Sulla (*Hedysarum coronarium*) broad acre demonstration at MAC

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RESEARCH

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Location:
Minnipa Agricultural Centre
Rainfall
Av. Annual: 325 mm
Av. GSR: 241 mm
2014 Total: 407 mm
2014 GSR: 290 mm
Yield:
Potential: 4.0 t/ha
Paddock History
2013: Sulla
2012: V. pasture/chem fallow
2011: Durum wheat
Soil Type
Red sandy loam
Plot Size
9 m x 275 m x 5 reps
Harvested area -
9 m x 15 m x 5 reps

Key messages

- **Weed control prior to sowing is imperative for successful establishment of sulla.**
- **Specific rhizobia inoculant for sulla must be used at sowing for effective nodulation.**
- **Sulla, medic and vetch all increased mineral N, but vetch more than doubled mineral N in one year.**
- **Regular monitoring in early spring will assist in managing pest outbreaks.**
- **There can be a grazing opportunity in the first year if sufficient biomass and flowers have been produced to ensure survival over summer and sufficient plant numbers in the second year.**
- **Sulla production was slow following establishment, but rapidly increased with the onset of warmer spring temperatures.**
- **There was an increase in Rhizoctonia (AG8) inoculum levels with sulla.**
- **There are presently no registered chemicals for weed control in sulla.**

Why do the trial?

The aim of the paddock demonstration was to measure the effects of sulla on soil health and weed burden, determine the financial viability of establishing a two-year break phase within an existing cropping rotation and the feasibility of harvesting the seed for on-farm use.

How was it done?

The barn paddock at Minnipa Agricultural Centre was a grass free pasture in 2012, the year prior to sowing sulla. The paddock was sown on 2 May 2013 using a 9 m air seeder with knife points and 30 cm row spacing. The paddock was divided into five blocks; consisting of three sulla, one vetch and one medic block in 9 m wide seeder widths. Sulla (Wilpena) seed coated with sulla specific peat inoculum was sown at 3 kg/ha at 2.5 cm depth. Vetch (Cummins) was sown at 40 kg/ha and 2.5 cm depth, not inoculated. Medic (Angel) Goldmark® was sown at 3 kg/ha and 1 cm depth. All strips had 9 kg of N and 10 kg of P applied as 50 kg/ha of DAP (18:20:0:0). Broad-leaved and grass selective herbicides and pesticides were applied when required. Additional fertiliser with 10 kg/ha of N and 12 kg/ha S as sulphate of ammonia was applied on 1 July 2013. The vetch areas were significantly reduced in plant numbers due to in crop herbicide damage.

On 2 October 2013, 340 ewes and 445 lambs had access to blocks of sulla, vetch and medic for two days until approximately 10 cm of biomass remained on the sulla plants. The decision to graze was based on better than expected dry matter yields. A block of sulla and vetch was kept un-grazed as a comparison of persistence into the second year.

In 2014, all treatments were left to regenerate/self-seed. There were two applications of broad-leaved herbicide; flumetsulum @ 25 g/ha on 5 May to address marshmallow, and metribuzin @ 300 g/ha on 11 July for thistles and other broad-leaved weeds. The paddock was treated twice with pesticides, once for pests early in the season and the second time to control green peach aphids.

Biomass production was measured on 27 August with a 0.5 m^2 quadrant at four locations per area. Samples were sorted for sulla, vetch, medic, broad-leaved weed species and annual grasses. The separated samples were oven dried at 70°C for 48 hours before recording dry weight.

On 4 September the paddock was cut for hay using a mower conditioner. The hay was left to cure for 24 days to ensure drying of the thick fibrous stems of the sulla plant. Following a raking of the hay on 25 September the hay was baled overnight on 28 September. Feed test samples were collected prior to baling on 24 September and analysed at Agrifood Technology FeedTest laboratory.

At the western end of the paddock, an area of approximately 15 x 9 m area from each sulla run was retained as a standing crop for the purpose of measuring seed production and harvestability. The sulla was not desiccated and was harvested (direct headed) with the farm header on 1 December 2014.

What happened?

Trying to make direct comparisons between the three pastures; vetch, medic and sulla, poses a challenge because sulla is a biennial with a 2-3 year lifespan compared to the annual medic and vetch species. For this reason sulla does not achieve peak biomass production until the second year, once it has established a deep root system. This was reflected in the 2013 dry matter data collected prior to grazing where vetch and medic produced 2.3 t/ha and sulla 1.3 t/ha on 203 mm of rainfall since sowing on 2 May 2013.

Summer rainfall and mild autumn conditions in 2014 resulted in rapid regeneration of pastures early in the season. Table 1 outlines the changes to soil chemistry in the 0-10 cm topsoil from pre-trial 2013 to after one year of pasture options. Most notable were decreases in sulphur despite the application of 12 kg/ha S in the form of sulphate of ammonia on 1 July 2013. Other soil properties changed little.

Table 1 Soil chemistry of 0-10 cm layer of demonstration paddock prior to sowing and post one year break

	2013	April 2014					
	Pre-trial	Grazed in 2013			Un-grazed in 2013		
		Medic	Sulla	Vetch	Medic	Sulla	Vetch
pH ($CaCl_2$)	7.8	7.8	7.6	7.7	8.0	8.0	7.9
Colwell P (mg/kg)	45	47	49	44	42	45	46
Colwell K (mg/kg)	1040	877	910	917	973	867	927
Sulphur KCl_{40} (mg/kg)	5.0	2.6	3.7	2.7	4.5	3.8	2.8
Organic Carbon (%)	1.19	1.16	1.25	1.24	1.43	1.23	1.31

Table 2 Comparison of treatments for Rhizoctonia root disease, soil water and mineral nitrogen to depth in soil

	April 2014					
	Grazed in 2013			Un-grazed in 2013		
	Medic	Sulla	Vetch	Medic	Sulla	Vetch
Rhizoctonia solani AG8 0-10 cm (pgDNA/g)	8	142	<2	5	262	<2
Soil water 0-90 cm (mm)	147	135	158	154	136	168
Mineral Nitrogen 0-90 cm (kg/ha)	146	174	229	296	174	211

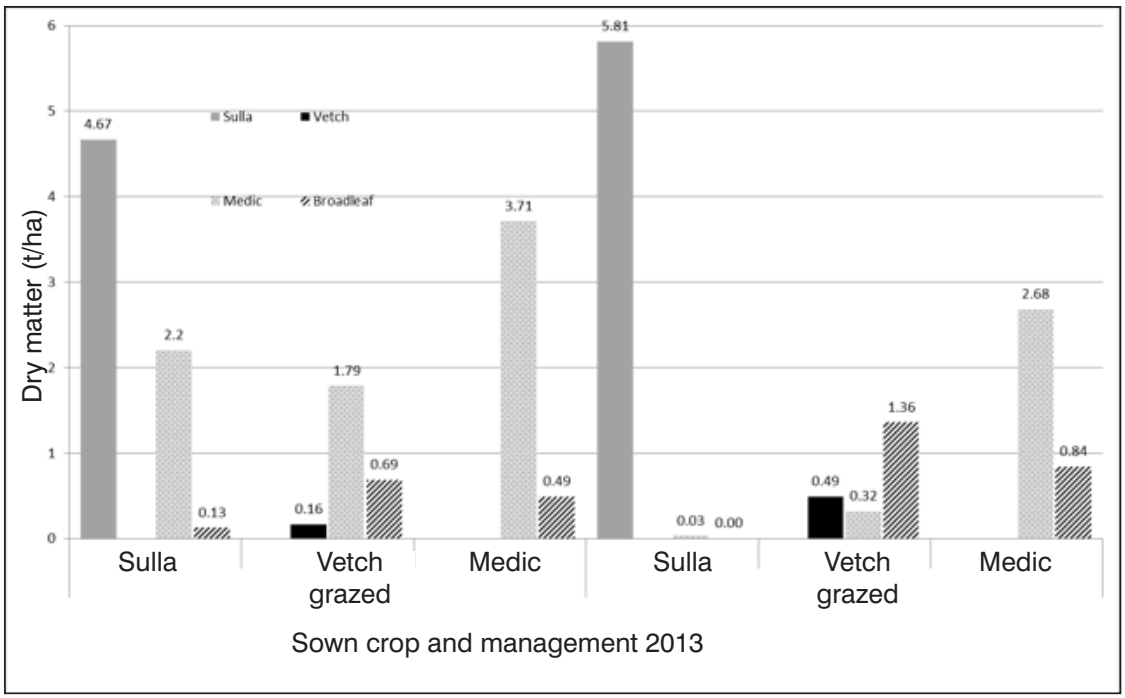

Figure 1 Dry matter production from cuts on the 27 August, 2014. The vetch area was reduced in plant numbers in 2013 by herbicide damage

Table 3 Feed test analysis from samples collected 24 September 2014. Percent composition of samples based on spring biomass cuts collected 27 August

	Grazed (2013)			Un-grazed (2013)		
	Sulla 15% medic	**Vetch** 68% medic, 27% b weeds	**Medic** 12% b weeds	**Sulla**	**Vetch** 13% medic, 64% b weeds	**Medic** 22% b. weeds, 7% grass
Crude Protein (% of DM)	14.4	18.5	18.6	15.2	17.6	18.4
Neutral Detergent Fibre (% of DM)	44.4	43.8	42.7	44.1	42.1	43.4
Digestibility DMD (% of DM)	66.6	64.2	64.4	67.6	66.8	63.6
Est. Metabolisable energy (MJ/kg DM)	9.8	9.4	9.5	10.0	9.9	9.3
AFIA grade*	A2	B2	B2	A2	A2	B2

**The Australian Fodder Industry Association (AFIA) has a developed set a national hay grades for domestic and export trade. The grades range from D4 to A1 with A1 being premium quality. The grade is calculated from the crude protein, digestibility and metabolisable energy, as analysed from common quality testing methods. B weeds = broad-leaved weeds.*

Table 2 shows that the incidence of *Rhizoctonia solani* AG8 in the sulla treatments has increased from initial levels of 8.5 pg DNA/g. It has been documented in other research that sulla is susceptible to the AG-2-2 strain of *Rhizoctonia solani* but not affected by the AG8 strain. A separate analysis from the root system of a sulla plant collected 25 July 2014 confirmed that the roots were infected with the AG8 strain. However, no visible Rhizoctonia patches have been observed in the sulla areas.

Prior to the trial being sown in 2013 soil analysis revealed 90 kg/ha of mineral N in the top 90 cm following a volunteer pasture/chemical fallow in 2012. After one year of either a medic, sulla or vetch pasture, nitrogen levels have increased further. Medic left un-grazed resulted in an extra 206 kg N/ha. Sulla showed no difference in mineral N between grazing or not grazing with an additional 84 kg/ha. Vetch more than doubled mineral N in one year with little difference in grazed versus un-grazed.

Feed test analysis has shown that the crude protein of Sulla was less than that of medic. The neutral detergent fibre, which is a measure of total cell wall content, was similar across the treatments with little variation between grazed and un-grazed, Sulla was slightly higher with figures above 44% of DM compared to 42-43.8% for other treatments. High quality feeds have a digestibility of > 65% of DM in conjunction with protein and fibre content (FeedTest interpretation sheet). The sulla is highly digestible with figures ranging from 66.7-67.6% of DM. In terms of energy, 8 MJ/kg of DM is required for maintenance of adult sheep and 11 MJ/kg for growing lambs or lactating ewes, therefore all treatments met the livestock requirements.

Soil water measurements collected after hay baling on 30 September showed similar levels with between 138 and 140 mm of water remaining in the 0-90 cm profile for the different crops.

The sulla area of approximately 0.06 ha was left to desiccate naturally and was harvested by direct heading using the farm header on the 1 December. There was a significant amount of seed loss due to shattering before harvest. The sulla was successfully harvested using canola settings for threshing and airflow but with wheat screens. The total sulla area produced 48 kg of clean seed which is a yield of 0.79 t/ha, despite pod shattering. The harvested seed was cleaned using a medic harvester and this process also de-hulled the seed, providing a sample which could be used for sowing in the future.

What does this mean?

Implications for commercial practice

The preliminary results suggest that sulla might be a viable break alternative in the low rainfall region of upper Eyre Peninsula. Sulla established well in 2013 in a higher than average rainfall season and the early rainfall events in 2014 resulted in greater dry matter production than self-regenerating vetch and medic stands by September. Sulla is a biennial with a 2-3 year lifespan compared to the annual medic and vetch species so it should have achieved peak biomass production in 2014, once it had established a deep root system. This is reflected in the dry matter data in 2013 where vetch and medic produced 2.3 t/ha and sulla 1.3 t/ha (297 mm Jan-2 Oct), compared to 2014 when sulla averaged 5.2 t/ha dry matter (24 Sept) compared to medic 2.4 t/ha and vetch 1.0 t/ha (390 mm Jan-24 Sept). The success of establishing plants during a below average rainfall year is yet to be determined.

Inoculation of sulla seed at sowing with the specific rhizobia is imperative for effective nodulation. After one year of either medic, sulla or vetch, nitrogen levels had increased, but vetch more than doubled mineral N in one year. Predicta B testing showed an increase in Rhizoctonia inoculum levels with sulla in rotation and further testing confirmed the AG8 strain responsible for Rhizoctonia damage in cereal crops.

Control of broad-leaved weeds is essential both for successful establishment, and to increase biomass production within the 2-3 year break phase. Although some trial work has been done on what chemicals can be sprayed on sulla, there are currently no registered chemicals. In this demonstration flumetsulam was applied to address marshmallow, which resulted in some yellowing of the leaves, but no long term damage. This was followed up with an application of metribuzin with no visible crop damage. Managing pests and diseases is also essential to produce higher biomass, with aphids, powdery mildew and rust all being issues during the season.

In good seasons it is likely that there would be an opportunity for either grazing or hay cut in the first year. However grazing the first year has shown to decrease dry matter, limit the seed set and subsequent self-sown plants in the second year and increase weeds through less competition. The sulla produced feed value similar to the vetch and medic and the hay produced (dominantly sulla) was increasingly accepted by the sheep. Similar to any new or foreign feed source, sheep need to be introduced to sulla slowly to familiarise them with the plant or hay and to also avoid any health issues. Sulla not only is highly palatable with excellent forage and fodder quality, it is also non-bloating and has anthelmintic qualities which may reduce worm burdens.

The cost of purchasing seed at $19.40/kg is a result of a complex de-hulling process requiring specialized machinery to be engineered. At the current price it has been cost prohibitive to most farmers in the region given unpredictable rainfall. It is anticipated that with the streamlining of the de-hulling process the cost will fall within the next few years. A section of the sulla was successfully harvested, yielding 0.8 t/ha with a commercial header, although seed loss was high due to pod shatter. The seed was successfully cleaned using a commercial medic harvester. In 2015 this paddock will return to cereal.

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Links and references

Sulla Management Package – A handbook produced by SARDI detailing how to establish and manage sulla

http://www.sardi.sa.gov.au/__data/assets/pdf_file/0019/136441/sardi_sulla_booklet_v5.pdf

Eyre Peninsula Farming Systems Summary 2013 p 70.