# SELECTION AND EVALUATION OF AUSTRALIAN LEGUMES FROM THE GENUS *CULLEN* FOR PERENNIAL PASTURE PHASES – NORTH EASTERN WHEATBELT TRIAL

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## AIM

Evaluation of a group of Australian perennial legumes to select species useful for perennial pastures adapted to the northern wheatbelt's low rainfall and acid soils.

## BACKGROUND

Several species of *Cullen* have agronomic traits which are suitable for perennial pastures. For example, *Cullen australasicum* has good nutritional value and had similar productivity and persistence as lucerne when trialed in the medium rainfall belt of New South Wales. Also, studies from Queensland on *C. australasicum*, *C. discolor*, *C. pallidum* and *C. patens* revealed that they could have deep roots to 4.3 m, equivalent productivity to lucerne when cut at 3 or 6 month intervals and an ability to persist and regenerate after grazing by cattle. These results suggest that these species and potentially other *Cullen* species may have agronomic traits making them suitable perennial pasture plants in WA.

The above studies were based on locally adapted populations from species naturally occurring in the areas. Unfortunately, there are no *Cullen* species naturally occurring in WA's wheatbelt. This makes the selection of species and populations adapted to WA's wheatbelt difficult. A broad-scale analysis of herbarium records to identify species adapted to WA's wheatbelt climate and soils showed that *Cullen* species naturally occur across many different soil types and a large range of climates. It identified ten perennial, herbaceous species that are adapted to areas with less than 650mm average annual rainfall, seven of which occurred on acidic or waterlogged soils. Many species came from areas with less than 250mm annual rainfall. So we expect that some populations from these seven *Cullen* species will be adapted to WA's wheatbelt.

All of the species which had good agronomic attributes in NSW and Queensland were included in the seven species selected in the climate and soil analysis, except *C. pallidum*. So we expect that some of these *Cullen* species may contain populations that have both adaptations and agronomic traits that make them suitable for use as perennial pastures in the low rainfall, Mediterranean climate of WA's wheatbelt. The study presented here tested this, by comparing the persistence and productivity of 120 germplasm collections from nine Australian *Cullen* species to two perennial *Lotus* species and to two lucerne cultivars between September 2006 and September 2008.

## TRIAL DETAILS

| | |
|---|---|
| **Property** | Liebe Group Long Term Research Site, west Buntine |
| **Plot size & replication** | Total size – 25m by 45m. Three replicates, each with three plants of 104 collections – 945 plants in total |
| **Soil type** | Loamy sand, pH in water ~ 5 |
| **Sowing date** | Seedlings were established for 5 weeks in the glasshouse and then planted out on the 6$^{th}$ of September, 2006 |
| **Seeding rate** | Single plants spaced 1 metre apart |
| **Fertiliser (kg/ha)** | None |
| **Paddock rotation** | Paddock has come out of wheat into lupins which were sprayed out a month before sowing |
| **Herbicides** | None |

## RESULTS

**Persistence and productivity of populations in September**

Compared to the best performing lucerne cultivar, 23 populations of *C. australasicum* had higher persistence, 10 populations of *C. australasicum* had higher average biomass and 7 populations were higher in both measures (Figure 1). All *Cullen* species except *C. patens* had populations which persisted better than Sardi 10 (Figure 1). The combined productivity and persistence of the best performing *C. australasicum* population was more than double that of Sardi 10 and around four times that of Sceptre (49.0, 24.2 and 13.0 g per established plant, respectively).

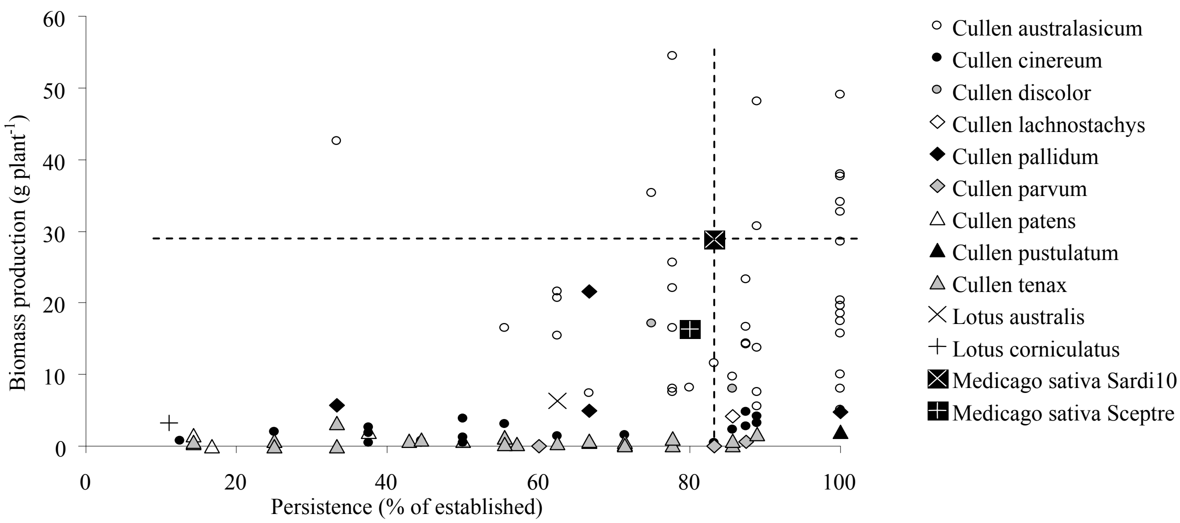


**Figure 1:** Persistence (percentage survival of established plants) and productivity in September (biomass after 8 months regrowth) of all *Cullen* populations trialed, two lucerne cultivars (Sceptre and Sardi 10), *Lotus australis* and *L. corniculatus*. Dashed lines are centred over Sardi 10, the best performing lucerne cultivar.

**Seasonal persistence and productivity of species**

When considered at the species level, *Cullen australasicum* and *C. pustulatum* both persisted better through the whole year than the best lucerne cultivar, Sardi 10 (Table 1). *L. corniculatus* displayed the poorest survival with one plant remaining alive in April which then persisted through to September. Of the *Cullen* species, *C. patens* had the poorest persistence with around one quarter of plants surviving in September. All species except *C. discolor* and *C. leucanthum* persisted better over the winter period between April and September than the preceding dry period between establishment and April. The persistence of *C. cinereum* was the poorest of all species over the April to September period; 19% of plants died.

*Cullen australasicum*, *C. pustulatum* and *C. lachnostachys* all had higher productivity ratings in April than Sardi 10 lucerne, the best lucerne cultivar (Table 1). However, the September productivity rating of *C. australasicum* was second best to Sardi 10 lucerne, whereas the September productivity rating of *C. pustulatum* and *C. lachnostachys* dropped further to the third and sixth lowest, respectively. *Cullen tenax* and *C. parvum* had consistently low productivity ratings. Productivity ratings of the lucerne cultivars were lowest in April and highest in September.

**Table 1:** Average persistence and productivity of nine native *Cullen* species, one native *Lotus* species, two lucerne cultivars, Sardi10 and Sceptre and *Lotus corniculatus* cv. San Gabriel between October 2006 and September 2007 at a field site 20km west of Buntine in WA's low rainfall wheatbelt. Persistence values are percentages of established seedlings and productivity scores are ratings out of 10.

| Spp | # populations tested | Persistence in April (SE) | Productivity in April (SE) | Persistence in September (SE) | Productivity in September (SE) |
|---|---|---|---|---|---|
| *C. australasicum* | 39 | 88 (3.1) | 4.4 (0.32) | 85 (2.9) | 5.0 (0.27) |
| *C. cinereum* | 22 | 71 (8.5) | 3.3 (0.06) | 52 (5.0) | 2.2 (0.22) |
| *C. discolor* | 2 | 92 (10.2) | 2.6 (0.35) | 81 (12.3) | 3.7 (0.43) |
| *C. lachnostachys* | 1 | 100 (0.0) | 5.1 (1.50) | 83 (20.4) | 2.5 (0.61) |
| *C. pallidum* | 4 | 75 (10.2) | 3.2 (0.28) | 67 (11.8) | 3.6 (0.23) |
| *C. parvum* | 3 | 79 (7.3) | 1.1 (0.07) | 79 (7.3) | 1.4 (0.12) |
| *C. patens* | 6 | 33 (9.4) | 2.4 (0.58) | 24 (7.3) | 2.1 (0.30) |
| *C. pustulatum* | 1 | 100 (0.0) | 5.3 (2.13) | 100 (0.0) | 1.8 (0.74) |
| *C. tenax* | 22 | 68 (7.4) | 1.7 (0.16) | 58 (10.0) | 1.6 (0.16) |
| *L. australis* | 1 | 61 (24.5) | 2.2 (0.95) | 61 (24.5) | 2.7 (0.82) |
| *L. corniculatus* | San Gabriel | 11 (13.6) | 0.0 - | 11 (13.6) | 3.0 - |
| Lucerne | Sardi 10 | 94 (6.8) | 4.0 (0.40) | 83 (0.0) | 5.9 (0.50) |
| Lucerne | Sceptre | 85 (9.4) | 2.9 (1.16) | 79 (3.0) | 4.2 (0.95) |

## COMMENTS

The most important findings of this study are that populations from eight *Cullen* species persisted better and seven populations of *C. australasicum* both persisted better and were more productive than Sardi 10 lucerne under the trial conditions. These results provide strong support for our expectation that some populations from *Cullen* species will have both adaptations and agronomic traits that make them suitable for use as perennial pastures in the low rainfall, Mediterranean climate of WA's wheatbelt.

*Cullen australasicum* was the best *Cullen* species overall, in terms of productivity and persistence throughout the year. *Cullen australasicum* contained the most productive populations in the study based on September productivity and was more productive as a whole than Sardi 10 in April. This is an important result, considering that wild germplasm is being compared to lucerne cultivars that have had many years of intensive breeding effort. This result may be somewhat expected because the September harvest was of eight months regrowth. It has been shown in the past that longer cutting intervals favour the cumulative productivity of *Cullen* species relative to lucerne and it was expected that lucerne was not highly productive in April as it is better adapted to winter growth, loses its leaves under drought conditions and was affected by pasture webworm. Nevertheless, this result shows that *C. australasicum* may be particularly useful when allowed to accumulate as a 'living haystack' which can be used strategically to fill feed gaps in summer or autumn, or during drought.

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