereal grain yields in 2020 ranged from 1.7 to 1.9 t/ha at Lock and from 1.0 to 1.2 t/ha at Wirrulla but there were no statistically significant differences between treatments.

Grain quality analysis was conducted for both sites and grain protein levels following the pasture treatments showed significant differences between treatments at both sites. At the Lock site, the average protein percentage ranged from 11.5% in the Volga vetch treatment to 10.5% for Scimitar medic (Table 2). At Wirrulla grain protein ranged from 11.6% in the PM-250 strand medic treatment to 10.8% in the Toreador disc medic.

Table 1. Grain yield of Spartacus barley (t/ha) at Lock and Scepter wheat (t/ha) at Wirrulla in 2020.

Lock		Wirrulla	
2019 Treatment	**Average yield (t/ha)**	**2019 Treatment**	**Average yield (t/ha)**
Casbah biserrula	1.88	Casbah biserrula	1.19
Toreador disc medic	1.85	Toreador disc medic	1.13
PM-250 strand medic	1.80	Scimitar spineless burr medic	1.12
Sultan-SU barrel medic 2.5	1.78	SARDI rose clover & Bartolo bladder clover mix	1.12
Scimitar spineless burr medic	1.78	Margurita French serradella	1.10
Volga vetch	1.78	Boron tolerant medic DL11	1.08
SARDI rose clover & Bartolo bladder clover mix	1.75	PM-250 strand medic	1.07
Sultan-SU barrel medic 10	1.73	Sultan-SU barrel medic 2.5	1.06
Volga & Sultan Mix	1.69	Volga & Sultan	1.06
Margurita French serradella	1.69	Sultan-SU barrel medic 10	1.06
		Volga vetch	1.04
LSD (P=0.05)	*ns*		*ns*

Table 2. Grain protein quality in 2020 from the Lock and Wirrulla sites.

Lock		Wirrulla	
2020 Treatment	**Grain protein (%)**	**2020 Treatment**	**Grain protein (%)**
Volga vetch	11.45 a	PM-250 strand medic	11.60 a
Sultan-SU barrel medic 10	11.20 ab	Volga Vetch	11.40 a
PM-250 strand medic	11.15 a	Boron tolerant medic DL11	11.35 a
Volga & Sultan Mix	11.15 a	Margurita French serradella	11.25 ab
Casbah biserrula	11.05 a	Sultan-SU barrel medic 2.5	11.20 ab
Margurita French serradella	11.0 a	Casbah biserrula	11.15 ab
SARDI rose clover & Bartolo bladder clover mix	10.95 ab	Sultan-SU barrel medic 10	11.15 ab
Toreador disc medic	10.75 ab	SARDI rose clover & Bartolo bladder clover mix	11.10 ab
Sultan-SU barrel medic 2.5	10.5 b	Scimitar spineless burr medic	11.10 ab
Scimitar spineless burr medic	10.5 b	Volga & Sultan Mix	10.95 ab
		Toreador disc medic	10.80 b
LSD (P=0.05)	*0.76*		*0.65*

What does this mean?

Grain protein content, but not grain yield was affected by the pasture treatment that proceeded the wheat crop. Wheat yield was not improved by biserrula, which produced inferior levels of dry matter production in 2019 (data not shown). Factors such as water availability, rather than pasture performance, were likely to have determined grain yield in this instance. Grain protein differences of about 1% were measured at both sites. At Lock, grain protein was highest following Volga vetch, which was the most productive species at that site, but otherwise grain protein was not obviously linked to previous legume production at either site. Whilst the trials indicate scope to improve grain protein by using pasture species aligned with the soil types, further work is needed to understand the transfer of N between the legume and crop phase.

In 2021 both sites will be left to regenerate back to their pasture species. This will provide critical information on the persistence of the sown legumes through a cereal crop and help select the best pasture prospects for future studies.

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