Hedysarum, a new temperate forage legume with great potential - Field Evaluation

Carolyn de Koning[1], David Lloyd[2], Steve Hughes[1], Don McLachlan[1], Graham Crocker[3], Suzanne Boschma[3] and Andrew Craig[1]

[1] South Australian Research and Development Institute (SARDI), GPO Box 397, Adelaide, S. Aust. 5001
www.sardi.saugov.gov.au Email dekoning.caroline@saugov.sa.gov.au, hughes.steve@saugov.sa.gov.au mclachlan.donald@saugov.sa.gov.au, craig.andrew@saugov.sa.gov.au
[2] Department of Primary Industries - Queensland, PO Box 102, Toowoomba, QLD 4350
www.dpi.qld.gov.au Email david.lloyd@dpi.qld.gov.au
[3] NSW Agriculture, Agricultural Institute, RMB 944, Tamworth, NSW 2340
www.agric.nsw.gov.au Email graham.crocker@agric.nsw.gov.au, suzanne.boschma@agric.nsw.gov.au

Abstract

Hedysarum has great potential in Australian farming systems. Field evaluation has commenced in SA, QLD and NSW and results to date are encouraging. Hedysarum has the capacity to produce high levels of quality dry matter in winter (5.5 t/ha, Moree, NSW) and spring (26 t/ha, Moree, NSW). In addition, Hedysarum recruits seedlings readily (up to ave. 1,884 plants/m^2 for H. coronarium). Overseas research reports anthelmintic and non-bloating properties, although these are yet to be confirmed for Australian conditions.

Key Words

Hedysarum, legume, forage and evaluation

Introduction

Hedysarum, a legume originating from the Mediterranean region, has been identified by the National Annual Pasture Legume Improvement Program (NAPLIP) as having great potential. In addition, reported animal health benefits (anthelmintic and non-bloating, 5, 6) of *Hedysarum coronarium* and the ability to produce quality (23% protein) high quantity (20t/ha) dry matter (1) have captured the attention of researchers and primary producers. Three species of *Hedysarum* (*H. coronarium*, *H. carnosum* and *H. flexuosum*) are being assessed in field sites in SA, Qld. and NSW. *Hedysarum coronarium* is a short-lived perennial which has been grown in Italy and New Zealand for forage and hay. *H. carnosum* is also a short-lived perennial and *H. flexuosum* is an annual. The main focus of the evaluation sites is to identify suitable parentage for a breeding program (4) and to begin to understand the adaptive range of the genus. Further studies are required to ascertain the agronomic requirements (eg. Fertilisers, sowing rates and times of sowing) of *H. coronarium* (Sulla) in Australia. A breeding program (4) has commenced to address issues such as grazing tolerance, high herbage and seed production, disease resistance to *Rhizoctonia* and hard-seededness (2).

Methods

A cohort was developed and consisted of 30 lines of *H. coronarium*, 10 lines of *H. flexuosum* and 5 lines of *H. carnosum*. Lines in the cohort have a variety of growth habits from erect, to semi-erect, to prostrate and a range of flowering times. Sites were sown in June 2000 in SA (Kapunda & Booborowie), Qld. (Oakey, Glenmorgan & Guluguba), and northern NSW (Moree). Further sites were sown in SA during 2001 at Turretfield Research Centre and Kybybolite Research Centre. The Kybybolite site consisted of a small subset of 6 lines of *H. coronarium* and Moree had 3 lines of *H. coronarium*, 2 lines of *H. carnosum* and 1 line of *H. flexuosum*. Sites were spatially designed with 2 - 4 replicates and sown at 10 kg/ha. Seed of *H. coronarium* and *H. flexuosum* was inoculated. *H. carnosum* did not have the most suitable rhizobia available at the time of sowing, and plots either had nitrogen applied (SA) or were inoculated with *H. coronarium* rhizobium (NSW and Qld). Establishment numbers, herbage production scores, dry matter

yield, seed yield, seedling recruitment and adult plant survival were measured. For the purpose of this paper only dry matter, survival and seedling recruitment will be presented and discussed.

Results

Dry matter production

A select few lines were cut at the Moree, Kapunda and Booborowie sites to provide information on dry matter yields of lines with different growth habits. Dry matter production figures are shown in (Table 1) in the spring of the second year (2001). Table 2 illustrates the seasonal dry matter production of selected lines of the three species at the Moree site.

Table 1: Comparative spring dry matter production (t/ha) of six *H. coronarium* lines at three sites.

Line/cultivar	Growth habit	Moree (NSW)	Kapunda (SA)	Booborowie (SA)
cv. Aokau	Semi-erect	-	3.5	19.4
HS04	Erect	-	7.5	21.8
HS07	Prostrate	23.3	-	-
HS14	Semi-erect	-	10.6	6.5
cv. Girmaldi	Prostrate	24.7	-	-
HS18	Erect	26.0	2.6	12.5

Table 2: Dry matter production (t/ha) of *H. coronarium*, *H. carnosum* and *H. flexuosum* at 4 times during 2001 at Moree NSW (site sown 2000).

Line	28 June	16 August	18 September	10 October
H. coronarium line HS18	5.5	8.7	26.0	19.6
H. carnosum line HC05	8.9	8.4	18.7	8.8
H. flexuosum line HF07	2.2	4.2	9.5	3.3
Lsd 5%	-	3.3	1.5	1.8

Second year regeneration, early spring growth of Sulla at the Booborowie site in South Australia.

Plant survival - adult plants

The number of adult plants to survive into the second year was measured at Kybybolite and at three Qld. sites. In 2001 at the Qld. sites, the best survivors and producers were not consistent from site to site though lines HS05, HS13 and HS19 were among the best at Gulugaba (15, 12 and 13 plants/m^2 respectively) and Oakey (2.5, 4.9 and 8.4 plants/m^2 respectively). Low plant numbers at these sites reflect the drought conditions in Qld during 2001. The Glenmorgan site was also affected by a root rotting disease caused by *Rhizoctonia solani* (4). *Hedysarum carnosum* also had low adult plant survival due to drought conditions (ranged from 6 - 12 plants/m^2 at Oakey and 1.2 - 2.8 plants/m^2 at Gulugaba). At Kybybolite in SA, the lines HS09 and HS26 had the best plant survival (56.3 and 65.2 plants/m^2 respectively).

Seedling recruitment

Table 3 shows the average levels of seedling recruitment of all three species. In SA and NSW, *H. coronarium* appears to be the most prolific in seedling recruitment while in Qld. *H. carnosum* was the most prolific.

Table 3: Average number of seedling recruitment (seedlings/m^2) at sites in SA, Qld and NSW for *H. coronarium*, *H. flexuosum* and *H. carnosum* (variation between lines is shown in brackets).

Site	(a) H. coronarium	Lsd 5%	(b) H. flexuosum	Lsd 5%	(c) H. carnosum	Lsd 5%
Kapunda, SA 2001	11 (0 – 94)	4	11 (2 – 86)	5	24 (0 – 176)	23
Kapunda, SA 2002	1151 (406 – 2130)	673	45 (0 – 458)	11	21 (0 – 695)	53
Booborowie, SA 2001	39 (6 – 188)	9	24 (0 – 425)	20	153 (29 – 546)	400

Booborowie, SA 2002	1884 (750 – 3475)	966	15 (0 – 128)	41	338 (0 – 546)	193
Turretfield, SA 2002	1400 (362 – 2889)	787	512 (0 – 1065)	296	365 (106 – 533)	310
Kybybolite, SA 2002	335 (100 – 500)	63	-	-	-	-
Oakey, Qld 2001	4.3 (0.6 – 13.5)	n.a.	3 (1 – 4)	n.a.	9 (6 – 11)	n.a.
Guluguba, Qld 2001	2.5 (0 – 48.7)	n.a	55 (0 – 189)	n.a.	1313 (1025 – 1725)	n.a.
Moree, NSW 2002	51 (25 – 96)	20	32	n.a.	7 (3– 12)	n.a

Conclusion

Passport data (SARDI Genetic Resource Centre) suggests *Hedysarum coronarium* appears to have a preference for growing on alkaline soils. Dry matter production at Kapunda was generally less than that for Booborowie. This maybe due to acidic soil at the Kapunda site (pH 5.5 in H_20) compared to the Booborowie site (pH 7.5 in H_20). However, despite the generally lower yield at Kapunda, one line cut 10.6 t/ha of dry matter (Table 1), considerably higher than the average pasture (approx. 4 - 5 t DM/ha) in the district at this time of year. Further adaptation studies are required to ascertain the range in soil pH, soil texture and rainfall to which *Hedysarum* spp. are suited.

In the first season *Hedysarum* invests much of its' energy into developing the tap root (3). Favourable seasonable conditions in the first year can result in good first year dry matter production. Nevertheless, the second year is when *H. coronarium* and *H. carnosum* can potentially make high levels of dry matter production. *Hedysarum coronarium* and *H. carnosum* are dormant during summer, but with the first autumn rains the adult plant crowns are very quick to respond. Early winter dry matter production potentially can be high (Table 2), where *H. carnosum* and *H. coronarium* had yielded 8.9 and 5.5 t/ha of dry matter- respectively by the end of June at Moree NSW.

Similar observations have been made at the SA site Booborowie, where estimated production in early June was 4 t DM/ha. Some prostrate lines are also very productive (Table 1).

On average individual plants of *H. coronarium* survive for two years (G. Crocker, pers. comm.). Factors such as drought and disease influence the level of plant survival into the second year. *Hedysarum* species in some situations recruit seedlings readily, generally germinating following the autumn rains in SA and some also germinating following early summer rains in northern NSW. In SA and NSW, *H. coronarium* appears to have the most prolific seedling recruitment. In Qld, species were generally ranked for seed production and recruitment: *H. carnosum* > *H. flexuosum* > *H. coronarium*.

Many issues still require further investigation with *Hedysarum* in Australia. These include the range of adaptation, agronomy (sowing rates/dates, fertiliser requirements), grazing tolerance, herbicide tolerances, animal production and health related issues (anthelmintic properties to be tested under Australian conditions with Australian breeds of livestock) and the role of *Hedysarum* within Australian farming systems. A research program is being prepared to investigate a number of these issues.

Acknowledgements

Funding provided for evaluation activities by the GRDC (Grains Research Development Corporation), AWI (Australian Wool Innovations), SARDI (South Australian Research and Development Institute), Queensland Department of Primary Industries and NSW Agriculture.

References

(1) Anon. (2001) Sulla (Popular brochure prepared by various Ag. Research (NZ) researchers).

(2) Bell, L.W., Lloyd, D.L., Johnson, B., Teasdale, K.C. and Bell, K.L. (2003) in press, 11th Australian Agronomy Conference.

(3) Kerr, G. A. (1995) International Fact Sheet Series. Nov. 6, www.forages.css.orst.edu

(4) Lloyd, D., de Koning, C.T., Hughes, S., Johnson, B. and McLachlan, D. (2003) in press; 11th Australian Agronomy Conference.

(5) Niezen, J.H., Robertson, H.A., Waghorn, G.C. and Charleston, W.A.G. (1998) Veterinary Parasitology 80 (1): 15 -27.

(6) Niezen, J.H., Waghorn, T.S., Charleston, W.A.G and Waghorn, G.C. (1995) J. Agric. Sc. 125 (2): 281 - 289.