ECONOMIC VALUE OF BIODIVERSITY

DEVELOPING NATIVE PERENNIAL LEGUMES AS PASTURE SPECIES FOR THE WA WHEATBELT

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Declining revenue coupled with a climate that is becoming drier and more variable each year has created a demand for low input, resilient farming systems in Western Australia's northern and eastern wheatbelt. According to recent research, hardy native legumes found in the region may have an important part to play in developing these new farming systems. Many native perennial legumes have the characteristics that could make them productive in low-input, water efficient farming systems.

Cullen graveolens *on the Fortescue River floodplain, Pilbara. Ph: D. Nicol*

WA has some of the most diverse vegetation in the world growing on poor soils in arid or semi-arid environments, much of which can be found next to some of the most efficient broadacre farming systems in the world. How native drought-tolerant legumes can be incorporated into new and pre-existing farming systems is currently being explored by Future Farm Industries CRC (FFI CRC) researchers based at the University of Western Australia (UWA) and elsewhere.

The need for new (perennial) pasture options in WA

With increasing input costs for cropping and predictions of a significantly drying climate, WA farmers are looking for options to offset risk and maintain primary production. Current farming systems have been developed using introduced species, predominantly from the Mediterranean region, with subsequent breeding to select for adaptation to Australian farming areas. However, this process can be slow and costly and encounter difficulties with quarantine restrictions. While a large array of new exotic annual pasture legumes are currently being released to farmers, choice of perennial pasture legumes is currently limited to lucerne (*Medicago sativa*) – which is being grown with mixed success in the drier areas of the WA wheatbelt due, in part, to poor adaptation to drought and difficult soils.

Increased adoption of perennial legumes is desirable as, in addition to their ability to fix atmospheric nitrogen, their year-round growth and deep roots will aid in rebalancing the hydrology and reducing the development of dryland salinity; reducing soil erosion especially in summer/autumn; quick production of biomass in response to the autumn break of season; and perhaps, provision of drought resilience within a farming system. Perennials also allow farmers to take advantage of summer rainfall instead of having to bear the high cost of spraying out undesirable summer weed species such as paddy-melon, mint weed and caltrop. Perennial pastures also have multiple factors that improve animal production and welfare such as provision of vitamin E during the summer drought and higher quality feed when summer rainfall destroys dry feed quality. Biodiversity benefits may also accrue. Adoption will be driven through the ability of perennial legumes to provide green feed for livestock in the traditional summer/autumn feedgap hence species with promise will be those able to keep leaves during hot, dry summer conditions.

Preliminary research shows that native plants can be both well-adapted to the soils and climate of the WA wheatbelt and may be highly productive. Some genera of native plants are showing significant promise for future domestication.

FFI CRC on-going research

The FFI CRC has conducted several preliminary screening and collection programs. Seed and rhizobia collected from natural populations during these projects have been placed in storage and are available to support future breeding and research programs. These preliminary programs, along with the sparse available literature, have highlighted *Cullen* species as highly productive, likely to be nutritious and palatable, and demonstrating many biological traits that make them well suited for domestication, such as good seed

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native legumes

production and physically dormant hard-seeds.

Currently there are a number of field experiments in WA involving natives, primarily species of *Cullen*. UWA PhD student, Richard Bennett, has trialled 120 populations (ie seed collected from discrete populations) from nine Australian *Cullen* species in deep yellow sands at Buntine in the northern wheatbelt. This field site typically receives about 300 mm of rainfall annually, but during the experiment it was considerably drier. Some populations of eight *Cullen* species persisted better, and seven populations of *C. australasicum* both persisted better and were more productive than the best performing lucerne cultivar in the experiment.

Cullen australasicum is a multi-stemmed, erect, herbaceous legume to one metre high. Stems can become woody with a diameter of ~15 mm at the base. It is a perennial, but often flowers in the first year with pink to mauve flowers in showy racemes to 300 mm long. It is a very variable species with regard to growth form, leafiness and seeding characteristics. It is native to the eastern states of Australia and also shows good potential for development as a pasture species on alkaline soils in South Australia. Further studies into breeding and drought tolerance will continue this year. Field sites are being established by the Department of Agriculture and Food at Buntine, Merredin and Newdegate.

Another field experiment, managed by UWA PhD student Dion Nicol, is located at Mukinbudin in the central eastern wheatbelt of WA (mean annual rainfall 285 mm) in a heavy clay soil with a calcareous and sodic (ie hostile) subsoil. This experiment will be the first to compare the basic agronomic information and yields between current pasture legumes and two native *Cullen* species (*C. cinereum* and *C. graveolens*). Access tubes to two metres are installed and water use through the profile will be measured along with plant survival and productivity over two years. This experiment was re-started in May 2008 after a poor initial establishment in 2007. Surviving plants sown in 2007 showed remarkable growth during the following summer and autumn prior to the autumn break.

Cullen cinereum and *C. graveolens* both occur naturally in northern WA, although not in the WA wheatbelt. As part of his honours studies, Dion observed these species growing prolifically in the Fortescue River floodplain – an area with similar soils to his field experiment site at Muckinbudin.

Associated research

There are also a number of on-going research projects focussed on *C. australasicum*, other *Cullen* species and other native perennial legumes. These include examination of the breeding system of *C. australasicum* and its ability to cross with other *Cullen* species and the tolerance of *C. australasicum* to herbicides commonly used to control broad-leaved weeds in pastures. Tolerance of phosphorus fertiliser, productivity under low phosphorus conditions, ability to access poorly soluble sources of soil phosphorus, along with tolerance of drought, waterlogging and soil acidity are being investigated. The use of unpalatable nurse shrubs to facilitate the growth of palatable climbing species (*Glycine canescens*) is being investigated as well as the regional adaptation and bioactivity of *Kennedia prorepens*. A small project is investigating grain legume potential of selected native annual and perennial legume species. Further exploratory research appears justified on many genera, particularly *Swainsona*.

Conclusions

Native perennial legumes show considerable promise as pasture species for the drier areas of the WA wheatbelt. Preliminary results suggest species will be identified that are both productive and well adapted to hostile soils and drought and/or a drying climate. However, results are preliminary and important issues remain to be investigated before cultivars are released to farmers, notably the impact of these native plants on animal productivity and health. Low seed supplies currently limit our ability to provide seed to farmers for trialling.

Note:

would you like to visit these trials at Buntine? Contact Fiona Falconer and, if enough people are interested, she will liaise with the authors to arrange a Field Day.

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