Sulla - a new break crop for EP?

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RESEARCH

Searching for answers

Location:
Minnipa Ag Centre
Rainfall
Av. Annual: 324 mm
Av. GSR: 241 mm
2013 Total: 334 mm
2013 GSR: 237 mm
Yield
Potential: (W) 2.5 t/ha
Actual: 2.4 t/ha
Paddock History
2012: Pasture
2011: Pasture
Soil Type
Red calcareous sandy loam

Location:
Edillilie
Shane Nelligan
Rainfall
Av. Annual: 420 mm
Av. GSR: 340 mm
2013 Total: 537 mm
2013 GSR: 463 mm
Yield
Potential: 7.0 t/ha Wheat
Actual: 3.9 t/ha
Paddock History
2012: Pasture
2011: Pasture
Soil Type
Acidic sandy gravel over clay
Environmental impacts
Soil Health
Soil structure: Stable
Compaction risk: Nil no livestock
Ground cover or plants/m^2: standard crop establishment and management practice no grazing
Perennial or annual plants: Short lived perennial and annual
Water Use
Runoff potential: Low
Resource Efficiency
Energy/fuel use: Standard
Greenhouse gas emissions (CO_2, N_2O): Cropping
Social/Practice
Time (hrs): No extra
Clash with other farming operations: Phase rotations as opposed to ley systems
Economic
Infrastructure/operating inputs: Sulla has high seed costs
Cost of adoption risk: Medium

Key messages

- **Sulla produced more spring biomass and similar or higher subsequent grain production to an annual legume pasture over a 3 year pasture-pasture-wheat rotation.**
- **Sulla provides an option to consider for a 2 year break on the more reliable cropping soils of EP.**

Why do the trial?

A recent survey on Eyre Peninsula indicated that many mixed farms are extending the number of years of continuous cereal to 3, 4 or more years followed by a 2 year break, as opposed to a 1 or 2 year cereal followed by a regenerating legume pasture. This is called a phase rotation where the pasture phase requires re-establishment at the completion of the crop phase as opposed to the ley system where the legume pasture will regenerate from a seed bank after a 1 or 2 year crop phase. This rotation adaption has provided the opportunity to consider *Hedysarum coronarium* (sulla) as a species that may better fit a 2 year break. Sulla is a highly productive biennial or short lived perennial pasture legume. It is highly palatable with excellent forage and fodder qualities, which may result in increased animal performance.

How was it done?

In 2010 sulla was established at four Eyre Peninsula perennial pasture evaluation sites, Minnipa, Rudall, Edillilie and Greenpatch (EPFS Summary 2010, 2011 and 2012, p 141, 139 and 138 respectively).

In 2011 sulla was included in 2 rotation trials; one at Minnipa and the second at Edillilie. These rotation trials included a number of crop and pasture break crop treatments, however this article is comparing sulla with the currently recommended annual pasture species in each region, annual medic at Minnipa and sub-clover at Edillilie. The trials were comparing the biomass production and the subsequent wheat yield of the 2 species, over a 3 year pasture-pasture-wheat rotation. Each trial was replicated 3 times; plot sizes were 20 m by 1.5 m at Minnipa and 12 m by 1.5 m at Edillilie. Soil type at Minnipa is a sandy loam pH $CaCl_2$ 7.8 increasing with depth, Edillilie is gravelly sand over clay pH 5.5 $CaCl_2$ declining with depth. Sulla seed was inoculated with its specific rhizobia, the annual medic and sub-clover were not inoculated based on background rhizobia populations.

Plant establishment densities in 2011 and biomass production data, in 2011 and 2012, were collected from 4 by 0.5 m^2, plant establishment, 2 by 0.5 m^2, biomass production, quadrats at Minnipa and from 3 by 0.2 m^2 quadrats at Edillilie. In 2012 canola was dry sown into the Minnipa annual medic treatment on 24 April to increase the potential biomass of the second year pasture. There was no fertiliser applied in 2012 at either site.

In 2013 Mace wheat was sown at Minnipa at 55 kg/ha with 65 kg/ha DAP (18:20:0:0) on 14 May and at Edillilie at 85 kg/ha with 80 kg/ha of DAP (18:20:0:0) on 20 May. At Edillilie, based on visual observation the wheat following the sulla treatment received 100 kg/ha of urea (46 units of N), the wheat following sub-clover 50 kg/ha of N, both were manually top-dressed on the 15 August. There was no in-crop nitrogen applied at Minnipa. Selective grass control was applied in 2011 and 2012; selective broadleaved weed control was applied in 2013 at both sites.

Table 1 Pasture variety, sowing date, seeding rate and fertiliser applied to sites at Minnipa and Edillilie in 2011

Minnipa	Variety	Sowing Date	Seeding rate	Fertiliser
Sulla	Wilpena	2 May	5	12 N and 13 P
Annual medic	Angel	2 May	5	12 N and 13 P
Edillillie				
Sulla	Wilpena	26 May	5	18 N and 20 P
Sub-clover	Dalkeith	26 May	10	18 N and 20 P

Treatment means were not statistically significant due to only 2 treatments and 3 replicates being analysed (2 degrees of freedom), however the results are discussed in the context of data presented.

What happened?

The Eyre Peninsula perennial legume evaluation study 2010 to 2012 has shown sulla to be highly productive on EP cropping soils when rooting depth was not constrained, especially in the growing season following establishment.

Minnipa received average rain in 2011 and 2013 and below average in 2012. Rain at Edillilie was above average in 2011 and 2013 and slightly below in 2012.

Pasture plots were mown to simulate grazing immediately following each biomass sampling. Canola as part of the 2012 regenerated annual medic pasture at Minnipa was a declining proportion over the 3 samplings, 100% on 9 July, and 20% on 17 September.

The annual pastures produced similar or more biomass in the winter than sulla, apart from the Minnipa site in 2012 where an annual medic canola mix produced less. The sulla produced similar or increased spring biomass production at both sites in both years.

Table 2 Minnipa and Edillilie 2011, 2012 and 2013 growing season and total annual rainfall (mm)

	Minnipa		Edillillie	
	April - October	Annual	April - October	Annual
2011	252	404	422	500
2012	185	253	290	400
2013	237	334	463	537
Mean	242	325	340	420

Table 3 Minnipa and Edillilie sulla and annual medic/sub-clover plant establishment (plants/m^2) in 2011 and biomass production (tDM/ha) in 2011 and 2012

	2011			2012		
	(plts/m^2)	(tDM/ha)		(tDM/ha)		
Minnipa	**27 May**	**11 Aug**	**19 Sept**	**9 July**	**8 Aug**	**17 Sept**
Annual medic (& canola**)	123	2.1	*	0.5	1.7	1.3
Sulla	26	<0.1	3	1	3.3	1.9
Edillillie	**17 June**	**1 Sept**	**22 Oct**	**13 July**	**22 Aug**	**1 Oct**
Sub-clover	170	1.5	4.4	0.8	1.9	2.1
Sulla	49	0.1	6.7	0.5	1.1	2.4

**Annual medic did not recover following 11 August mowing (simulated grazing treatment) as a result of powdery mildew infestation.*
***In 2012 only.*

Table 4 Minnipa and Edillilie soil water content (mm) and nitrogen (mg/kg NH_4 and NO_3) in April, grass weed populations (plants/m^2) in July and wheat grain yield (t/ha) and protein content (%) in 2013

	Soil water	Soil nitrogen	Grass weeds	Grain yield	Grain protein
Minnipa	**(0-1.2 m)**	**(0-0.3 m)**	**(plts/m^2)**	**(t/ha)**	**(%)**
Annual medic	113	42	10	2.4	10.3
Sulla	111	50	20	2.2	11.4
Edillillie	**(0-0.6 m)**	**(0-0.1 m)**			
Sub-clover	91	29	16	3	9.6
Sulla	87	20	5	3.9	9.9

The soil water contents and residual soil nitrogen levels were similar in April between treatments at both sites, grass weed densities were variable. Grain yield at Minnipa following sulla was 10% less than following annual medic with a similar 10% increase in grain protein content. Grain yield at Edillilie was 30% higher with a similar grain protein content following sulla compared to sub-clover, however the sulla-wheat treatment received an extra 23 units of nitrogen in August 2013.

What does this mean?

In this study sulla has produced similar or increased biomass to the annual pastures in seasons of above and below annual average rainfall. However sulla shifted the pasture biomass production to later in the season, outside the normal period of winter forage deficit. The value of that spring flush may be in hay production or protecting annual pastures while awaiting the availability of crop stubbles. There is also the potential opportunity for increasing weight gains in prime lambs in preparation for an early turn-off.

The subsequent wheat production at Minnipa was similar between treatments in an average rainfall season, and there were no indications in soil water or residual N of a yield benefit resulting from either treatment. The higher protein content after sulla may have been a response to a lower yield trend.

At Edillilie the higher wheat grain yield with similar protein content after sulla compared to sub-clover has several possible explanations. An extra 23 kg/ha of N in August was a possible reason coupled with lower annual rye grass populations. This is supported with the results from not reported companion treatments which also received 23 kg/ha of N in August, canola-lupins-wheat and lupins-canola-wheat yielded 3.8 and 3.7 t/ha with a grain protein content of 9.9 and 10% respectively, a similar result to the sulla-sulla-wheat treatment. There was no suggestion of increased soil water use by the wheat after sulla with similar soil water contents between treatments on 29 November, however samples were physically unable to be removed below 0.3 m and therefore is not a conclusive outcome.

This study provides preliminary information relating to the potential of sulla as an inclusion in mixed farming systems where the farmer is addressing crop production constraints, including grass, pest and disease control, through implementing a 2 year non-cereal break. Economically the current cost of sulla seed may restrict its use to the more reliable rainfall regions of EP. Sulla will also need to demonstrate a wide range of agronomic and animal production benefits, such as effective alternative grass control options, and animal health and production advantages before it is widely introduced on Eyre Peninsula.

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