# Evaluation of perennial legume and herb cultivars and lines, North-West Slopes of New South Wales

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**Abstract:** *Herbage mass (spring 2003–spring 2005) and plant frequency (spring 2003–autumn 2006) of 34 cultivars/lines of perennial legumes and two herbs were evaluated at a site near Manilla in northern NSW. With intermittently dry conditions Sceptre lucerne was the best performing species, with none of the other cultivars/lines tested matching both its herbage mass and persistence.*

## Introduction

In 2002, a national program was developed within the Cooperative Research Centre for Plant-based Management of Dryland Salinity to evaluate a range of perennial forage species (legumes and grasses) identified in scoping studies (e.g. Bennett *et al.* 2002; Dear *et al.* 2003) to expand the range of options available to producers. Evaluation of a range of perennial legume species on the North-West Slopes of New South Wales (NSW) was advantageous because, while annual legumes had previously been widely evaluated in the region (e.g. Lodge & Harden 2007*a*,*b*; Crocker 2008), there had not been an extensive evaluation of perennial legumes in recent years. The availability of such a wide range of material that was mostly untested in a summer-dominant rainfall environment, provided a unique opportunity to compare the performance of this material (as measured by herbage mass and persistence) with that of lucerne (*Medicago sativa* subsp. *sativa*), the most widely sown perennial legume in the region.

This experiment examined the hypothesis that among the perennial legume and herb cultivars/lines tested, some may have similar performance to that of lucerne. Identification of superior cultivars/lines would provide a firm basis for future selection and breeding programs, and development of informed local cultivar/species recommendations.

## Materials and methods

This study was conducted at a site previously described in detail by Boschma *et al.* (2009). The site was located on a Brown Vertosol soil, 12 km west of Manilla, NSW (30.74°S 150.61°E; elevation 400 m). Average annual rainfall at Manilla (1884–2008) is 651 mm. The site had a long (>40-year) history of cropping and lucerne ley pastures. Soil was sampled for chemical analyses (0–0.10 and 0.10–0.20 m) in October 2002 and the results were reported by Boschma *et al.* (2009). Rainfall data during the study were recorded (30-min intervals) by an automatic weather station located at the site. These data were summed to monthly values and compared with the long-term average monthly rainfall for Manilla Post Office (Table 1).

In May 2003, 33 cultivars/lines of perennial legumes and 2 herb cultivars were sown in plots (5.0 by 1.35 m) arranged in a spatially adjusted randomised complete block design with partial neighbour balance and 4 replicates. The full list of species and cultivars/lines sown is given in Figure 1. Plots were sown at a rate of ~5 kg/ha (adjusted for differences in seed germination) at <5 mm depth in 6 rows, 0.20 m apart, using a tyned cone seeder. All seed was lime-pelleted and legume seed was inoculated with an appropriate strain of rhizobia. The experiment had a 1.35 m wide buffer of lucerne cv. Genesis around its perimeter. To assist establishment, all plots were irrigated with 6–8 mm of water in June 2003. Plots were top-dressed in winter 2004 and 2005 with 125

**Table 1. Monthly rainfall (mm) at the site and mean and the long-term average monthly rainfall (LTA, 122 years) for Manilla, NSW.**

| | Rainfall (mm) | | | |
|---|---|---|---|---|
| **Month** | **2003** | **2004** | **2005** | LTA |
| January | 9.5 | 155.5 | 77.5 | 88 |
| February | 104.0 | 37.0 | 18.0 | 66 |
| March | 11.0 | 45.0 | 9.5 | 54 |
| April | 110.0 | 20.0 | 1.5 | 40 |
| May | 8.0 | 15.5 | 16.5 | 42 |
| June | 35.0 | 17.5 | 116.0 | 44 |
| July | 20.3 | 34.5 | 24.0 | 42 |
| August | 30.5 | 39.5 | 18.5 | 40 |
| September | 3.5 | 32.0 | 92.0 | 42 |
| October | 49.5 | 75.5 | 67.5 | 58 |
| November | 53.0 | 70.0 | 118.0 | 66 |
| December | 48.5 | 152.0 | 87.0 | 73 |
| Annual | 482 | 694 | 646 | 655 |

kg/ha molybdenised superphosphate (8.8% phosphorus, 11% sulphur, 0.05% Mo). Prior to sowing, the experimental area was sprayed with 2.0 L/ha and 1.0 L/ha of glyphosate (450 g a.i./L) in March and April 2003, respectively. In August 2003, plots were sprayed with 2.5 L/ha of 2,4-DB (500 g a.i./L) to control wireweed (*Polygonum aviculare*), except those sown with herbs which were covered to protect against herbicide. All plots were also sprayed with 0.1 L/ha of omethoate (290 g a.i./L) to control blue oat mite (*Penthaleus major*).

Herbage mass was assessed on 10 occasions (spring 2003–spring 2005) and plant frequency on 6 occasions (spring 2003–autumn 2006) using the procedures described by Boschma *et al.* (2009). All cultivars/lines were allowed to set seed in spring 2003. Plots were defoliated or grazed after each herbage mass assessment, except for the initial period described above. From October 2003 to October 2004, plots of the woody species *Argyrolobium uniflorum*, *Dorycnium hirsutum* and *Cullen australasicum* were defoliated to a height of ~0.10 m above ground level using a rotary brush-cutter. At all other times defoliation of all plots was to a height of ~0.05 m above ground level, using a rotary lawnmower with a catcher fitted to remove the cut material from the plots. Plant frequency was assessed in spring and autumn each year in a permanent quadrat (1 by 0.5 m with 50 cells, each 0.10 by 0.10 m) centrally located in each plot. Cells containing a portion of a live plant of the sown species recorded presence, and the proportion of occupied cells was used to estimate plant frequency.

Herbage mass and plant frequency data were analysed using the cubic smoothing spline approach of Verbyla *et al.* (1999) which incorporated cubic splines into a linear mixed model. This model was fitted to transformed herbage mass data (square-root herbage mass, kg DM/ha) and percent frequency with day as a covariate. Details of these analyses have been given previously by Boschma *et al.* (2009). Plots of predicted initial and final herbage mass and plant frequency values were used to describe the performance of cultivars/lines over time (Lodge & Harden 2007*a*), with mean values being used to divide the graph into 4 quadrants. Cultivars/lines in the upper right quadrant had both initial and final predicted values that were greater than the mean, with those in the lower left quadrant being lower than the mean. Those in the upper left quadrant had lower initial and higher final predicted values, while those in the lower right quadrant had initial values higher than the mean, but lower final values.

## Results and discussion

After sowing in May 2003, rainfall was below average for 11 of the next 12 months (Table 1), but was above average in spring–early summer 2004–05. Rainfall was below average for 25 of the 36 months (70% of the time) that the experiment was conducted.

Predicted herbage mass of most cultivars/lines was highest in spring–summer of each year, but generally decreased over time, being lowest in autumn 2005 during an extended period of below average rainfall (data not shown). Of the 34 cultivars/lines tested, 16 had above average herbage mass (>860 kg DM/ha) at the initial assessment (Fig. 1*a*), but only 8 cultivars/lines exceeded this level (>190 kg DM/ha) at the final assessment (Fig. 1*a*). Many cultivars/lines

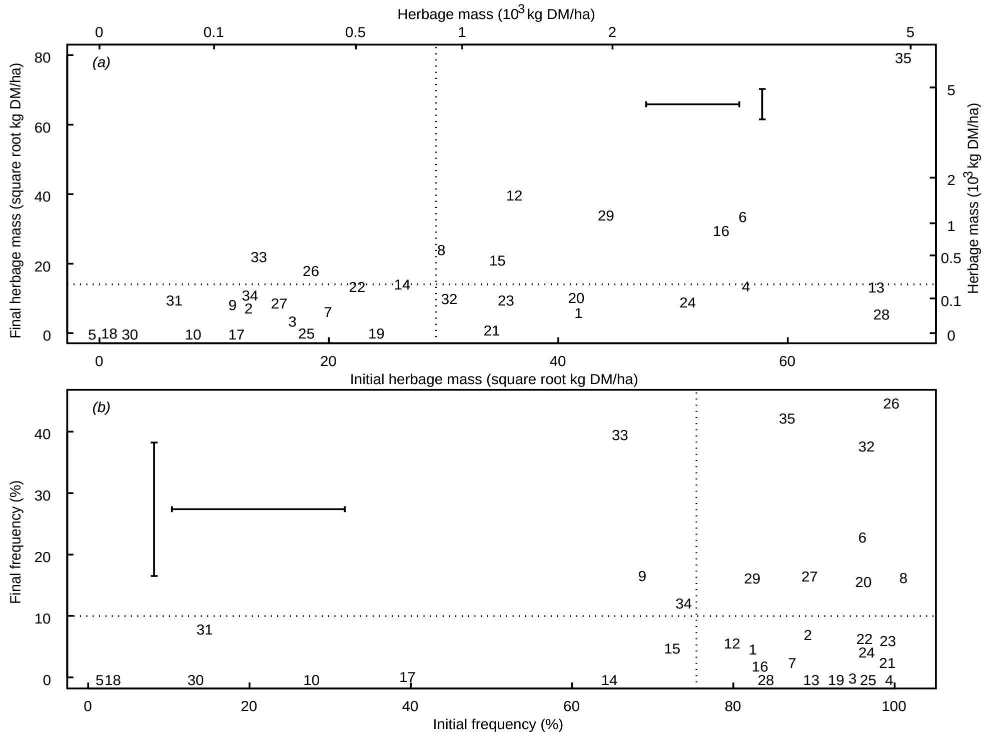


**Figure. 1. Predicted initial and final values of cultivars/lines for (*a*) herbage mass (square-root herbage mass, kg DM/ha) and (*b*) plant frequency (%). Numbers on both figures are the cultivar/line identification code corresponding to; 1** *Adesmia mucronata*, **2** *Argyrolobium uniflorum*, **3** *Astragalus palaestinus*, **4** *Astragalus suberosus,* **5** *Chamaecrista rotundifolia* **cv. Wynn, 6** *Cichorium intybus* **cv. Grasslands Puna, 7** *Securigera varia*, **8** *Dorycnium hirsutum,* **9** *D. pentaphyllum*, **10** *D. rectum* **Tas135, 12** *Hedysarum boutigynanum*, **13** *Hedysarum carnosum*, **14** *Hedysarum coronarium* **cv. Grasslands Aokau, 15** *Hedysarum coronarium* **(Fodder bulk), 16** *Hedysarum coronarium* **(Grazing bulk), 17** *Indigofera patens*, **18** *Lotononis bainesii* **cv. Miles, 19** *Lotus corniculatus* **cv. Goldie, 20** *L. corniculatus*, **21** *L. creticus*, **22** *L. cytisoides*, **23** *L. glaber*, **24** *L. arenarius*, **25** *L. uliginosus*, **26** *M. sativa* **ssp.** *caerulea*, **27** *M. suffruticosa*, **28** *Onobrychis viciifolia* **cv. Othello, 29** *Cullen australasicum*, **30** *Ptilotus polystachyus* **(Merredin), 31** *Sanguisorba minor,* **32** *Trifolium hybridum*, **33** *Trifolium physodes*, **34** *Trifolium uniflorum*, **35** *Medicago sativa* **ssp.** *sativa* **cv. Sceptre. Error bars indicate the l.s.d. (*P* = 0.05) for the predicted initial and final values and the dotted lines indicate the mean predicted initial and final values.**

failed to recover after the dry period in winter 2005 and had predicted herbage mass of <900 kg DM/ha at the final assessment. The major exception was Sceptre lucerne, which recovered and had a predicted herbage mass of ~6200 kg DM/ha in October 2005, which was similar to that in previous spring periods. Other cultivars/lines which recovered, but to a lesser extent included *Hedysarum boutigynanum*, *Cullen australasicum*, *Cichorium intybus* (chicory) cv. Puna and *Hedysarum coronarium* (Sulla) (Grazing bulk) that had a final herbage mass of 880–1500 kg DM/ha.

Twenty three cultivars/lines had above average predicted plant frequency (>76%) at the initial assessment while 6 cultivars/lines had a plant frequency <50% (Fig. 1*b*). Predicted plant frequency was lowest in autumn 2005 (data not shown) during an extended dry period (Table 1). Recovery of cultivars/lines occurred in 2 categories; those that recovered so that by autumn 2006 (final assessment) their plant frequency was >30% (*Medicago sativa* subsp. *caerulea*, *M. sativa* ssp. *sativa* cv. Sceptre, *Trifolium physodes* and *T. hybridum*) and those with poor recovery and <20% plant frequency in autumn 2006 (Fig. 1*b*).

Sceptre lucerne was the best performing species with superior herbage mass and persistence. Total cumulative herbage mass of Sceptre lucerne (spring 2003–2005) was 33750 kg DM/ha and its final plant frequency was 41% compared with a cumulative herbage mass of 12000–17000 kg DM/ha for *Astragalus suberosus*. *Hedysarum carnosum*, Puna chicory, *Dorycnium rectum*, *Onobrychis viciifolia* (sainfoin) cv. Othello and *Cullen australasicum* and 4000–6000 kg DM/ha for *Astragalus palaestinus*, Aokau sulla, Sulla (Fodder bulk), *Lotus corniculatus* (lotus), Goldie lotus, *L. creticus*, *L. cytisiodes*, *L. glaber*, *L. arenarius* and *M. sativa* subsp. *caerulea*. These results reinforced the superiority of lucerne in this environment and soil type, with none of the other species matching both its persistence and herbage production. *M. sativa* subsp. *caerulea* had excellent persistence, but low herbage mass and further studies are being conducted in this environment to assess its potential.

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