

Development of new pasture systems in NW Victoria



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Project Title: Dryland Legume Pasture Systems

Key Words: *Pasture establishment, novel pasture species*

Key Messages

- A 4-year pasture development project was established near Piangil in 2018.
- Legume pasture species that have not traditionally been grown in the Victorian Mallee established, largely successfully, in 2019 from hard but germinable seed sown in June 2018 (Twin sown) and February 2019 (Summer sown).
- They produced up to 2 t/ha of biomass and 400 kg/ha of seed in a season of only 40% of average growing season and annual rainfall.

Background

This article introduces the project “Dryland Legume Pasture Systems” (DLPS) which aims to discover resilient low-cost pasture legumes with appropriate management packages to provide livestock and cropping benefits to the low-medium rainfall mixed farming regions of Australia. There are two main components of novel pasture systems studied through this project.

1. New legume pasture species/cultivars that have not traditionally been grown in the target region. Each species may provide benefits such as increased production on certain soils types; improved value to livestock; the ability for seed to be machine harvested and retained; hard seed characteristics that provides a viable pasture after many cropping phases.
2. Alternative pasture establishment systems aimed at reducing the cost of pasture establishment and potentially improved productivity from greater water use efficiency.

About the trial

Piangil trial site on the property of Rodney Haydon. A red loamy sand, pH CaCl₂ 7.4 0-10 cm, 8.4 70-100 cm. 2019 rainfall 142 mm, 100 mm growing season rainfall, approximately 40% of long-term averages with a total 25 mm for August, September and October

The trial included three establishment methods; Twin sowing (28 June 2018) with a companion crop of wheat, summer sowing (7 February 2019) and autumn sowing (13 May 2019) of 7 legume pasture species. To protect against a false break the twin and summer sown seed was “hard”, but assessed to be germinable by the autumn seasonal break at a specie specific level. The seeding rates of the legume pastures (Table 1) were calculated on the basis of providing each specie with similar numbers of germinable seeds in autumn 2019, taking into account specie specific “soft” seed percentages. The autumn sown seed was commercially prepared scarified seed with approximately 80% “soft” seed. The vetch and barley were autumn sown only with commercial seed.

Plant measurements of the novel pasture legumes included emergence on 5 June from 8 by 0.1m² quadrants, pasture biomass on 19 August, 17 September and 16 October, seed yield on 5 Dec 2019 all from 5 by 0.1m² quadrants. The vetch was chemically fallowed on 5 September 2019 with 3.2 tDM/ha. The barley continued on to harvest yielding 2.7 t/ha. The 5 June plant emergence and 19 August biomass measurements of the vetch and barley are presented as standard commercial comparisons to the novel pastures.

Table 1. Alternative pasture legume common names, species and cultivars, and seed (kg/ha) sown at the twin, summer and autumn time of sowing and vetch and barley sown at the autumn sowing

Treatment		Cultivar	Twin	Summer	Autumn
Sowing rate (kg/ha)					
Biserrula	(<i>Biserrula pelecinus</i>)	Casbah	5.7	5.7	4.5
Bladder clover	(<i>Trifolium spumosum</i>)	Bartolo	14.7	14.7	6.8
Gland clover	(<i>Trifolium glanduliferum</i>)	Prima	Not determined		4.6
Annual medic	(<i>Medicago littoralis</i>)	PM 250	7.2	7.2	6.8
Rose clover	(<i>Trifolium hirtum</i>)	SARDI	9.8	12.5	6.8
Serradella	(<i>Ornithopus sativus</i>)	Margurita	7.4	7.4	6.8
Trigonella	(<i>Trigonella balansae</i>)	5045	4.9	4.9	4.5
Vetch	(<i>Vicia sativa</i>)	Studenica			25
Barley	(<i>Hordeum vulgare</i> L.)	Compass			50

Results & Discussion

A key trial impact was the rainfall, 100- and 142-mm growing season and annual rainfall respectively, approximately 40% of the long-term average for that location.

Table 2. Mean 2019 plant establishment (plts/m²) biomass production (tDM/ha) and seed yield (kg/ha) for the three establishment methods

	5 June (plts/m ²)	19 August	17 Sept. (tDM/ha)	16 October	5 Dec. (kg/ha)
Twin Sowing	34	0.57	1.1	1.15	174
Summer Sowing	48	0.39	0.92	0.9	183
Autumn Sowing	58	0.55	1.25	1.45	240
Lsd $P=0.05$	13.9	nsd	nsd	nsd	nsd

The mean plant density of all 7 pasture legumes (Table 2) had less established plants on 5 June 2019 from twin sowing (June 2018) than summer (February 2019) and autumn (May 2019) sowing treatments. The biomass and seed production were similar for all establishment methods at each time of measurement.

Table 3. Plant establishment (plts/m²) biomass production (tDM/ha) and seed yield (kg/ha) of 7 pasture legumes as a mean of the 3 times of sowing

	5 June (plts/m ²)	19 August (tDM/ha)	16 October	5 Dec. (kg/ha)
Biserrula	15	0.3	0.5	62
Bladder clover	53	0.5	1.4	440
Gland clover	23	0.2	0.5	69
Annual medic	47	0.8	1.8	255
Rose clover	50	0.6	1.6	192
Serradella	78	0.7	1.5	150*
Trigonella	61	0.3	1	225
Lsd $P=0.05$	15.4	0.21	0.25	76

*Serradella pod weight not seed

The means of the three establishment methods found Biserrula and Gland clover had lower plant numbers, biomass and seed yield, and Trigonella lower biomass, than other entries. Bladder clover produced more seed and annual medic similar or more biomass than all other entries.

Table 4. Plant establishment (plts/m²) biomass production (tDM/ha) and seed yield (kg/ha) of 7 pasture legumes at 3 times of sowing (TOS)

	TOS	5 June (plts/m ²)	19 August (tDM/ha)	16 October	5 Dec. (kg/ha)
Biserrula	Twin	<1	0.01	0.21	31
	Summer	1	0.08	0.09	20
	Autumn	45	0.42	1.08	135
Bladder clover	Twin	54	0.57	1.37	401
	Summer	31	0.42	1.28	432
	Autumn	74	0.61	1.61	487
Gland clover	Twin	28	0.24	0.62	41
	Summer	5	0.05	0.12	19
	Autumn	35	0.4	0.81	148
Annual medic	Twin	33	0.92	1.81	249
	Summer	29	0.71	1.64	239
	Autumn	80	0.8	2.01	277
Rose clover	Twin	56	0.8	1.91	185
	Summer	28	0.29	1.13	153
	Autumn	66	0.68	1.86	237
Serradella	Twin	61	1.06	1.44	119
	Summer	130	0.68	1.33	163
	Autumn	44	0.46	1.56	169
Trigonella	Twin	4	0.04	0.72	191
	Summer	115	0.42	0.93	257
	Autumn	66	0.45	1.24	227
Lsd <i>P</i> =0.05		26.7	0.41	0.44	102.9
Barley	Autumn	156	3.2		
Vetch	Autumn	77	2.3		

In comparison to autumn sowing; Biserrula established less plants and was less productive from twin and summer sowing. Bladder clover was similarly productive from all times of sowing irrespective of less plants from summer sowing. Summer sown gland clover failed. Annual medic established less plants from twin and summer sowing but had similar biomass and seed production across all establishment treatments. Rose clover had less plants and biomass production from summer sowing. Serradella established more plants from summer sowing and more biomass in August from twin sowing. Trigonella twin sown established less plants and was less productive.

Vetch and barley established at greater than optimum plant densities, more than 50 and 150 plants/m² respectively. Vetch produced similar biomass by August to the total annual biomass of annual medic, the next best.

Implications for commercial practice

The trial aims to identify the application and system benefits of novel legume pasture species that have not traditionally been grown in the target region (Victorian Mallee). Recent research (Moodie et al. 2017) found that legumes grown in sequence with cereals increased wheat yields by 0.5 – 1.5 t/ha and improved annual profits by up to \$100/ha in the low rainfall mixed farming regions.

Vetch is the most commonly grown pasture legume in the region. However, there are alternative pasture legumes which have the potential to increase production on certain soils types unsuited to vetch. They also have hard seed characteristics that may allow them to regenerate after a cropping phase, similar to annual medic. Pastures regenerating at high populations will increase early biomass production and livestock forage, with associated N fixation and weed competition benefits for the following cereal. The hard seed characteristic may also allow the pasture seed or pod to be sown in the cereal crop or during the summer preceding the pasture phase.

The trial did not measure any production benefits from the novel pasture systems in comparison to vetch in 2019, the initial pasture establishment year. Vetch is well adapted to the alkaline loamy sand soil type of the trial site and by August had produced similar biomass to the best novel pasture legumes total October 2019 production. However, it should be noted that vetch established at near optimum plants density, 77 plants/m², compared to only approximately 25% of optimum densities for the pasture legumes.

The ability for seed to be harvested and retained by the farmer was considered possible with the seed pods, apart from the annual medic, remaining largely attached to the vines in December. This would allow some seed to be collected by mechanical harvester, however lack of plant height due to low plant populations and rainfall would limit potential yields in 2019. The hard seed characteristics that allow the novel pastures to produce a viable pasture after a cropping phase will not become evident until 2021, following the 2020 cropping phase.

The second trial component based on alternative pasture establishment systems targeting opportunities to reduce the cost of pasture establishment and potentially improved productivity provided useful outputs. Sowing “hard” pasture seed/pod with a crop (twin sown) or late in the summer with no companion crop (summer sown) was partially successful. While there was generally less plants established from the twin and summer sowings than the autumn sowing control the production differences were minimal, except in the cases where virtually no plants established. This included *Biserrula* following both the twin and summer sowing and *Trigonella* following the twin sowing. There is some anecdotal evidence, based on biomass production figures, that more plants established after the 5 June plant counts from both the *Biserrula* and *Trigonella* twin sowings. The reasons for this are open to conjecture but it is unlikely that seed softening continued through until June and more seed became available to germinate. Seed depth and the seasonal rainfall pattern may have been factors. However, in the case of *Serradella* and *Trigonella* more plants established from the summer sowing than the autumn sowing, suggesting a greater level of “soft” seed than calculated.

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References

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