Persistence of pasture legumes in southern and central Queensland

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Abstract
Incorporating legumes into grass only pastures has been identified as the best long term option for increasing pasture production, animal performance and economic returns on rundown sown grass pastures. Pasture legumes that can persist and be productive with sub-tropically adapted sown grasses in inland areas of Queensland, especially on clay soils, were only released in relatively recent times. Commercial results from legumes have been mixed, with many graziers reporting poor persistence of legumes with sown grasses. Thirty six pasture evaluation trials or commercial plantings across southern and central Queensland that have been established for greater than ten years were evaluated for legume persistence; some of the newer legume species have persisted well. Caatinga stylo was persistent across a range of soils and environments. Desmanthus has persisted well on brigalow clays but not as well on basalt soils. Butterfly pea performed well on deeper basalt soils in central Queensland but has not been persistent on brigalow clays. Burgundy bean was not persistent. Leucaena was persistent on deeper and more fertile soils in central Queensland. This research demonstrates that there are persistent legume species available for a wide range of land types although some gaps may still exist. Further research and development will improve the reliability and productivity of these legumes in sown grass pastures.

Key Words
Pasture legumes, persistence, sown pastures.

Introduction

Sown pasture grasses are highly productive when they are planted after tree clearing or into fertile cropping soils. However, the productivity of these pastures typically declines with time, a phenomenon often described as “pasture rundown”. Productivity decline in sown grass pastures is widespread in northern Australia and reduces production by approximately 50%, a farm gate cost to industry of >$17B over the next 30 years (Peck *et al.* 2011).

The large quantities of dry matter produced initially after pasture grasses are established is a response to the high levels of available nitrogen (N) and water that accumulate on fertile soils during a fallow prior to planting. However, dry matter production and subsequent animal performance decline as the available N reserves decline and become less available to pasture grasses. The annual dry matter production and animal live weight gains from sown grass pastures can decline by approximately 50% within five to ten years of establishment across a range of soil and seasons (Graham *et al.* 1981; Jones *et al.* 1995; Myers and Robbins 1991; Radford *et al.* 2007; Robbins *et al.* 1987; Rudder *et al.* 1982).

Legumes can improve production on rundown sown grass pastures through biologically fixing atmospheric nitrogen and thereby improving diet quality directly as well as nitrogen cycling to companion grasses (which improves both the dry matter production and feed quality of the grass). However incorporation of legumes into sown grass pastures has not been extensive with 70% of the total area planted in northern Australia being sown only with tropical grasses and, even when planted, many earlier legume varieties proved not to be persistent with grass pastures (Peck *et al.* 2011; Walker *et al.* 1997; Walker and Weston 1990).

Graziers report that many commercially available legumes have not persisted over the long term when sown with grasses in inland districts of Queensland but some ‘newer’ varieties showed promise during evaluation trials (Peck *et al.* 2011). The ‘newer’ varieties of legumes (especially Caatinga stylo and desmanthus) offer the potential to extend the range of land-types and climates where pasture legumes can improve animal production if they prove to be adapted and persistent.

This paper reports the persistence of pasture legumes across 36 pasture evaluation trials or commercial plantings across southern and central Queensland that have been established for greater than 10 years. The

Proceedings of the 16th ASA Conference, 14-18 October 2012, Armidale, Australia. Web site www.agronomy.org.au

legumes evaluated for persistence were Caatinga stylo (*Stylosanthes seabrana*), desmanthus (*Desmanthus* spp.), leucaena (*Leucaena leucocephala*), butterfly pea (*Clitoria ternatea*) and burgundy bean (*Macroptilium bracteatum*).

Methods

Old pasture evaluation and demonstration sites were inspected to observe the persistence of legumes. All sites were established for greater than 10 years. At each site the following information was collected:

- Site description (property name, GPS coordinates)
- Soil and vegetation description
- Legume species found and descriptions of persistence including current patch sizes, plant density, population structure (i.e. mainly old plants, mainly young plants, range of ages) and evidence of spread
- Legume health and vigour
- Grass health and vigour
- Current grazing management
- At some sites, nodule number

Results and Discussion

Sites

Legume persistence at 33 old trial and demonstration sites were recorded in May 2011 across southern and central Queensland. An additional three sites were recorded in October and November 2011 in central Queensland (CQ). All sites in CQ were on clay soils. Southern Queensland (SQ) sites had a range of soils from sands to heavy clays however there were few heavy clay soils (Figure 1).

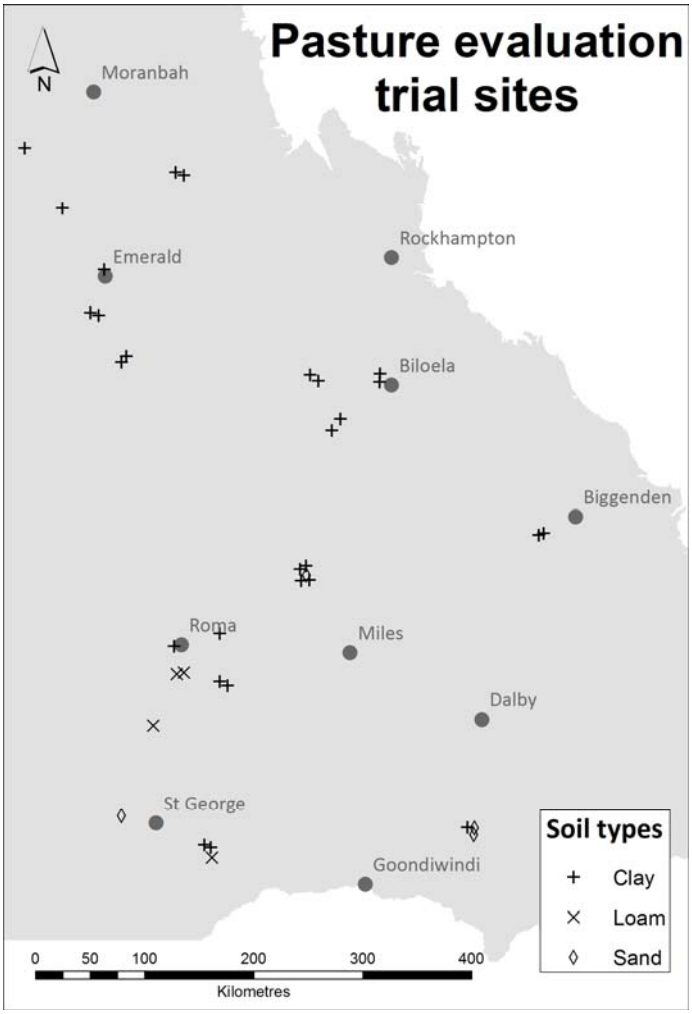

Figure 1: Location of 36 pasture evaluation sites where legume persistence was recorded.

Legume species
Many of the trial sites had multiple lines of multiple species planted making field identification to the species level difficult. The *Desmanthus* genus in particular was difficult to identify to species level in the field. At a few *Stylosanthes* evaluation sites, it was also difficult to identify to the species level.

Preliminary results and conclusions from the old legume plantings are described below. Original planting details are still to be checked (i.e. which species and accession was planted) for several sites; original species planting lists are not available for all sites.

Desmanthus
Desmanthus was still present at 19 of the 26 sites at which it was planted. Conclusions to date are:

- *Desmanthus virgatus* (cultivar Marc and other accessions) is persistent where it has established, however there are questions about its productivity (dry matter production and leaf retention).
- Cultivar Bayamo and other taller types (within the same species and in other species) deserve further evaluation as they have been persistent at several sites and appear more productive with better leaf retention.
- Marc was dominant at several sites and appeared to have reduced companion grasses considerably. It will be important to follow how pasture composition changes over time and what management is required to maintain both suitable grass and legume components in the pasture.
- Desmanthus did not persist on sandy soils and has not persisted well on basalt derived vertosol soils downs soils in CQ with either no plants or only isolated plants found at old trial sites; but it has persisted well on brigalow clay soils.

Caatinga stylo
Caatinga was still present at 21 of the 23 sites at which it was planted. One of the sites where Caatinga stylo has not persisted, had never been grazed. Key points and conclusions about Caatinga stylo were:

- It is widely adapted, persistent and productive on clay soils in southern and central Queensland.
- It looked better in CQ than SQ when the recordings were carried out with generally more biomass and healthier looking plants. However it is hard to conclude whether or not Caatinga stylo is better adapted to CQ than SQ. Recordings were done in May at the time that the first widespread frosts occurred in SQ.
- Caatinga stylo has often been promoted as being suitable to light clays and loamy soils. However, it may be better adapted to heavy clays than has been suggested. Caatinga stylo has done well at several sites on heavy clay soils derived from basalt in CQ. In SQ, Caatinga has generally been recommended for light clays and loams. It could be useful to establish Caatinga stylo trials on heavy clays in SQ.
- Caatinga stylo has not done as well on un-grazed or infrequently grazed sites. Caatinga stylo seems to require some disturbance and reduction in competition from companion grasses to thrive.

Leucaena
Leucaena persisted and seemed to be producing reasonable amounts of biomass at most sites where it had been planted, but did not persist at two trial sites. However, all leucaena sites visited were in CQ.

Butterfly pea
Butterfly pea has persisted and appeared to be highly productive on the better basalt derived vertosol soils in CQ. It has not persisted as well in SQ or on brigalow clay soils. Grazing management seems to be important, with butterfly pea appearing more productive in un-grazed or rotationally grazed sites.

Burgundy bean
Burgundy bean has persisted and appears productive at only one un-grazed site. It appears better suited to short-term pastures in rotation with cropping or requires special management to allow it to persist.

Conclusions
Persistent legumes
Although commercial results from incorporating legumes into sown grass pastures in inland Queensland has been considered un-reliable, the old trial sites evaluated during this project demonstrated that there are commercially available persistent legumes for land types with medium and heavy textured soils in southern and central Queensland. The high level of persistence of several legumes observed during these site visits

should provide confidence to industry and research, development and extension organisations that it is worthwhile to invest resources to improve the reliability and performance of incorporating legumes into sown grass pastures and learning how to better manage them for persistence under grazing.

Geographic spread of sites
The old trial sites visited provide a good geographic coverage of CQ. However all sites recorded were clay soils. There is arguably a lack of described sites on medium and lighter textured soils. However shrubby and Caribbean stylos combined with the legumes described during this study, provide a good coverage of suitable legumes for permanent pastures on the land types and climates of CQ.

In SQ there were no old trial sites visited for the Darling Downs, Goondiwindi and Moonie districts for the commercially available varieties of desmanthus and Caatinga stylo. No sites were visited in northern NSW which has similar soils and climate to southern Queensland. There are some old CSIRO pasture evaluation trials (e.g. ley legumes project trial sites) and commercial plantings that may have planted these legumes that could help with testing whether these legumes are persistent in these districts. However it is likely that there will remain a gap in old trial sites to compare persistence and productivity of summer growing legume options in SQ and northern NSW.

Based on the old trial sites visited there are no commercially available summer growing legumes that are widely adapted and persistent for lighter soils (loams to sandy and hard setting surfaced soils) in SQ.

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