

Dryland Legume Pasture Systems: Evaluating pasture establishment methods for Mallee mixed farms

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Location
Waikerie
Schmidt Family

Rainfall
Av. Annual: 253 mm
Av. GSR: 164 mm
2019 Total: 161 mm
2019 GSR: 119 mm

Yield
Potential: Medic, 2 t/ha based on 20 kg/ha/mm from French (1981) for annual legume pastures
Actual: 0.7 t/ha

Soil type
Sandy loam

Soil test
pH CaCl₂ 7.8 0-10 cm, 7.7 70-100 cm
Nitrate N 0 -10 cm 18 mg/kg
Colwell P 0 -10 cm 13 mg/kg
S KCL 0-10 cm 6.9 mg/kg, 70-100 cm 6.5 mg/kg
OC 0-10 cm 0.42%, 70-100 cm 0.43%
Salinity Ec 1:5 0-10 cm 0.11 dS/m, 70-100 cm 0.11 dS/m

Plot size
1.68 m x 32 m x 4 reps

Trial design
Fully randomised block with time of sowing as main plots and pasture species as the sub plots

Yield limiting factors
Drought, weeds

Key messages

- **Field experiments located near Waikerie and Piangil are evaluating establishment methods (summer, twin and autumn sowing).**
- **Although the alternative pasture species established adequate plant numbers under the establishment**

methods, they may be less productive than medic.

- **Serradella, Rose clover and Bladder clover performed well under summer sowing, however under twin sowing, establishment and production for all the legume species was poor at Waikerie.**
- **Further investigation is required to define the conditions where summer and twin-sowing practices are reliable.**

Why do the trial?

A significant obstacle to the adoption of pasture species is difficulty in successfully establishing high seed cost pastures, particularly in low-medium rainfall areas. The optimal establishment time for pastures in autumn is a compromise between early enough for sufficient rooting depth and biomass production, but late enough that the risk of a false break is low and high soil temperatures do not limit germination and seedling growth (Puckridge and French, 1983). Unfortunately, this sowing window coincides with the optimal sowing window for the main cropping program on mixed farms (Flohr *et al.*, 2017).

Together with improved pasture cultivar options, systems need to be developed to help mixed farmers overcome logistic and economic issues surrounding pasture establishment. In Western Australia, summer and twin sowing methods have shown promise but these alternative

establishment methods have had limited evaluation in south-eastern Australia (Revell *et al.*, 2012). A feature of some of the legumes under investigation is their aerial seeded habit and retention of seed, allowing seed to be farmer harvested and re-sown. This project is examining the potential of different pasture legume species to be established more efficiently, to provide growers with greater flexibility in moving between crop and pasture phases by avoiding clashes with peak crop sowing times, reduce establishment costs and increase early season feed.

How was it done?

Three establishment methods were evaluated at Waikerie (SA) and Piangil (Vic) in 2019 using legume pasture species/cultivars that have not been traditionally grown in the Mallee region (Table 1). Growing season rainfall in Waikerie in 2019 was 119 mm (long-term average 164 mm) and in Piangil 100 mm (long-term average 220 mm).

Establishment methods evaluated were:

- Twin-sown, where “hard” pasture seed/pod was sown with wheat seed in 2018 for 2019 pasture establishment.
- Summer-sown, where “hard” seed/pod was sown in summer and softened to establish on the autumn break.
- Autumn-sown (control treatment), where “soft” seed was sown on the break of the season.

In Waikerie twin-sown treatments were sown on 5 June 2018, summer-sown treatments were sown on 14 February 2019, and autumn-sown treatments on 23 May 2019. In Piangil twin-sown treatments were sown 28 June 2018, summer-sown treatments were sown on 7 February 2019, and autumn-sown treatments on 13 May 2019. Indicative sowing rates are in Table 1, and all pastures were sown with a base level of either 45 kg/ha of MAP in Waikerie or 50 kg/ha of MAP in Piangil.

At each site plant number/m² was recorded in June, and two measures of biomass production were recorded.

The experiment was a general treatment structure in randomised blocks with sowing method and cultivar as treatment factors with four replications, and designed and analysed using Genstat.

What happened?

Establishment

In Waikerie the seasonal break (> 15 mm) occurred on 9 May with 20 mm rainfall. Summed rainfall prior to 9 May 2019 was 22 mm. In Piangil, the seasonal break occurred on 2 May with 19 mm rainfall, with summed rainfall prior to 2 May of 17 mm. At both sites all establishment treatments emerged within 2 weeks of each other. Sowing method had a significant

effect on plant density at both sites (Figure 1). The targeted population for sown pastures is typically 150-200 plants/m².

Production

Treatment differences in dry matter production were measured at Waikerie, despite production being limited by rainfall (Figure 2). Production was greatest for summer and autumn-sown PM-250 medic. Although Serradella and Rose clover produced more dry matter when summer sown, the overall production was lower. Dry matter was lowest in twin-sown treatments, consistent with lower plant numbers.

Table 1. Indicative sowing rates of pod or seed (kg/ha) and equivalent amount (kg/ha) of viable hard seed sown in twin and summer sown treatments; and sown rate of germinable seed (kg/ha) in the autumn sown treatment.

Legume	Twin and summer sown treatments (kg/ha)	Autumn sown treatment (kg/ha)
PM-250 medic	30 pod, 8 viable hard seed	8
Trigonella balansae	11 seed, 5 viable hard seed	5
Bladder clover	18 seed, 16 viable hard seed	8
Rose clover	74 seed, 11 viable hard seed	8
Biserrula	9 seed, 5 viable hard seed	4
French serradella	30 pod, 8 viable hard seed	8
Gland clover	Not measured	4

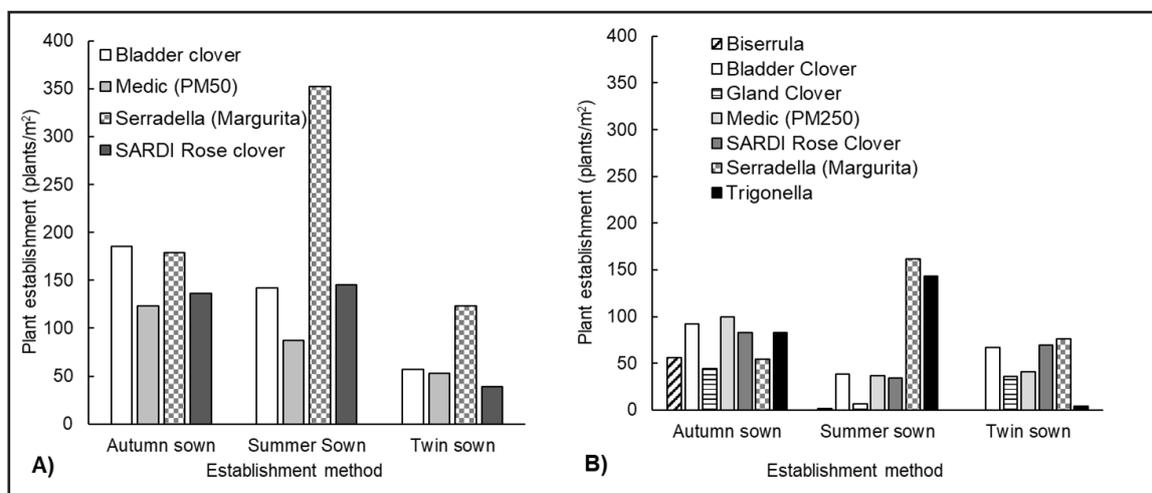


Figure 1. Plant establishment resulting from different establishment methods at a) Waikerie on 25 June 2019, vertical line is LSD (5%)=41, P <0.001 and b) Piangil on 5 June 2019, vertical line is LSD (5%)=27, P <0.001.

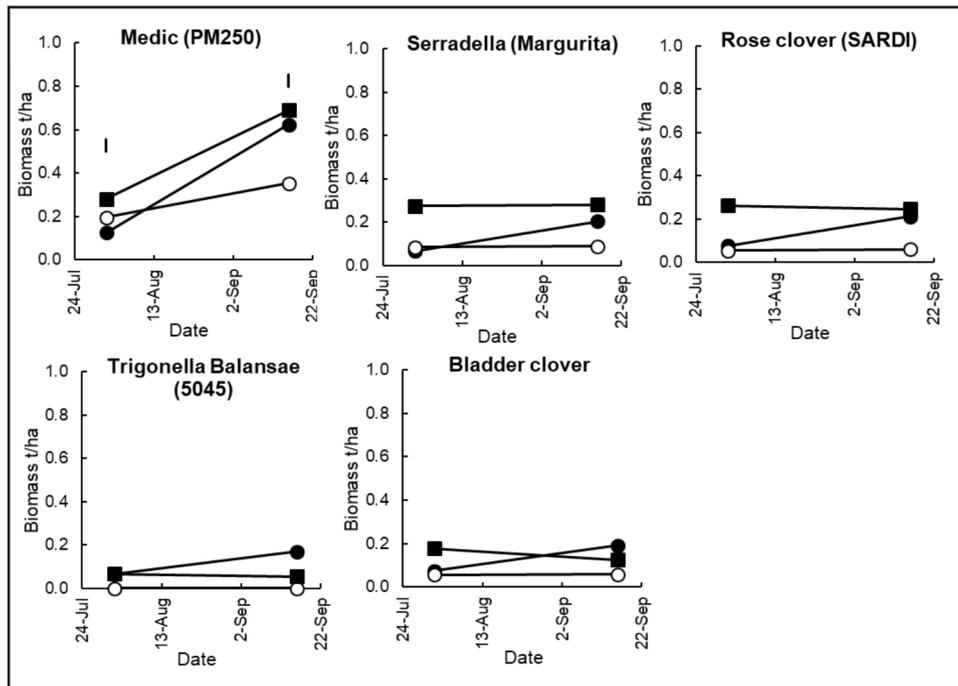


Figure 2. Biomass production (t/ha) in 2019 at Waikerie in the establishment treatments autumn sowing (●), twin-sowing (○) and summer-sowing (■), vertical line is LSD (5%) = 0.1, $P < 0.001$.

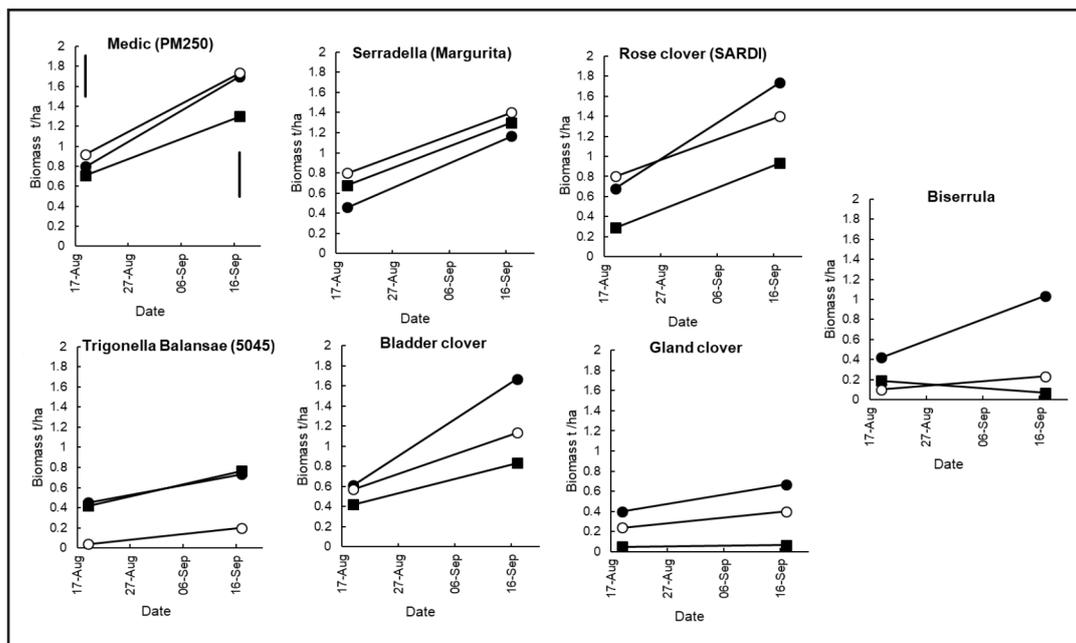


Figure 3. Biomass production (t/ha) in 2019 at Piangil in the establishment treatments autumn sowing (●), twin-sowing (○) and summer-sowing (■), vertical line is LSD (5%) = 0.41, 0.44 respectively, $P < 0.05$.

While establishment counts were higher for summer and autumn sowing at Waikerie, biomass production tended to be higher at Piangil (Figure 3). The twin sown treatments at Piangil had establishment counts similar to the other sowing techniques, however plant density did not necessarily directly relate to biomass production. For example, there was higher plant density in summer-sown Serradella, but twin-sown treatments produced similar biomass. Medic produced similar

biomass in the autumn- and twin-sowing treatments. Production of Trigonella and Gland clover was generally low, indicating they are not as well adapted to the soil type.

Results from 2019 indicate that twin and summer-sowing may be viable establishment methods for the Mallee region, however they might not be suitable for all legume species. In both environments, Margurita Serradella gained the greatest advantage from the alternative establishment methods.

Results for PM-250 medic were inconsistent, with twin-sowing inferior at Waikerie and summer-sowing inferior at Piangil. Given that all treatments emerged on similar dates, and there was very little summer rainfall in 2019, further exploration of the methods are required under a range of growing seasons such that risks and/or benefits associated with earlier seasonal or false breaks can be evaluated. This experiment will be repeated in Lameroo, SA in 2020.

Weed management

An important consideration with twin- and summer-sowing is weed control. At Waikerie, there were significantly more broad-leaved weeds in the twin- and summer-sown plots compared to autumn-sown plots (data not shown). On 1 August weed dry-matter was 3.6 vs. 44 vs. 50 g/m² for autumn, summer and twin treatments respectively (P<.001). Autumn-sown plots received a knock down spray at sowing, while twin and summer sown plots did not. Twin- and summer-sowing methods should

only be considered for paddocks with low weed levels.

Seasonal analysis

To understand the likely suitability of summer and twin-sowing to Mallee environments, historic climate records (1970-2018) were analysed to reveal the distribution of when the seasonal break occurred. Using the APSIM model (version 7.10) and historic weather records, the mean break of a season was predicted (7-day period where rainfall exceeds evaporation, Unkovich 2010). The analysis revealed that Lameroo has the

earliest median break and a higher probability of a break occurring before 25 April, while Piangil and Waikerie typically have a later seasonal break. In environments with a greater probability of an early seasonal break, summer-sowing will likely be more beneficial as a longer growing season can be exploited more often (Figure 4). In environments where the seasonal break is often later, there is greater risk of seed losses or burial, rhizobia death and exposure to pathogens.

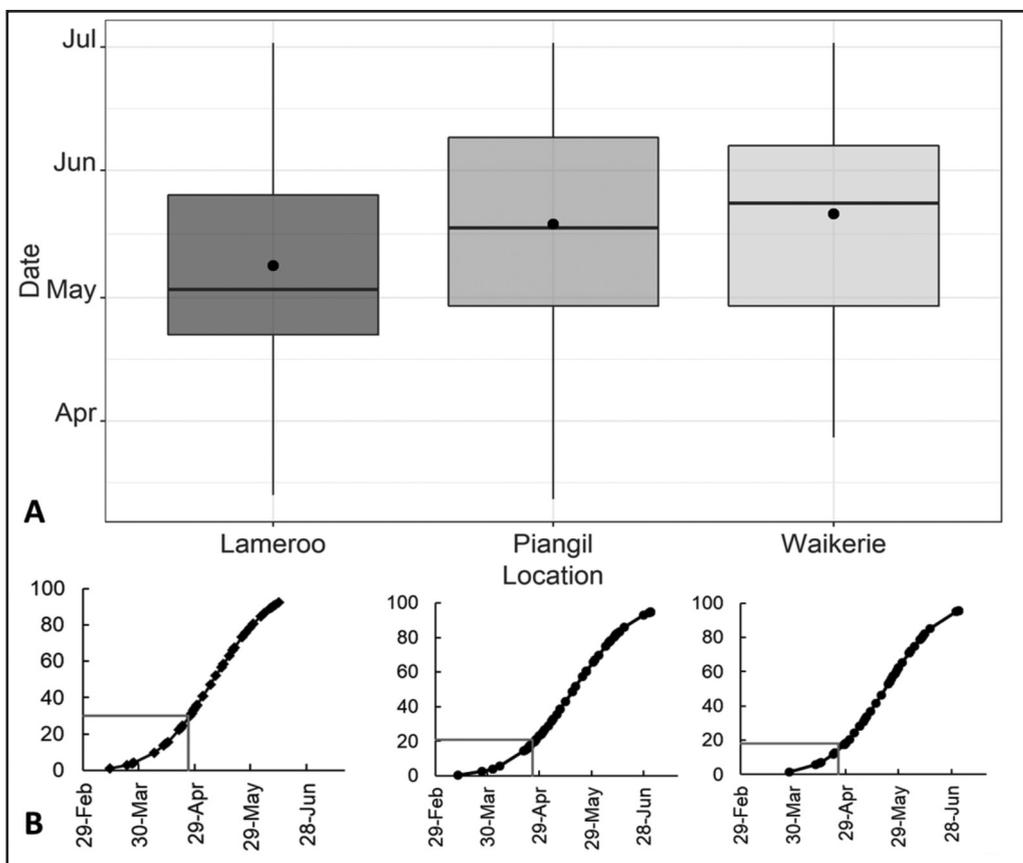


Figure 4. a) Box and whisker plots showing 25th-75th percentiles of when the autumn break occurred in the historic data set 1970-2018 using the Unkovich (2010) rule, b) the probability of the seasonal break occurring on 25 April.

What does this mean?

Alternative establishment methods have demonstrated potential in the Mallee, however they are not suitable for all legume species. The alternative legume species Serradella, Rose clover and Bladder clover have demonstrated potential for summer sowing, however establishment and production under twin sowing was low at Waikerie. While PM-250 medic was the highest biomass legume, it is not yet clear which establishment technique will consistently give the best results. This is worthy of further investigation given the potential to provide growers with greater sowing flexibility and reduced seed costs.

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