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Livestock

Enrich – Incorporating a perennial shrub feedbase into mixed farming systems on Eyre Peninsula

RESEARCH

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Searching for answers

Location: Minnipa Ag Centre
Rainfall
Av Annual: 325 mm
Av GSR: 241 mm
2011 Total: 404 mm
2011 GSR: 252 mm
Soil Type
Red sandy loam

Location: Piednippie
Tim and Trecina Hollitt
Rainfall
Av Annual: 379 mm
Av GSR: 305 mm
2011 Total: 464 mm
2011 GSR: 302 mm
Soil Type
Grey calcareous sandy loam

BOTH SITES
Plot Size
Plant spacing 2 meters within rows and 3 meters between rows
Livestock
Enterprise type: Self replacing merinos
Stocking rate: Rotational grazing and district practice
Environmental Impacts
Soil Health
Soil structure: Stable
Compaction risk: Grazing
Ground cover or plants/m^2: Forage shrubs

Key messages

- **Farmscapes can be redesigned to incorporate a mixture of perennial shrubs as an addition to the existing feedbase, offering multiple benefits for mixed farming systems in low rainfall areas.**
- **Perennial shrubs complement rather than compete with cropping and can contribute to whole-farm profitability and sustainability.**
- **Developing a mixed stand of perennial shrubs is the best way of balancing establishment risk, survival, growth and livestock utilisation.**

Why do the trial?

Eyre Peninsula low rainfall mixed farming systems have the potential to incorporate a mixture of shrubs as a perennial feedbase for innovative, profitable and more sustainable grazing enterprises that are based on sound resource management principles.

There are opportunities to utilise unproductive and underutilised land to redesign farmscapes in the livestock-cropping zone to achieve multiple benefits for the animal, the farmer and the environment. In most cases, perennial shrubs complement rather than compete with cropping and furthermore do not compete with pasture but are an addition to the existing feedbase.

Producers can gain major advantages by incorporating perennial shrubs into their system through improved livestock production and health, providing green feed over summer/autumn, making use of unseasonal rain and providing shade and shelter for livestock. In addition, there is a suite of other natural resource management benefits such as reducing salinity through more effective water use, controlling erosion and soil degradation through better land cover and improving biodiversity in farming systems. By developing productive use of land that is unsuitable, or becoming unsuitable for profitable grain/pasture production, farmers can contribute to whole-farm profitability and sustainability.

How was it done?

With the support of the Eyre Peninsula Grain & Graze 2 project, the Future Farm Industries Cooperative Research Centre (FFI CRC) research project 'Enrich' has been established to investigate the potential to incorporate a mixture of perennial species into farming systems in low-rainfall areas across southern Australia.

Perennial or annual plants: Perennial
Grazing Pressure: Piednippie (148 DSE/ha), Minnipa (90 DSE/ha)
Water use
Runoff potential: Low
Resource Efficiency
Energy/fuel use: Standard
Greenhouse gas emmissions (CO_2, NO_2, methane): Livestock
Social/Practice
Time (hrs): Extra livestock management
Clash with other farming operations: Standard practice
Labour requirements: Livestock may require supplementary feeding and regular checking
Economic
Infrastructure/operating inputs: High cost of establishment
Cost of adoption risk: Low

Two Enrich perennial shrub sites at the Minnipa Agricultural Centre (MAC) and Piednippie were planted on upper Eyre Peninsula as tubestock in 2009, each with 4 replicates of 15 species with 36 plants in each replicate.

Refer to the EPFS Summary 2010, pg 139 for a list of the botanical and common names of the forage shrub species planted at the Minnipa and Piednippie Enrich field trials.

Ongoing measurements in autumn and spring have monitored plant survival, growth, plant health, flowering/fruiting, recruitment, edible biomass, as well as defoliation (palatability) and recovery after the first grazing period in autumn 2011.

The 4 replicates at the Minnipa site were fenced separately and grazed individually, whereas the Piednippie site was not fenced, thus all replicates were grazed at the same time. Grazing information for both sites is given in Table. 1.

What happened?

Measurements taken at both sites have shown that there are a selection of perennial shrub species that have adapted well to the regions and have favourable survival and growth characteristics, compared to other species that have very few remaining shrubs on both sites. Figure 1 shows the survival characteristics of the shrubs since their establishment of 36 plants in 2009.

Table 1 Grazing method, grazing period, days grazed, sheep numbers and stocking rate for both Minnipa and Piednippie Enrich sites, 2011

Site	Grazing method	Grazing period	Days grazed	Sheep number	Stocking rate
Minnipa	Rotational	15 March - 23 May	15, 22, 16, 18 days/replicate	22 wethers	90 DSE/ha
Piednippie	Set-stocked	25 March - 5 April	12 Days	120 dry ewes	148 DSE/ha

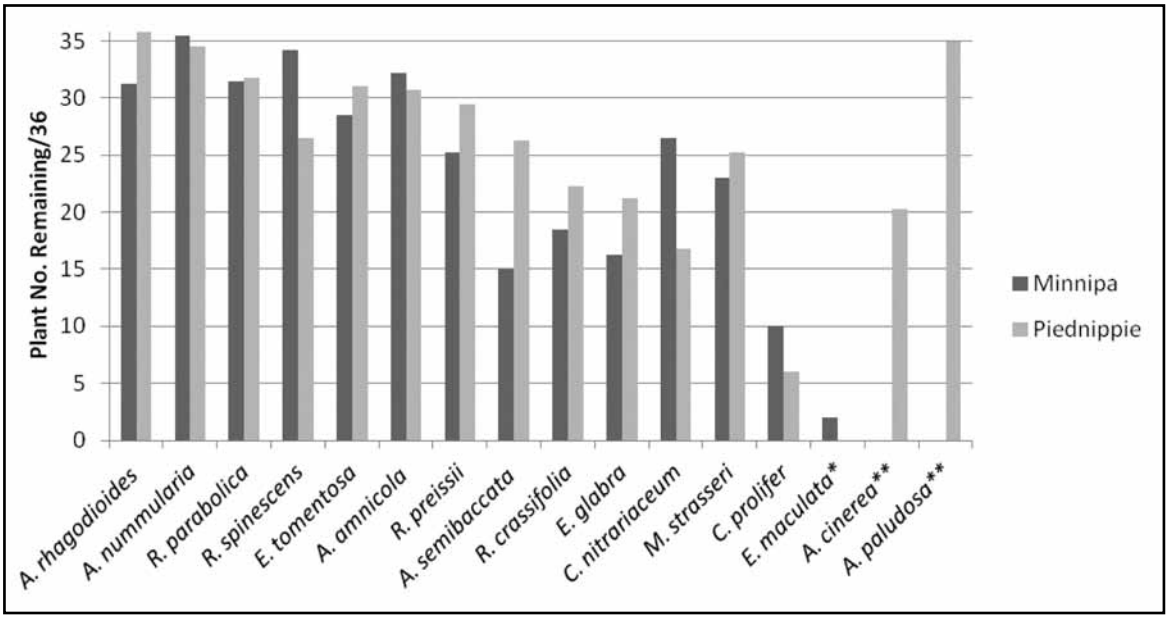

Figure 1 Perennial shrub survival for Minnipa and Piednippie Enrich sites in spring 2011 (plant numbers remaining out of 36 established in 2009)

**Species at Minnipa site only, **Species at Piednippie site only*

Biomass production measurements were taken for each shrub (excluding the outside shrubs in each species for edge effect for a total of 24 plants for each species) using two different techniques in the autumn and spring sampling periods. The first method used height x width x depth calculated measurements of each shrub, which can give an advantage to the taller shrubs, or those that have long branches. The 'Adelaide Technique' was also used for better accuracy, which was calculated by choosing a representative individual plant 'unit' of each shrub species, measuring this 'unit' objectively, through sampling a portion of the shrub for dry matter and the shrub given a corresponding score. The sampled 'unit' was then separated for edible and inedible proportions dried and weighed.

Table 2 Average edible biomass (grams of dry matter/ plant) and average biomass (height x width x depth in m³) for Minnipa and Piednippie sites pre and post grazing 2011 (autumn and spring measurements)

Scientific name of shrub	Minnipa			Piednippie	
	Average Biomass*			Average Biomass*	
	Edible (g/plant) Pre-grazing	Edible (g/plant) Post-grazing	HxWxD (m³) Post-grazing	Edible (g/plant) Pre-grazing	HxWxD (m³) Post grazing
C. prolifer	4	7	0.01	40	0.07
R. parabolica	1736	2095	2.87	1425	2.98
A. nummularia	2349	1526	4.19	2831	4.81
R. crassifolia	369	673	0.79	666	1.38
R. spinescens	1231	843	1.45	581	0.93
C. nitrariaceum	133	130	0.68	48	0.47
M. strasseri	27	22	0.02	103	0.15
C. remotus/ A. nummularia	0/1730	0/1218	0.32/3.73	n/a	n/a
E. tomentosa	1001	297	0.32	1178	0.47
E. glabra	187	72	0.05	600	0.44
A. amnicola	720	335	0.39	1357	0.49
A .rhagodioides	2606	1074	3.45	1582	1.64
A. semibaccata	390	153	0.14	2068	0.25
R. preissii	662	809	1.33	1864	3.66
E. maculata	2	6	0.01	n/a	n/a
A. cinerea	n/a	n/a	n/a	770	1.37
A. paludosa	n/a	n/a	n/a	1427	1.05

**Averages are calculated from the plants surviving on each site*

Table 3 Average defoliation percentages over the grazing periods at Minnipa and Piednippie Enrich sites (i.e. 10% defoliation refers to 10% of shrub edible biomass)

Scientific name of shrub	Minnipa Defoliation %				Piednippie Defoliation	
	Rep 1**	Rep 2**	Rep 3**	Rep 4**	@ 5 days	@ 12 days
*C. prolifer**	-	100	100	100	100	100
R. parabolica	0	0	5	5	0	0
A. nummularia	95	30	100	100	50	100
R. crassifolia	5	90	100	100	5	5
R. spinescens	5	60	100	100	20	65
*C. nitrariaceum**	100	100	100	100	95	100
*M. strasseri**	100	100	100	100	100	100
C. remotus/ A. nummularia	-/95	-/30	-/100	-/100	n/a	n/a
E. tomentosa	100	95	100	100	50	100
*E. glabra**	100	100	100	100	85	100
A. amnicola	100	95	95	100	10	85
A .rhagodioides	50	50	90	90	50	100
A. semibaccata	100	100	100	100	65	95
R. preissii	5	90	100	100	0	0
*E. maculata**	-	100	-	-	n/a	n/a
A. cinerea	n/a	n/a	n/a	n/a	20	100
A. paludosa	n/a	n/a	n/a	n/a	0	10

** Please note some of the species had minimal survival and biomass recordings at the commencement of grazing*
*** Please note that sheep grazed each replicate (1-4) for different periods, at 15, 22, 16 and 18 days respectively*

Each plant within the species was given a comparative score to the sampled shrub and the individual plant biomass calculated by multiplying the sampled biomass by the given score of each shrub. Table 2 presents both the biomass measurements and the averages for each species over both sites.

The sheep grazed one replicate at a time at the Minnipa site, changing dietary preference with each area and becoming more adventurous with species selection. Although the entire site was grazed at one time at Piednippie with a different livestock class, selection trends were very similar.

At the beginning of the trial the sheep targeted 9 species for the majority of their feed intake with defoliation percentage ranging from 95-100 and other species ranging from 0-50 percent. Favoured species with 100 percent defoliation throughout the trial included the *M. strasseri*, *A. semibaccata* and *C. nitrariaceum*, which were always the shrubs selected first by the sheep. Although the shrub commonly known as the *R. parabolica* had plenty of edible biomass and was similar in structure and texture to other very palatable shrubs, the sheep would not graze this particular species. By the end of the trial period this changed significantly and sheep were grazing the entire palatable component of the shrub in 14 out of the 15 species on site.

The changing pattern of grazing behaviour in the Enrich trial is shown in Table 3, which portrays one of the interesting learning experiences observed in livestock in the forage shrub grazing system research.

What does this mean?

Obtaining an ideal balance of desirable properties in a perennial shrub feedbase can be quite difficult as survival, growth and palatability properties can often vary greatly within species. On the Minnipa and Piednippie sites *R. parabolica* and *A. paludosa* had excellent survival and growth characteristics but were not eaten by the sheep. Conversely the *M. strasseri* and *E. glabra* species were quite palatable; however they had low growth and survival statistics. This highlights the significance of having a range of perennial shrub species in a feedbase to offset desirable and non-desirable properties of other species.

It is obvious from the data presented in Table 3 that once livestock familiarised themselves with a particular new feed, they learnt to incorporate it into their diet and did not hesitate the next time the feed was offered. Understanding the behavioural phenomenon of livestock diet selection in these grazing systems is a fascinating area of study, yet is one that still has some grey areas that need to be explored further. A mixture of forage shrub species in a grazing system can provide the best opportunity for livestock to do well on perennial shrub stands as it provides a better balance in livestock diet compared with single species shrub stands, and also allows for equilibrium of species with advantageous properties in different areas. Furthermore, livestock would be more productive if a perennial shrub feedbase was offered to complement existing annual pasture, rather than providing the animals with shrubs alone.

Selecting a range of perennial shrub species and subsequently incorporating the feedbase into farming systems can be extremely beneficial for a variety of reasons benefiting both the livestock and the land, thus contributing to whole-farm profitability and sustainability.

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