Improving medic pastures in low rainfall mixed farming systems - how to get the most 'free' N

Jessica Crettenden
SARDI, Minnipa Agricultural Centre

RESEARCH

Almost ready

Location:
Minnipa Agricultural Centre
Paddock S7
Rainfall
Av. Annual: 325 mm
Av. GSR: 241 mm
2015 Total: 333 mm
2015 GSR: 258 mm
Yield
Potential: 8.46 t DM/ha
Actual: 5.37 t DM/ha
Paddock History
2014: Wheat
2013: Wheat
2012: Medic pasture
Soil Type
Red sandy loam
Soil Test
Organic C%: 0.6
Phosphorous: 2-22 mg/kg
Plot Size
22 m x 24 m x 3 reps
Yield Limiting Factors
Broadleaved weeds, aphids (late Sept.)
Livestock
Stimulated grazing

Key messages

- **The paddock utilised for the trial had a significant number of effective naturalised medic rhizobia. There was no rhizobial inoculation response.**
- **Total annual biomass was higher in the regenerating medic plots versus sown treatments due to earlier germination and growth of naturalised medic.**
- **Grazing increased overall medic production.**

Why do the trial?

Medics are a common and attractive break 'crop' option in low rainfall mixed farming systems due to their natural regeneration, good quality feed value, low cost maintenance and valuable nitrogen (N) fixation qualities. To capture these advantages, medic pastures need to be kept in a productive state to ensure that the seed bank is adequate and that the plant is fixing the N that is needed for the following crop.

In recent years, some medic pastures have been of poor quality due to a range of factors including chemical usage, incorrect grazing methods, mechanical damage and other modern farming practices, resulting in reduced production and subsequent N_2-fixation. Best practice medic production guidelines have already been established, however some of these techniques are not adopted due to the time and expense involved. For these reasons, many farmers are looking for simple practices to establish medic pastures and boost their production using cost and time efficient methods.

The aim of this trial was to look at current techniques used by farmers, or recommended by consultants, to improve medic pastures and determine the most effective method to optimise N_2-fixation. Biomass, nodulation and N_2-fixation differences between management practices, including inoculation treatments on both sown and regenerating medic stands were measured. The trial also investigated if grazing medic pastures in the break phase of the rotation benefits or impedes nodulation and subsequent N_2-fixation.

How was it done?

The trial was designed to mimic current options used by farmers to manage their regenerating and sown medic pastures, with a focus on treatments adding fertilizer and/or rhizobial inoculant in some form (Table 1). Simulated grazing (mowing) was imposed on half of each plot at opportune periods throughout the season, to imitate the grazing management of medic pastures in a mixed farming system. A site was located in a paddock that had grown wheat for the past two years.

The trial site was burnt on 15 April to remove stubble residue. Soil was sampled for pre-sowing soil water content, soil chemical analysis, deep soil N and rhizobia number and effectiveness on 4 May. Seed rhizobia counts were also measured prior to sowing. The site was prickle-chained on 9 May prior to sowing over two days on 18 and 19 May. Fertilizer broadcasting for treatment 5 occurred on 12 June prior to a substantial rainfall event. Plant counts were taken prior to prickle-chaining to determine early germination and at establishment stage on 15 June after sowing. Grass weeds were sprayed out of all treatments using 200 ml/ha of Elantra Xtreme and Hasten spray adjuvant @ 500 ml/100 L water on 16 July. Plant samples were taken for nodulation assessment on 4 August. Biomass was measured and simulated grazing on half of each plot was imposed on the regenerated medic only (treatments 1-5) on 17 August due to their advanced growth compared to the sown treatments.

Table 1 Number, sowing method, seed type and rate of trial treatments.

No.	Sowing method*	Seed type**	Treatment
1	R	Nil	Control
2	R	Nil	Inoculum liquid mix*** sprayed on regenerated medic
3	R	Nil	None (in-season opportune treatment)
4	R	Nil	In-furrow inoculum liquid mix*** applied to regenerated medic
5	R	Nil	Fertiliser broadcast @ 50 kg/ha MAP
6	S	B	Sown
7	S	C	Sown (commercial seed coat)
8	S	B	Sown, pre-coated with peat slurry inoculant
9	S	B	Sown with in-furrow inoculum liquid mix***
10	S	C	Sown (commercial seed coat) with fertiliser @ 50 kg/ha MAP
11	B	C	Seed broadcast (commercial seed coat) and prickle-chained
12	S	B	Powdery Mildew tolerant medic seed (new variety), pre-coated with peat slurry inoculant

**Sowing method: R=regenerated, S=sown (10 kg/ha), B=broadcast (10 kg/ha)*
***Seed type: B=bare, C=commercial pre-coated treatment (Jaguar variety)*
****Inoculum liquid mix created through peat inoculant hung by tea-bag (stockings) in spray/liquid fertiliser tank and dissolved in water (in-furrow or sprayed @ 10 kg/ha peat inoculant with 100 L/ha water)*

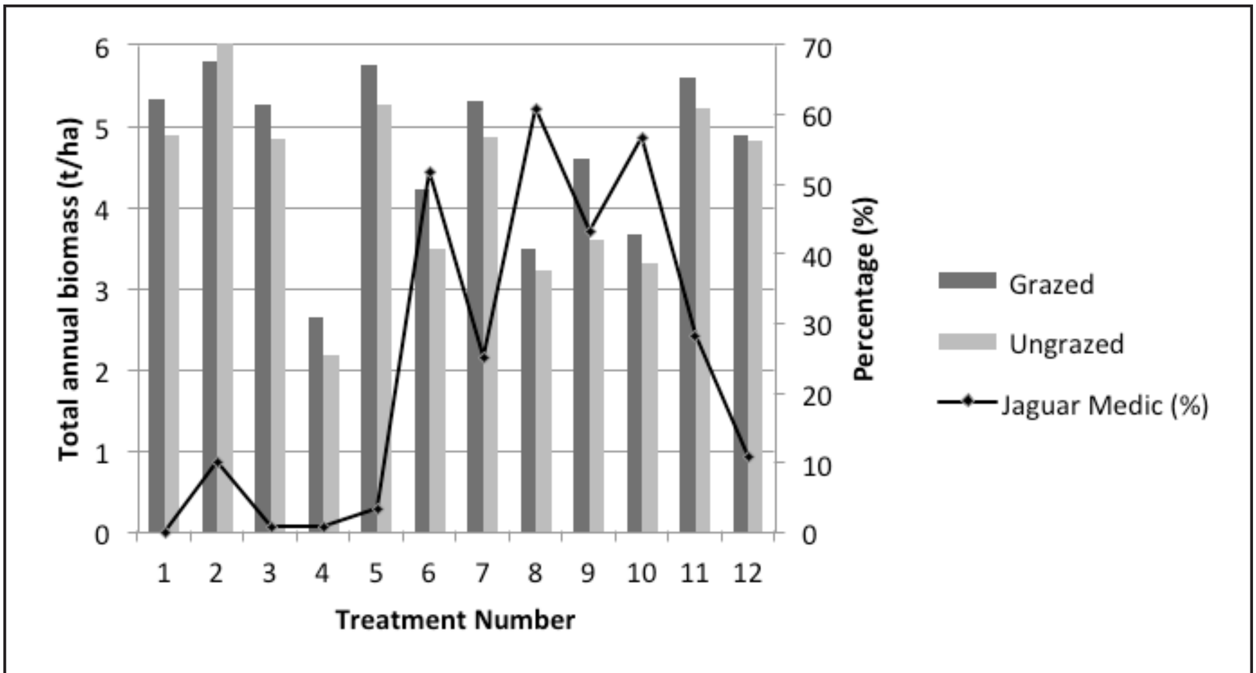

Figure 1 Total annual biomass figures treatment and grazed versus ungrazed differences LSD (P=0.05) is 2.2 and the percentage of Jaguar medic LSD (P=0.05) is 26.

Biomass cuts were taken and the percentage of grass and broad-leaved weeds, in addition to sown versus regenerated medic plants (visual through marked leaves) were recorded in all treatments prior to the second grazing simulation on 16 September. Anthesis biomass was measured on 2 November. Sampling for post-anthesis soil water content occurred on 21 December, and soil N will be measured prior to sowing in 2016.

What happened?

Plant growth and type

Establishment plant counts ranged from 217-426 plants/m^2 for all treatments other than treatments 4 and 5, which recorded lower plant counts of 74 and 171 plants/m^2 respectively. Treatment differences were measured in the percentage of sown medic (Jaguar medic with prominent leaf marker) compared to the naturalised medic (which has no leaf marker) in-season, with sown treatments containing 40% more Jaguar plants (Figure 1).

Biomass after the first graze was higher in the ungrazed plots with 3.1 t/ha versus 2.0 t/ha measured in the grazed plots a month after the first simulated grazing event. There were also treatment differences measured at this time with treatment 12 recording the highest biomass of 3.2 t/ha and treatments 8 and 4 measuring the lowest at 1.9 and 1.7 t/ha respectively. All other treatments ranged from 2.2 to 2.9 t/ha.

Pastures

Dry matter (DM) measured approximately six weeks after the second graze (at anthesis) showed differences between all treatments, ranging from 2.1 to 4.3 t/ha in treatment 8 and the control respectively. The ungrazed plots had higher biomass than the grazed treatments at anthesis, averaging 4.3 t/ha versus 2.3 t/ha. Total annual biomass differed between treatments with an average of 0.4 t/ha more biomass measured in the grazed versus the ungrazed plots, which is summarised in Figure 1.

Soil water and nutrition

The measured available soil N content in the root zone at seeding averaged 25.3 kg/ha plus an estimated 24.5 kg/ha N had mineralized, which resulted in an average of almost 50 kg/ha N likely to be available to the plant throughout the growing season. Pre-seeding soil nutrition tests also showed the site had low Colwell phosphorous (P) levels, averaging 19 mg/kg with a moderate phosphorous buffering index (PBI), averaging 92.1 in the top 10 cm, meaning P levels and tie-up may have been a limiting factor to plant growth across the entire trial area.

Rhizobia and nodulation

The number of medic rhizobia pre-sowing averaged 9220/g soil (top 10 cm) and the effectiveness of these 'natural' rhizobia averaged 97% (relative to the commercial strain RRI128). There were no differences in nodule number or appearance between treatments. The average number of effective nodules on the tap roots and lateral roots was 4.1 and 1.7 nodules per plant respectively. The mean number of all nodules per plant was 7.3 which is reasonable for strand medic which is sometimes referred to as a 'shy' nodulator. A moderate level of root damage was observed. Root health score averaged 7.4 (0=good, 15=bad).

What does this mean?

Medic growth across the site was substantial in 2015. The timing of medic emergence and growth stages varied between treatments due to differences in treatment management around this period, which mostly correlated to biomass growth later in the season. Sown treatments 4 (cultivated at the time of liquid in-furrow inoculation), 6-10, and 12 had slower growth than the regenerated treatments due to late sowing, which resulted in these plots only being grazed once. Total annual biomass results showed that regenerated treatments produced more biomass per hectare, regardless of whether they were grazed or not, which is most likely due to earlier germination of naturalised medic and consequent greater production levels. It is important to note that how the pasture performs over the longer term following the introduction of the new cultivars is crucial to pasture improvement; therefore these results may not reflect the success of each treatment. In particular, comparing sown to regenerated medic should be determined by plant growth in the following season. For this reason, regeneration will be measured on the trial site in 2016.

Although not significant, grazed treatments showed a trend towards higher total biomass, which is most likely due to the initial medic establishment and ensuing substantial growth throughout the season. Grazing allowed the medic to boost production levels with timely rainfall events throughout the growing season.

Legume pastures typically fix around 20 kg/ha of N per tonne of dry matter (GRDC Nitrogen fixation factsheet, 2014). However, a poorly nodulated legume plant will contribute less fixed nitrogen to soil reserves, which can occur due to a number of agronomic factors affecting rhizobial persistence or the processes of nodulation (e.g. low soil pH, herbicide residues). The number of medic rhizobia measured at the site indicated that there were liberal numbers of 'natural' rhizobia and they were good at N_2-fixation. At these levels (and effectiveness), an inoculation response is unlikely because inoculating usually adds 100 rhizobia/g of soil (top 10 cm) and so the inoculant strain is outnumbered by more than 10:1.

The amount of N contributed from each treatment will be determined when soil nitrogen levels are measured prior to sowing the site in 2016. Medic regeneration on each treatment will also be measured in-season. The trial will be repeated in 2016 on a site that has a history of poor pasture establishment and production.

Acknowledgements

I gratefully acknowledge Jake Howie and Ross Ballard for their guidance throughout the trial and Leigh Davis, Brenton Spriggs, Brett McEvoy and John Kelsh for site establishment and management. The Eyre Peninsula Grain and Graze 3 project is funded by GRDC (SFS00028).

Registered products: see chemical trademark list.

GRDC Grains Research & Development Corporation
Your GRDC working with you

SARDI
SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

Grain & Graze
Profit through knowledge
EYRE PENINSULA