Selection of alternative 'lucernes' and native legumes for Australian farming systems.

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Introduction

Lucerne (*Medicago sativa*) is the predominant perennial legume grown in mixed farming systems in southern Australia. It provides a weed and disease break in crop rotations, restores soil fertility through N fixation, provides high quality forage for livestock, and reduces the risk of soil acidity and salinity by drying the soil profile and reducing deep drainage. The incorporation of pasture plants such as lucerne needs to be increased in local farming enterprises to increase the environmental sustainability of production agriculture (Cocks 2001).

Current commercial cultivars of lucerne are poorly adapted to acidic and waterlogged soil conditions. They also require higher levels of grazing management than grasses such as phalaris (*Phalaris aquatica*) or cocksfoot (*Dactyilis glomerata*). In order to increase the zone of adaptation of lucerne, further breeding and selection is required to increase its tolerance of grazing, and of acidic and waterlogged soils. A wide range of germplasm is currently being evaluated to identify material that could potentially be used in breeding or selection programs to expand the zone of adaptation of lucerne, and to identify potential alternatives to lucerne in these environments.

Materials and methods

A series of evaluation nurseries were established between 2002 and 2005 across five agro-ecological zones of southern Australia; summer rainfall (northern NSW), even distribution rainfall (southern NSW), cool climate (Vic), Mediterranean acid soil (WA) and Mediterranean neutral/alkaline soil (SA). Nurseries were managed according to pre-determined protocols, with a view to compare the same germplasm across the different environments.

An experiment was sown on the 30 August 2005 at Barmedman NSW to compare the performance of some species which had shown potential in the preliminary evaluation nurseries with germplasm genetically similar to traditional lucerne. Included in the experiment were 35 entries (including eight commercial lucerne cultivars) from different lucerne sub-species (*M. sativa. sativa* (common lucerne), *M. sativa. falcata, M. sativa. caerulea, M. sativa. varia*), one line of an unrelated perennial medic species (*M. suffruticosa*) and eight lines from five perennial native legume species (*Cullen australasicum, C. tenax, C. cinereum* and *C. parvum*). The experiment was a randomised design incorporating small plots (1 x 5 m) replicated four times. All lines were sown at 4 kg/ha, with appropriate adjustment made for lines with poorer seed quality. Seedling establishment was measured on 28 October 2005 and herbage yield was assessed on 21 December 2005.

Results

Establishment of all lines was satisfactory with plant densities ranging from 24–168 plants/m^2, except for one *M. sativa* line (Sardi 7) which established at a density of 12 plants/m^2. Density of the larger seeded *Cullen* spp. was generally lower (24–49 plants/m^2) than that of most perennial medic species which generally exceeded 53 plants/m^2. Herbage yield in the spring of the establishment year differed between lines ($P< 0.001$), demonstrating a large degree of variation within and between most species groups (Figure 1). All lines of *M. suffruticosa, C. tenax* and *C. parvum* grew very slowly in the first four months after sowing.

Discussion

Although in its infancy, this experiment demonstrates a wide diversity of genetic material within most of the perennial legume species tested. *M. falcata, M. caerulea* and *M. varia* are genetically similar to *M. sativa* allowing the opportunity to introduce new traits into traditional lucerne from these alternate subspecies (Irwin *et al.* 2001). *M. falcata* and *M. caerulea* in particular have more prostrate growth habits than traditional lucerne suggesting a potential to at least develop superior grazing tolerance in lucerne by incorporating this genetic material. Other perennial medic species such as *M. suffruticosa* are unlikely to suitable for agriculture in southern NSW due to very low herbage yields.

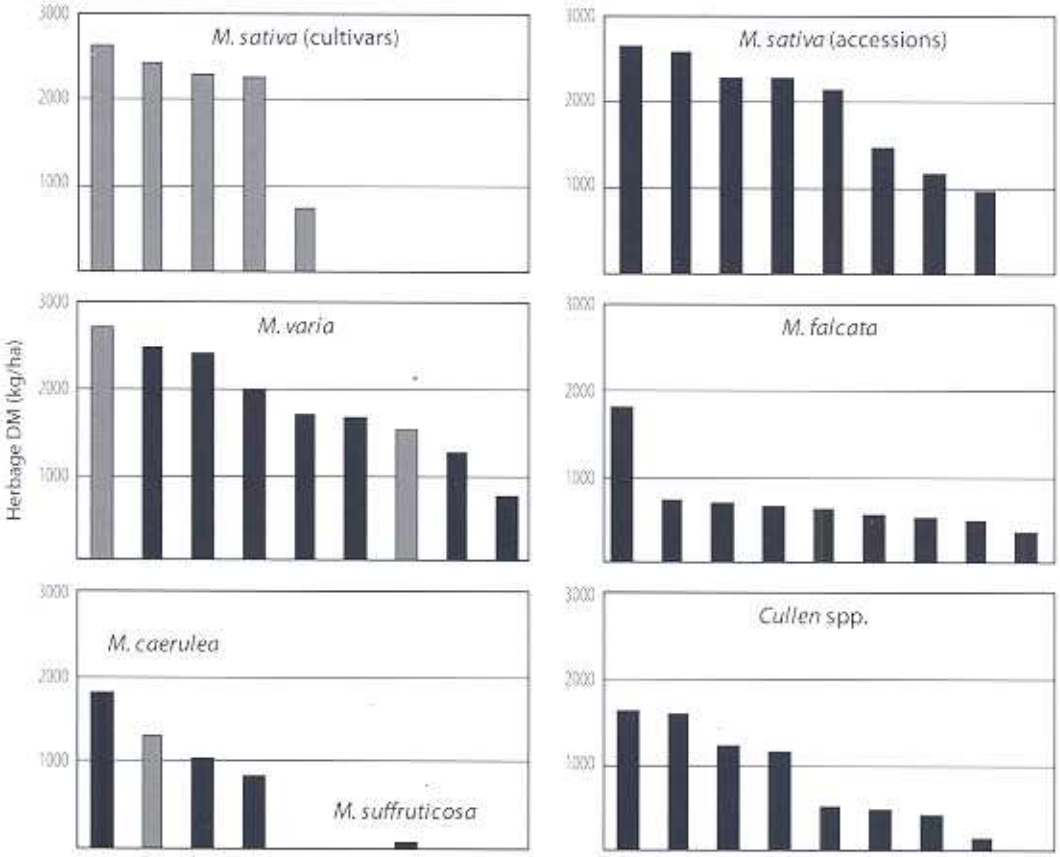

Figure 1 Herbage yield (kg/ha) of perennial legumes at Barmedman in spring of the establishment year (l.s.d. 508). Grey bars represent production of commercial cultivars.

Of the native species *C. australasicum* shows the most potential. Herbage yield of all *Cullen* spp. was lower than that of most perennial medic species, which is partly due to lower plant densities as a result of its larger seed size. In this and other nurseries, *C. australasicum* has proven to be easy to establish and to have a reasonable level of grazing tolerance, making it of potential use to agricultural enterprises in the future.

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References

Cocks, P. S. (2001). Ecology of herbaceous perennial legumes: a review of characteristics that may provide management options for the control of salinity and waterlogging in dryland cropping systems. *Australian Journal of Agricultural Research* **52**, 137–151.

Irwin, J. A.G., Lloyd, D.L. and Lowe, K. F. (2001). Lucerne biology and genetic improvement - an analysis of past activities and future goal in Australia. *Australian Journal of Agricultural Research* **52**, 699–712.