# Selecting suitable pasture legume species as fodder crops for the central wheatbelt of southwest Western Australia

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## Abstract

Twenty six lines and varieties from 19 different species of annual pasture legumes were compared in a field trial near Brookton, Western Australia, in 2003 for their potential to be used as fodder crops. Characters considered included visual growth score, biomass production early and late in the season, flowering time, the ability to maintain green late in the season and tolerance to water stress. Although a dry season restricted herbage production, most new lines included in the trial failed to reach the production levels of the commercialised lines used as controls. French serradella (cv Cadiz), crimson clover (cv Caprera), and some lines from *T. dasyurum*, *T. hirtum*, and *T. purpureum* were amongst the best performing lines. Simple correlations showed that early vigour as indicated by a visual score and early biomass production was closely related to biomass production late in the season. However, time of flowering, water stress tolerance and the ability to maintain greenness late in the season showed little relationship with biomass production under the conditions experienced at the site.

## Media summary

Pasture legumes vary widely in their potential to be used as fodder crops as revealed by a field screening of 26 lines from 19 different species.

## Key Words

Fodder crop, pasture legumes, farming system.

## Introduction

High value fodder crops provide farmers with a capacity to diversify their production systems and are an integral part of strategies to intensify animal production. Recent history has seen a steady increase in fodder production in Australia (Stubbs, 2000). Legume based fodder production systems can also play important roles in the integrated management of weeds, improvement of soil fertility, efficient use of water and nutrients, and better management of pastures (Evans, 1999, Doonan *et al*, 2003). In the last couple of years, a number of new annual pasture legume species with the potential as fodder crops have been commercialised, although often the original purpose for the development of such species was not for them to be used as conserved fodder (Ewing, 1999). Furthermore, a large collection of genotypes has also been accumulated at the Genetic Resource Centre for Pasture Legumes for Acid Soils, but limited information is available on their potential as fodder crops in the wheatbelt environment of Western Australia. This poster will report the results from a screening trial on lines from species maintained by the Centre together with some commercialised varieties.

## Methods

*The site*

The site was situated 10 km east of Brookton, Western Australia (32°22'20''S, 117°00'42''E). It has a brown-grey loamy soil and has been in permanent pasture for several years. At the beginning of the season, soil analysis indicated that it had 25 ppm of nitrate-N, 5 ppm of ammonium-N, 46 ppm of P (Colwell), 108 ppm of K, 1.2% of organic-C, 803 ppm of Fe and a pH of 4.57. Soil conductivity was 0.110 dS/m. The long-term average rainfall for Brookton is 451 mm (358 mm May-Oct), and rainfall in 2003 on the farm where the trial was conducted was 362 mm (287 mm, May-Oct).

*Treatment and design*

Twenty six lines/varieties from 19 different species were tested at the site, which included two commercialised varieties as controls (Table 1). A Latinised alpha design was used with three replicates. Plots were 2 m by 3 m in size and the seeds were sown on 29 & 30 May 2003 to around 1.5 cm deep in three separate rows for the convenience of weed control. Two hundreds kilograms of superphosphate plus muriate of potash (1:1) per hectare was applied to the site a couple of months before the soil samples were taken. Biomass was estimated through cutting a 25 cm by 50 cm quadrat and oven-dried at 60°C for more then 2 days.

*Statistical analysis*

Statistical analysis of variance was conducted using GenStat (Release 6.1, Lawes Agricultural Trust).

**Table 1. Species and lines used in the trial and their basic background information.**

| Species | Accession/varieties | Country of origin | Site rainfall | Collection site soil & pH |
|---|---|---|---|---|
| *Trifolium angustifolium* | 140751 | Greece (Lesvos) | 600 mm | |
| *T. arvense* | S3588ARV | Italy (Sicily) | 500 mm | brown black silty loam, 7.5 |
| *T. berytheum* | 86671 | Israel | | |
| *T. dasyurum* | GCN39 | Greece (Naxos) | 550 mm | light brown sandy loam, 7.0 |
| *T. dasyurum* | 124545 | Turkey (Adiyaman) | 550 mm | valley top and small hillside, 9.0 |
| *T. dasyurum* | 141070 | Jordan (Irbid) | 500 mm | |
| *T. dichroanthum* | 34549 | Israel (Sharon Plain) | | sandy loam |
| *T. diffusum* | 13589 | | | |

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|---|---|---|---|---|
| *T. echinatum* | 87231 | Israel (donor) | | |
| *T. hirtum* | 140845 | Turkey (Icel) | 450 mm | red redzina, 8.5 |
| *T. hirtum* | 139164 | Greece (Mykonos) | 450 mm | grey clay loam, 9.0 |
| *T. incarnatum* | S3352MOL-A | Italy (Sicily) | 600 mm | silty brown black, 6.5 |
| *T. incarnatum* | Caprera | Italy (Sardinia)cultivar | | |
| *T. michelianum* | 98GRC7MIC | Greece (Lemnos) | 400 mm | dark brown sandy loam, 6.0 |
| *T. nigrescens* | 139204 | Greece (Mykonos) | 450 mm | grey-brown sandy loam, 6.5 |
| *T. palaestinum* | 28416 | | | |
| *T. palaestinum* | ISR63-198.y | Israel (Sharon Plain) | | |
| *T. pallidum* | 139888 | Turkey (Aydin) | | yellow brown clay loam, 8.5 |
| *T. resupinatum* | 27376-1B | Portugal (donor) | | |
| *T. resupinatum* | 132812 | America/US | | |
| *T. squarrosum* | N2669 | | | |
| *T. vavilovii* | 86743 | Israel (Afula) | | |
| *T. purpureum* | CIZ12PUR-A.early24/98 | Turkey (Manisa) | | brown sandy loam |
| *T. purpureum* | 32835 | Israel (donor) | | |
| *T. vesiculosum*[1] | Cefalu, control | cultivar | | |

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|---|---|---|---|---|
| *Ornithopus sativus*[1] | Cadiz, control | South Africa | 400 mm | gritty sand, 6.0 |

[1]Control species repeated three times within each replicate

**Results**

The site did not enjoy a favourable season during 2003. Dry conditions after seeding and during spring restricted plant growth. However, most species managed to produce a reasonable amount of biomass.

There were wide variations among species in biomass production, flowering time, and tolerance to water stress late in the season (Table 2). Species with highly productive lines included *T. hirtum*, *T. purpureum*, *T. dasyurum*, and the two commercial varieties (French serradella, *Ornithopus sativus* cv Cadiz, and crimson clover, *T. incarnatum* cv Caprera). Significant differences between lines within the same species were also observed.

Simple correlations between characteristics examined revealed that the visual growth score early in the season is a good indicator for biomass production ($r^2$ = 0.6339** for the cut on 15 Sep 03, n=28) and early growth (vigour) is closely related to the performance at the 2nd cut (13 Oct 03, $r^2$ = 0.7386**, n=28). Flowering time, water stress score and greenness at the end of season did not appear to bear a significant relationship with biomass production under the trial conditions.

**Conclusion**

Species vary significantly in their biomass production, from 207 kg/ha in mid September to 3825 kg/ha in mid October. There was also considerable variation amongst lines within the same species, indicating the importance of sourcing a wide germplasm base for this type of evaluation. It appears that under short-season conditions early vigour is an important trait to be considered. The lack of a relationship between biomass production and the ability to withstand drought conditions or a capacity to maintain greenness at the end of the season could have been due to differences in the shoot/root partitioning of some lines, or the specific circumstances where the trial was conducted and needs to be clarified in further trials.

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**Table 2. Major characteristics examined in the species/lines.**

| Species | Lines/varieties | Growth score[1] 10/09/03 | Biomass 15/09/03 (kg/ha) | Biomass 13/10/03 (kg/ha) | Flowering (%) as on 15/09/03 | Water stress[2] 03/10/03 | Late-season greenness[3] 13/11/03 |
|---|---|---|---|---|---|---|---|
| *Trifolium angustifolium* | 140751 | 2.7 | 593 | 2376 | 2 | 1.2 | 0.7 |
| *T. arvense* | S3588ARV | 3.5 | 620 | 1892 | | 1.0 | 4.3 |

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|---|---|---|---|---|---|---|---|
| *T. berytheum* | 86671 | 2.0 | 207 | 776 | | 2.0 | 1.0 |
| *T. dasyurum* | GCN39 | 4.0 | 611 | 2703 | 100 | 2.0 | 0.0 |
| *T. dasyurum* | 124545 | 1.7 | 311 | 906 | | 1.3 | 0.0 |
| *T. dasyurum* | 141070 | 3.3 | 798 | 2924 | 100 | 1.7 | 1.0 |
| *T. dichroanthum* | 34549 | 3.0 | 651 | 2205 | | 1.7 | 2.8 |
| *T. diffusum* | 13589 | 3.2 | 716 | 1302 | | 2.7 | 4.7 |
| *T. echinatum* | 87231 | 3.7 | 677 | 1987 | 13 | 2.7 | 1.0 |
| *T. hirtum* | 140845 | 1.8 | 529 | 1728 | | 1.0 | 3.0 |
| *T. hirtum* | 139164 | 4.0 | 1680 | 3825 | 2 | 1.7 | 0.7 |
| *T. incarnatum* | S3352MOL-A | 2.5 | 583 | 1280 | | 2.3 | 1.0 |
| *T. incarnatum* | Caprera | 4.8 | 1068 | 3378 | | 3.8 | 1.0 |
| *T. michelianum* | 98GRC7MIC | 2.8 | 594 | 1485 | 53 | 2.0 | 0.0 |
| *T. nigrescens* | 139204 | 2.8 | 561 | 996 | 100 | 1.7 | 0.3 |
| *T. palaestinum* | 28416 | 1.7 | 420 | 1739 | | 1.3 | 0.3 |
| *T. palaestinum* | ISR63-198.y | 1.2 | 277 | 906 | | 1.3 | 0.7 |
| *T. pallidum* | 139888 | 3.2 | 554 | 1281 | | 4.3 | 2.3 |
| *T. resupinatum* | 27376-1B | 2.5 | 420 | 869 | 93 | 2.0 | 0.0 |
| *T. resupinatum* | 132812 | 3.2 | 460 | 1018 | 3 | 2.0 | 1.7 |
| *T. squarrosum* | N2669 | 1.7 | 350 | 711 | | 3.0 | 0.3 |

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|---|---|---|---|---|---|---|---|
| *T. vavilovii* | 86743 | 3.3 | 602 | 1805 | 93 | 1.7 | 0.0 |
| *T. purpureum* | CIZ12PUR-A.early24/98 | 2.2 | 331 | 1826 | 5 | 1.7 | 2.5 |
| *T. purpureum* | 32835 | 4.7 | 996 | 3530 | 18 | 1.2 | 1.7 |
| *T. vesiculosum* | Cefalu (control) | 2.5 | 400 | 1324 | | 1.6 | 3.3 |
| *Ornithopus sativus* | Cadiz (control) | 4.6 | 971 | 3140 | 100 | 1.0 | 2.8 |
| LSD (P=0.05) | (variety vs control) | 0.95 | 302 | 519 | 9.3 | 0.85 | 1.35 |

[1]Growth score, visual assessment from 1 (low) to 5 (high), based on the bulk of plant material presented
[2]Water stress score: 1 no obvious symptom, to 5 worst when most plants wilted.
[3]Greenness score: 0=senesced, 5=60% green.

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