Improving regenerating medic pastures in low rainfall mixed farming systems

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RESEARCH

Searching for Answers

Location:
Piednippie
Rainfall
Av. Annual: 379 mm
Av. GSR: 304 mm
2016 Total: 485 mm
2016 GSR: 323 mm
Paddock History
2016: Parabinga medic
2015: Mace wheat
2014: Mace wheat
Soil Type
Calcareous grey sand
Plot Size
3 m x 1.5 m x 3 reps

Key messages

- **The paddock contained a population of effective rhizobia and so the number of nodules on lateral and taproots was not affected by the addition of different rhizobial inoculants.**
- **Improved soil nutrition did not affect dry matter production and nodulation.**
- **Grazing (simulated) reduced the total dry matter produced by the medic pasture, however the use of sheep would provide a more realistic assessment of grazing on DM production, nodulation and N_2-fixation.**

Why do the trial?

The use of pasture legume species such as annual medics *(Medicago spp.)* has long been considered to be a sustainable and profitable means of maintaining soil nitrogen (N), fertility, forage quality and productivity in both permanently grazed pastures and ley-farming systems. However, due to current farming methods there has been a decline in the level of management inputs routinely supplied to pastures for wool and meat production, and a trend towards shorter pasture phases in pasture-crop rotations in low rainfall mixed farming systems. This general neglect of pastures and increased grazing pressure has resulted in poor seedbank persistence and pasture regeneration, and poor nodulation and N-fixation in some cases. The aim of this trial was to investigate the impact of grazing, soil nutrition and rhizobial inoculants on dry matter production, nodulation and N_2-fixation of a regenerating medic pasture under field conditions.

How was it done?

A replicated field trial was established on 7 April 2016 on a regenerating barrel medic pasture *(var. parabinga)* at Piednippie on a grey sandy soil with 1.5% organic carbon, 24 mg/kg Colwell P and 20 kg N/ha in the 0-10 cm root zone. Before sowing, the soil contained 823 medic rhizobia per gram (0-10 cm) and they were 76% as effective as the commercial inoculant (WSM 1115) in combination with Parabinga. All treatments (Table 1) were imposed on 24 May, which was followed by 26 mm of rain over three days. ALOSCA rhizobia granules (containing approx. 23,000 rhizobia/g) were spread over the plots by hand. Peat inoculant was dissolved in water overnight and sprayed onto plots using a backpack sprayer at 250 L/ha of water. Parabinga seed was spread by hand (over the treatments with added seed) and raked in to simulate prickle-chaining in order to improve seed-soil contact and the inoculated Parabinga seed had 26,000 rhizobia/seed. The trial site was sprayed with Broadstrike @ 25 g/ha, Verdict @ 75 ml/ha and uptake oil @ 500 ml/ha on 22 June to control broad-leaved and grass weeds, and simulated grazing (only on 'grazed' main plots) was imposed by mechanical mowing on 21 July after sampling for early dry matter (DM). Sampling for nodulation was done on 17 August, late dry matter (DM) on 29 August and N_2-fixation 9 September.

What happened?

Initial crop establishment counts indicated a satisfactory plant density for a regenerating medic pasture with 188 plants/m^2. Dry conditions at the start of the season resulted in slow dry matter production. There were no differences in early DM (Figure 1) prior to the imposition of the simulated grazing treatment. However, there was a significant ($P<0.001$) response to the main plot grazing effect, with the un-grazed treatment averaging 4.2 t DM/ha and grazed 2.2 t DM/ha. An average of 0.9 t DM/ha was removed from the 'grazed' plots through simulated grazing, and reduced total medic DM production for the season (3.2 t DM/ha compared to 4.2 t DM/ha).

Table 1 Treatment details

Treatments	Formulation/application	Application rate/ha
Peat	Dissolved	250 g/250 L water
*ALOSCA gran 10	Granular	10 kg
*ALOSCA gran 5	Granular	5 kg
Phosphorous	Triple super phosphate	10 kg
Phosphorous	Triple super phosphate	5 kg
Zinc	Zinc sulphate	2 kg
Sulphur	Gypsum	20 kg
Manganese	Manganese sulphate	3 kg
Nitrogen	Urea	100 kg
Peat inoculated seed	Broadcast	4 kg
Non-inoculated seed	Broadcast	4 kg
Control ^	Nil	Nil

**Alosca granules*
^ Control – regenerated medic with no added nutrition or inoculant

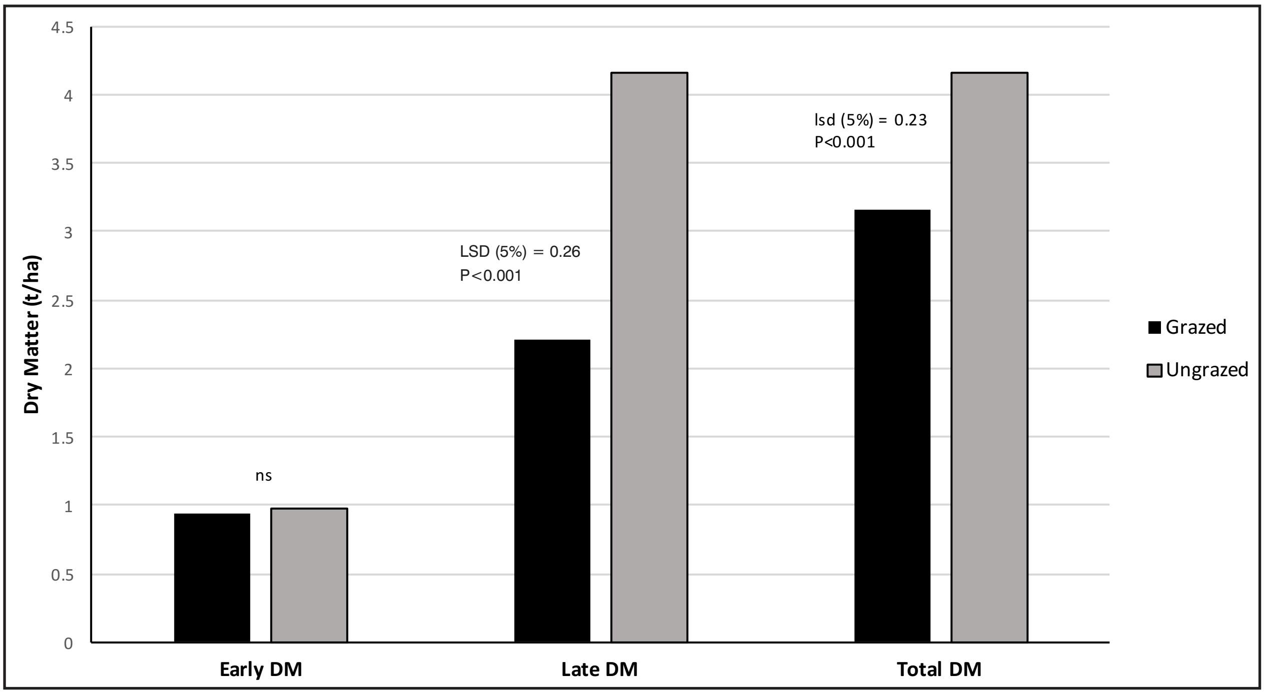

Figure 1 Dry matter (t/ha) for grazed vs un-grazed medic

There were no visible or significant measured effects of the nutrition or rhizobia treatments on above ground DM production irrespective of grazing at any of the 3 sampling times. For total DM (Figure 2), the un-grazed plots produced more DM than the grazed plots with peat (4.8), urea (4.7), and ALOSCA gran 5 (4.7) having the biggest effect on DM (t/ha).

The medic plants at the time of sampling for nodulation and N_2-fixation were large and mature (some had pods). Because of their maturity, it was not possible to distinguish between ineffective and effective nodules and so nodule numbers on the tap and lateral roots was determined. Using a split plot analysis (grazed/un-grazed) there were no significant treatment effects on total nodules per plant (Figure 3). These results are consistent with the presence of reasonably effective background population of rhizobia at the site. That said, the site mean of 6.4 nodules per plant was below the optimum of 10-20 nodules per plant after eight weeks of growth The peat inoculant treatment did have the highest mean nodule number (7.8) and the N_2 fixation data (pending) may provide support to this trend. There were no significant treatment effects on root DM and root damage score.

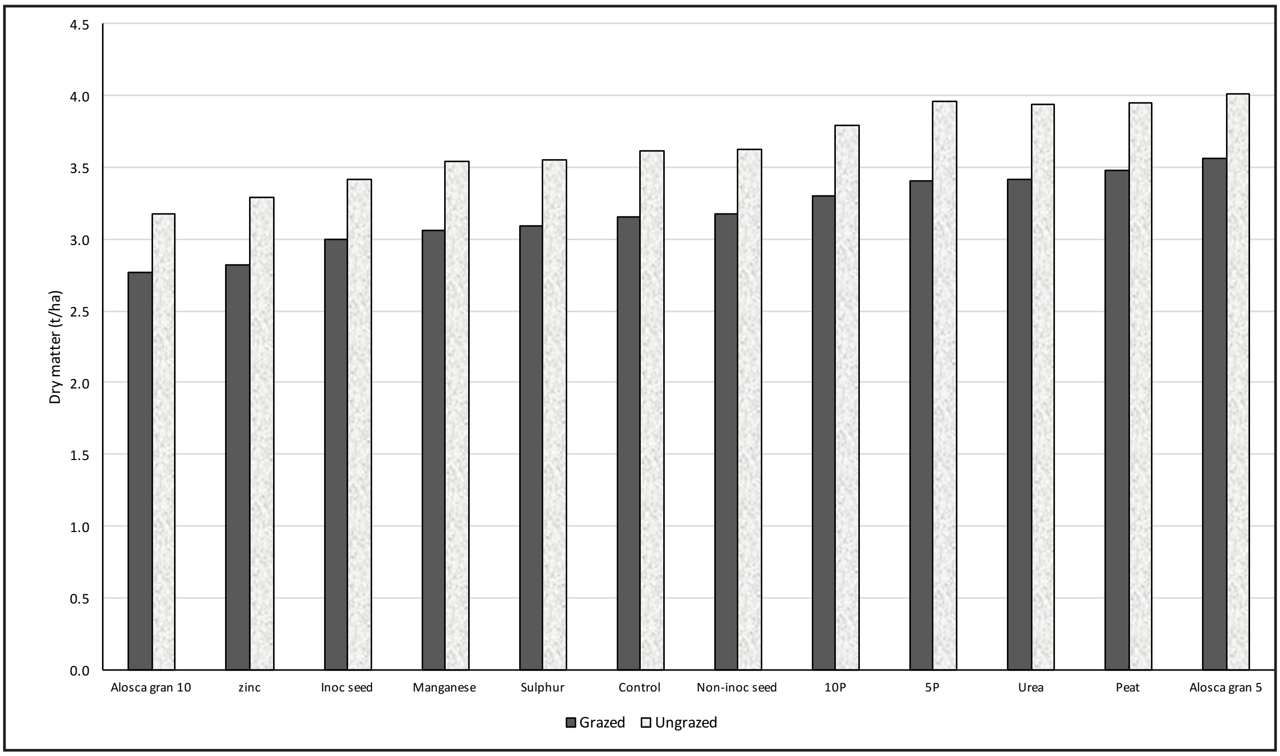

Figure 2 Total dry matter (t/ha) with the grazing effect

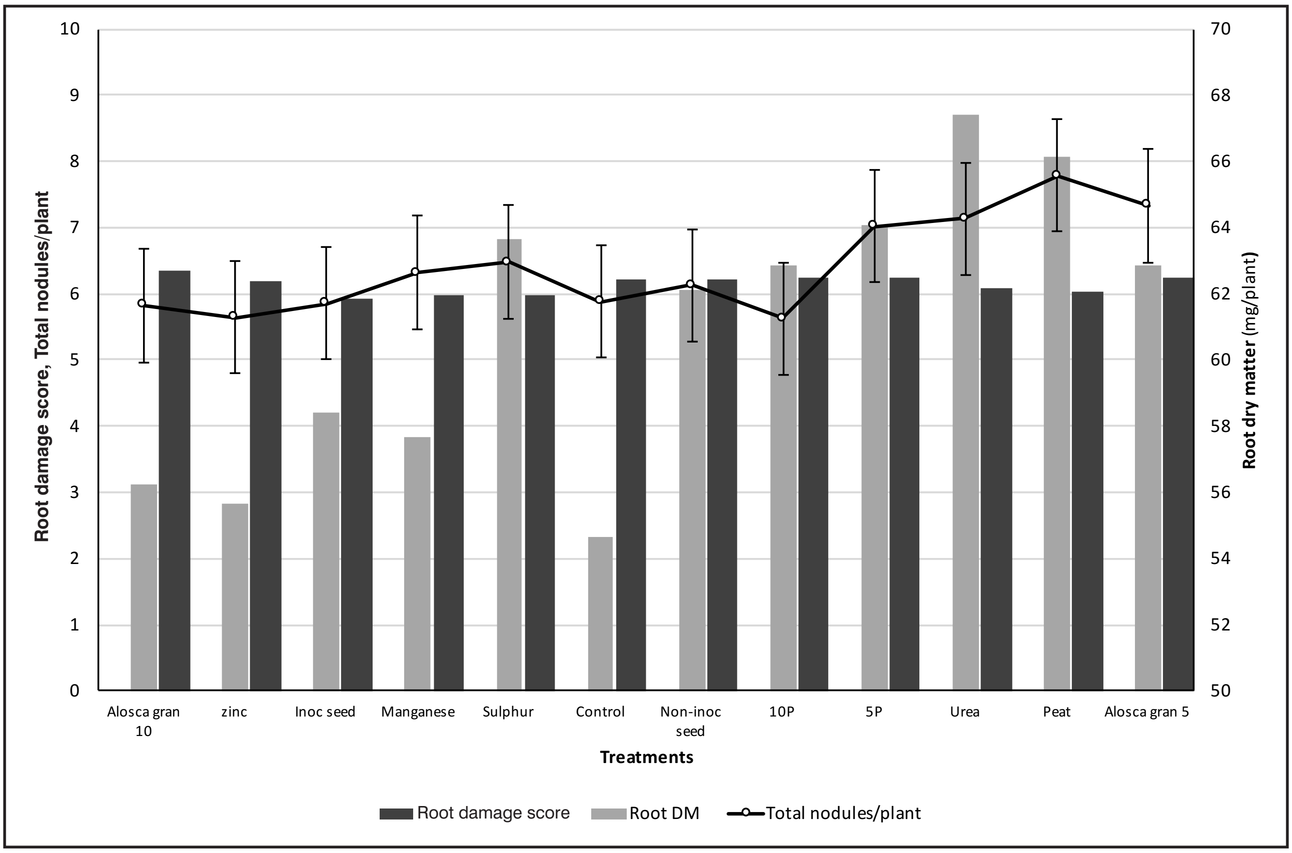

Figure 3 Root damage score, root dry matter and total nodules per plant

Pastures

What does this mean?

Factors that influence the quantity of N fixed are the level of soil N, the number and N_2 fixation capacity of rhizobia that nodulate the legume, and the amount of legume plant growth which is affected by how the legume is managed and the length of growing season. The 2016 growing season was above average and medic growth was good, averaging 3.6 t DM/ha across the site. The lack of any inoculation response was likely the result of the paddock already supporting a satisfactory number (823/g soil) of effective rhizobia. Sowing seed to increase plant numbers did not have a positive effect on plant density and DM production because of the good starting plant population (site mean = 188 plants/m^2). This management strategy is likely to have a positive effect if the background seed for regeneration is low. Good starting levels of macronutrients i.e. 24 mg/kg Colwell P, 20 kg N/ha, 664 mg/kg K and 6.7 mg/kg S; and trace elements 1.2 mg/kg DTPA zinc and 8.8 mg/kg DTPA manganese in the 0-10 cm root zone also confirmed the lack of a DM and nodulation response by the medic pasture.

Total medic DM production was reduced by simulated grazing (3.2 t DM/ha vs 4.2 t DM/ha). The 0.9 t DM/ha removed through grazing (early DM) can support 10 DSE/ha with a DM intake of 1.5 kg DM/ha/day for approximately two months, therefore if we factor in the value of DM removed by grazing, then the overall benefit of grazing would increase. The difference in total DM can also be attributed to the fact that simulating grazing through the use of a mechanical mower is not ideal as sheep are usually selective when they graze and also they put back into the system some nitrogen, particularly in urine, while the mowing is non-selective and provides no nutrients. The use of sheep would provide a more realistic assessment of grazing on DM production, nodulation and N_2-fixation.

While there are general concerns about medic nodulation and N_2 fixation, the paddock in this study provides an example of what is possible where there are adequate numbers of effective rhizobia and reasonable nutrition. Future studies should target paddocks with less nutrition, where poor medic growth has been observed and the rhizobia background has been confirmed as poor so that the importance of re-inoculating low rhizobia paddocks and improving soil nutrition can be demonstrated. N_2 fixation data are still pending, but if 20 kg/t shoot DM is achieved then the 4.2 t/ha of un-grazed regenerating medic pasture will have contributed about 100 kg/ha of fixed N (including a contribution from roots).

Acknowledgements

Thanks to Brent Cronin and family for allowing us to have the trial on his property, Ian Richter for technical support, Ross Ballard and Nigel Wilhelm for their continued input in this project. The Eyre Peninsula Grain and Graze project is funded by GRDC (SFS00028).