

The performance of a range of annual pasture legumes on acid saline soils in Tasmania

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ABSTRACT

The herbage production of 60 accessions and cultivars representing 32 annual legumes from the genera *Trifolium*, *Ornithopus*, *Melilotus*, *Lathyrus* and *Vicia* was assessed on an acid saline soil at Symmons Plains in the Northern Midlands of Tasmania. The soil type is a sandy clay loam with a pH of 5.4 (1:5 water) and an electrical conductivity (EC) (1:5 water) ranging from 0.2 to 3.25 dS/m. There were significant differences in dry matter production between species, with *Ornithopus* hybrid cv. Spectra, *T. michelianum* cv. Bolta, *T. squamosum* and *T. resupinatum* having the highest mean yields across all levels of salinity. However, there were significant differences in the rate of change in herbage production with changing salinity levels between species and also between accessions of the same species.

KEY WORDS

Annual legumes, salinity, acid soil, herbage production.

INTRODUCTION

Dry-land salinity affects over 2.5 million hectares of Australian farmland (20,000 ha in Tasmania) and is expanding at the rate of 2 to 3 per cent a year. Legumes are considered to be either sensitive or only mildly resistant to salinity, with only a few tolerant species known (1). Those recognised to be more salt tolerant include Berseem clover (*T. alexandrinum*) (2), Sweet clover (*M. alba*) (3), Persian clover (*T. resupinatum*) (3,4) Moroccan clover (*T. isthmocarpum*) (R.Reid pers. comm.) and Balansa clover (*T. michelianum*) (3,4). Rogers and Noble (5) reported that intra-specific variation in salt tolerance is common in some *Trifolium* species. The aim of this work was to examine the performance of a range of annual legume species on an acid saline soil in Tasmania, specifically looking at the behaviour of different accessions and species under a gradient of salinity.

MATERIALS AND METHODS

An experiment was established at Symmons Plains in the Northern Midlands of Tasmania on the 28th April 1999. The mean annual rainfall for this area is 684mm. The soil type is a sandy clay loam with a pH of 5.4 (1:5 water), Colwell P 36 mgkg⁻¹ and Colwell K 87 mgkg⁻¹. EC (1:5 water) ranged from 0.2 to 3.25 dS/m across the site. Sixty accessions and cultivars from the genera *Trifolium*, *Ornithopus*, *Melilotus*, *Lathyrus* and *Vicia* were drilled into 5m x 1.5m plots. A split plot randomised block design with three replicates was used. Each plot was split into treatments of nil lime and 4 t/ha lime. Treatments were applied by hand two weeks prior to sowing. Fertiliser was predrilled at 300kg/ha of 0-6-17 NPK. Inoculated seed was sown at a rate of 10 kg/ha for all treatments. Seedlings were counted in four 0.0625m² quadrats per plot six weeks after emergence. Dry matter production of the best 23 accessions/cultivars (Table 1) was determined by herbage cuts of one 0.25m² quadrat per plot and oven drying at 100°C. At the same time, five soil cores were removed from each plot to a depth of 7.5cm for EC measurements. Analysis of variance using salinity levels as a covariate were carried out on the data.

RESULTS AND DISCUSSION

All lines germinated well except Berseem clover. Plant counts at week six showed that seedlings of species with poor adaptation to higher EC levels had not survived. The application of lime had no significant effect on seedling survival or herbage production. There were significant differences in herbage production between and within species, in their response to increasing salinity, l.s.d. (P=0.05)

743.7 (Table 1). At slight to moderate salinity (0.25 to 0.9 dS/m), Spectra and Bolta, were the highest yielding lines with more than 3 t DM/ha. At very saline levels (0.91 to 1.75 dS/m) Nitro Plus and SA 2998, were the most productive with 2.3 and 1.4 t DM/ha respectively. At the highly saline level (> 1.75 dSm), SA2998 was the only line to produce over 1 t DM/ha while Tas 2254, produced 0.8 t DM/ha.

Table 1. Seedling numbers at six weeks from sowing (plants/m²) and Spring herbage dry matter production (kg DM/ha) at three levels of electrical conductivity (6).

Species	Accession/Cultivar	slight – moderate (0.25 – 0.9 dS/m)		very saline (0.91 – 1.75 dS/m)		highly saline (> 1.75 dS/m)	
		plant/m ²	DM	plant/m ²	DM	plant/m ²	DM
<i>Ornithopus compressus</i>	Tas 1700	147	771	33	22	-	-
<i>Ornithopus hybrid</i>	Spectra	230	3150	129	1060	-	-
<i>Trifolium carmeli</i>	Tas 2266	130	1694	27	139	76	0
<i>Trifolium clusii</i>	SA 2998	89	873	113	1354	71	1309
<i>Trifolium clusii</i>	Tas 439	17	162	-	-	0	0
<i>Trifolium diffusum</i>	SA 17357	149	1355	109	191	-	-
<i>Trifolium hirtum</i>	95Tur47hir	111	1205	50	18	-	-
<i>Trifolium isthmocarpum</i>	Bulk	54	640	82	607	-	-
<i>Trifolium michellianum</i>	Bolta	89	3043	-	-	47	84
<i>Trifolium purpureum</i>	Tas 1042	78	1709	21	39	4	0
<i>Trifolium resupinatum</i>	132625	13	181	37	228	4	0
<i>Trifolium resupinatum</i>	Nitro Plus	31	1292	89	2279	94	344
<i>Trifolium resupinatum</i>	Tas 1041	92	904	28	575	-	-
<i>Trifolium resupinatum</i>	Tas 1646	60	76	-	-	91	0

<i>Trifolium resupinatum</i>	Tas 611	33	342	31	291	4	18
<i>Trifolium resupinatum</i>	Tas 622	16	1027	84	724	49	321
<i>Trifolium salmoneum</i>	Tas 2254	191	1481	110	339	36	786
<i>Trifolium squamosum</i>	SA 370	120	2432	71	1052	36	8
<i>Trifolium striatum</i>	Tas 1698	56	619	29	20	4	0
<i>Trifolium subterraneum</i>	Denmark	187	1944	111	644	40	0
<i>Trifolium vesiculosum</i>	Arrotas	67	1153	16	10	7	0
<i>Trifolium vesiculosum</i>	MO 92	50	1833	22	58	7	0
<i>Vicia Sativa</i>	Tas 697	73	954	73	282	53	0

l.s.d. (P=0.05) plants/m² = 56.3, l.s.d. (P=0.05) DM = 743.7

' - ' There were no plots of this accession/cultivar at this salinity level

The level of tolerance within the six Persian clover lines was also significantly different (P<0.05), at the slight to moderate salinity level Nitro Plus produced 126% more than the next best Persian clover and at the very saline level it produced 315% more dry matter than the next best. *Melilotus alba*, highly salt tolerant in Victoria, failed at this site, probably due to the low soil pH, as it has failed in other acid soil sites in Tasmania.

CONCLUSION

These results confirm the tolerance of Balansa and Persian clovers to moderate levels of salinity. The behaviour of *T. clusii*, *T. squamosum*, *T. salmoneum* and Spectra serradella is encouraging and warrants further investigation. Additional species/accessions with combined tolerance to acid and saline conditions needs to be sourced and evaluated.

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