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PROGARDES™: a legume for tropical/subtropical semi-arid clay soils

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Introduction

The range of available sown pasture legumes for the vast heavy clay soil regions of northern Australia has long been regarded as being deficient (Burt 1993; Jones and Clem 1997; Pengelly and Conway 2000). Indeed immense areas of northern Australia's semi-arid clay soil regions have no sown pasture legume with proven adaptation and persistence through the long annual dry seasons (Gardiner and Swan 2008).

The genus *Desmanthus* is a Mimosaceae legume containing some 24 species which are native to the Americas and range from being herbaceous to suffruticose in habit (Luckow 1993). *Desmanthus* is one of the very few legumes consistently observed to persist under heavy grazing on clay soils in their native environments (Pengelly and Conway 2000). Numerous accessions of *Desmanthus* were collected and introduced into Australia by various institutions, notably CSIRO and QDPI, over the past 50 years (Reid 1983; Pengelly and Liu 2001), as potential legumes for clay soils. After years of multi-site field evaluation of *Desmanthus* and other species, in 1991 QDPI released 3 *Desmanthus* cultivars, cvv. Marc (*D. virgatus)*, Bayamo (*D. leptophyllus*) and Uman (*D. pubescens*), which were marketed as a blend named "Jaribu" (Cook et al. 1993). Currently, only cv. Marc is available commercially with a focus on southern subtropical Queensland markets. However, Pengelly and Conway (2000) state that, owing to Marc's low dry matter production, its contribution to animal diets and soil N is limited.

Development of Progardes™

In the 1990s Chris Gardiner at James Cook University, Townsville, started to survey legumes at a number of old abandoned trial sites across remote northern and central western Queensland's semi-arid clay soil regions (<500 mm AAR). He found that various *Desmanthus* accessions were the only surviving and thriving legumes of all species sown in those environments. These particular accessions had persisted for a decade or more (now more than 2 decades) and had survived grazing, drought, flooding, fire and frosts and had therefore withstood the full gambit of environmental stresses (Gardiner and Swan 2008). The selection and breeding of plants from these survivors and others from other similar old sites and their subsequent evaluation in new trials and seed multiplication have led to the development of new lines of *Desmanthus* for northern Australia and similar environments**.**

The best of these varieties have been released by Agrimix Pty Ltd, JCU's commercialization partner, as a blend named Progardes™ (www.progardes.com.au). Progardes being, **Pro** for protein, **gar** for Gardiner and **des** for *Desmanthus* The blend comprises new selections of the species *D. bicornutus, D. leptophyllus* and *D. virgatus* giving it a broad range of early to late maturity types, plus a range of habits (herbaceous to suffruticose) and edaphic and climatic tolerances. In recent times Progardes™ has been sown in trials and demonstration areas totaling some 2000 ha in a wide range of environments including: open Downs, cleared Gidgee/Boree and Brigalow land types across Queensland and via a number of sowing techniques including aerial, blade ploughing, stick raking, broadcasting onto cultivated seedbeds in a buffel grass renovation and broadcasting onto unprepared native grass pasture, all with considerable success. By the end of the 2012/13 season, Agrimix had some 12,000 ha commercially sown.

As with most crops and pastures, the key to successful establishment is one of timing, and with Progardes™ in northern Australia planting at the end of the dry season/start of the wet season gives the establishing plants a good opportunity to come away with the sown or native

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grasses. Annual rainfall on our rangelands is highly variable (McKeon 2006), so the common practice is to plant a mixture of hard and soft (scarified) seed, which gives some insurance against false seasonal starts. Scarification typically enhances germination from about 10% to 70−80%. Experience is showing that 2 or 3 wet seasons may be required for the Progardes™ to become well established in the harsher drier environments such as on the Mitchell Grass Downs, but only one season in the more favorable Brigalow region of Queensland.

Grazing and feeding trials with both sheep and cattle have been undertaken. Steers grazing a buffel grass-Progardes™ mixed pasture in central Queensland gained an additional 40 kg live weight over a 90-day study period compared with steers on an adjacent buffel grass-only pasture during a cool dry winter (Gardiner and Parker 2012). In a feeding study with sheep, adding Progardes™ to a Flinders grass diet resulted in a positive N balance and significantly improved intake and weight gains over that of sheep fed only Flinders grass (Ngo 2012). Concentrations of crude protein in leaf, stem and pods with seeds of Progardes™ have been recorded as being 20.2, 11.9 and 17%, respectively, while energy (ME) levels of the whole plant were 10.3 MJ/kg DM.

Commercial seed crops are being grown successfully on the Atherton Tablelands and the Burdekin Irrigation areas; some hay has also been effectively made from Progardes™. It is expected that even small amounts of Progardes™ will improve animal production in the targeted dry environments owing to what Bell (2009) terms the marginal value of feed that such nutritious plants offer. Kretschmer and Pitman (2001) stated that as little as 10% of a legume in poor quality grass pasture would make significant impacts on animal intake and therefore production. In a 250 ha trial in central Queensland's Brigalow region, sowing Progardes™ into renovated buffel grass resulted in a legume density of 7 plants/m^2, with a frequency of 75% at the end of the 1st growing season. This indicates potential compatibility with buffel, where few legumes, as stated by Robertson et al. (1997), have been successful. Reid (1983) noted, when collecting *Desmanthus* in Mexico, that in certain regions on clay soils it often occurred with the introduced buffel grass. Its compatibility with buffel suggests too that it has potential to alleviate buffel run-down, a widespread problem which reduces animal production.

Conclusions

Progardes™ appears to be an appropriate legume for improving livestock production in terms of increased liveweight gains, reproductive rates, turn-off and wool production, particularly in the semi-arid clay soil regions of northern Australia, where few, if any, other herbaceous sown pasture legumes are currently adapted. Widespread plantings by commercial graziers will confirm whether this potential can be realized and what contribution the legume can make to sustainability of pastures in these regions.

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