Discontinued legume trials yield potentially valuable genotypes

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Abstract
Across northern Queensland and other regions various institutions such as CSIRO, Department of Agricultures, Universities and seed companies have over the decades sown numerous pasture trials consisting of multiple species and accessions with the aim of seeking new well adapted pasture plants for particular climate and edaphic circumstances. Often these trials are on private farms and are operational for relatively short times such as 2-3 years but then they are discontinued and abandoned. The trial sites then typically become incorporated into regularly farmed/grazed paddocks and in many cases they become forgotten about. The well-adapted species at these sites however survive and persist in the given environment, often for decades. These discontinued trial sites can be extremely valuable as the pasture species that have survived have usually been thoroughly tested by the test of time, enduring droughts, floods, grazing, fire, insects, that is, the full gambit of biotic and abiotic tests. Thus surviving accessions are potentially a valuable resource not only for northern Australia but similar climates in Africa, Central and South America and Asia. This paper outlines a number of discontinued trials particularly in north Queensland and highlights some long surviving accessions of potential such as various accessions of *Arachis*, *Centrosema*, *Desmanthus*, and *Macroptilium*, and encourages others to seek out and re-evaluate old discontinued trial sites which may contain accessions with potential for the grazing industry.

Keywords
Abandoned trials, pasture legumes, tropical legumes.

Introduction
Across northern Queensland, and other regions, various institutions such as CSIRO, Department of Agricultures, Universities and seed companies have sown numerous pasture trials consisting of multiple species and accessions with the aim of seeking new well adapted pasture plants for particular climate and edaphic circumstances. Often pasture evaluation projects are funded for relatively short periods of time, typically for 2-3 years, and then they are concluded and are discontinued. Biologically, 2-3 years is a very short time to test pasture plants, particularly considering the variability of our climate (McKeon 2006). The 2012 -2017 drought in Queensland, highlights this point in which four wet seasons failed to deliver average rainfall. Similar severe drought conditions were occurring in the Horn of Africa. Any trial established in this period are most likely to have yielded very poor results and have been discontinued. However, certain hard seeded species may emerge at a much later date long after the trial has officially ended.

There are numerous examples of old abandoned discontinued pasture trial sites across northern Australia's semiarid tropical and subtropical environments. Many sites have been now abandoned for 20 plus years and a number of potentially valuable pasture legumes are still present and thriving at some of these sites. The well adapted plants in these discontinued trials, however live on despite plot fences being removed and the trial site becoming incorporated in to regular commercially grazed paddocks.

The survivors at these sites hold considerable potential and we wish to briefly document five cases and highlight them for possible future use.

Hillgrove Station – Charters Towers, North Queensland. Site 1 - the CSIRO Ecossat site
Hillgrove Station north of Charters Towers is located in the semiarid rangelands, and has had a long history of collaborating particularly with CSIRO and DAF into pastures and grazing management. The Ecossat site ($19^0$40'S 140^0 45'E) is a *Eucalyptus* woodland on Euchrozem soils (red/brown light clays) with a pH of 6.5 in a 520 mm rainfall see; McIvor and Gardener (no date). The site was sown in 1982 to *Stylosanthes* cvv Verano, Seca, Graham plus *Macroptilium* cv Siratro, and a number of grasses including *Cenchrus* cv American, *Brothicochloa* cv Hatch, *Chloris* gayana cv Callide and *Urochloa mosambicensis* cv Nixon. After 35 years of the research having been done, the site is dominated by Seca and Verano stylo and the native

grasses particularly *Bothriochloa ewatiana*. The site has been incorporated into an adjacent large grazed paddock for many years. At this site there is also an un-referenced additional legume trial probably established by RL Burt (CSIRO) who left several photographs of the site from which the locality of the site could be identified and in which *Arachis pusilla* (syn *A.triseminalis*) has been found to be numerous in small plots and persistent amongst the stylos and native grasses (Photo 1). *Arachis pusillia* is a small herbaceous legume originating in Brazil and is known to be quite drought tolerant (Amar 1996). Valls and Simpson (1993) stated that it is a species of high yield and quality and remains alive under intense grazing during long dry seasons. It is also worthy of note that within the Ecossat site there is also a plot of various *Leucaena* spp surviving including *L. leucocephala and L. collinsi*, these are mostly now tall and ungrazed apart from numerous seedlings which are grazed. No records of what these accession are or what was planted have been found however the plants have persisted unattended for decades.

Photo 1. *Arachis pusilla*, Hillgrove, Charters Towers.

Hillgrove Station – Charters Towers, North Queensland Site 2 Basaltic soil adjacent to the Ecossat site
Burt (2016) indicated the previous existence of three legume trials (90 accession) from Townsville to Hillgrove in 1982. The objective of the trials was to evaluate legumes in a climate gradient but due to drought the Hillgrove site was abandoned. Hillgrove site was re discovered in 2007, and it is on a dark basaltic clay soil adjacent to the Ecossat site. The current vegetation of the site includes; *Acacia farnesiana*, *Neptunia gracillis* and a variety of native and introduced grasses including *Bothriochloa ewatiana*, *B. pertusa*, Buffel grass and Sabi grass. Gardiner and Swan (2008) reported that populations of *Desmanthus* with up to 5.75 plants/m^2 and *Clitoria ternatea* with 1.8 plants/m^2 were surviving. The *Desmanthus* genotypes included prostrate and decumbent *D.virgatus* accessions, erect *D.leptophyllus* to low growing shrubby *D. bicornutus*. However, an inspection during 2016 indicated that after severe drought only the well grazed *Desmanthus* accession were present. Furthermore, a plot *of Acacia angustissima* was found thriving at this site. However, there are not any records of when or who planted it.

A. angustissima was introduced in Australia as a potential shrub legume but being an exotic *Acacia* is now a declared weed. Thus, revisiting old abandoned trial sites can also yield species that are deemed weeds and can then be controlled. The *Arachis* and *Desmanthus*, at these Hillgrove sites, are worthy of particular note as these genotypes are not commercially available. These species have considerable potential as illustrated by their longevity in a harsh grazed environment where neither inputs of fertiliser nor irrigation were supplied. Adapted legumes on these dark and also the red basaltic soils of this region could potentially be of benefit to the grazing industry.

Woodbine Station, Blackall – Central Western Queensland
Gardiner et al. (2004) described the legumes surviving in this abandoned site which was originally sown in 1989 with accessions of *Alysicarpus, Arachis, Chamaecrista, Centrosema, Clitoria, Desmanthus, Macroptilium, Stylosanthes and Vigna. Desmanthus* cv JCU 5 (Gardiner 2016) was derived from plants from this abandoned site. In a recent inspection, 28 years post planting of the original trial, it was found that numerous *Desmanthus* accessions were still thriving, and a new selection was collected for possible breeding purposes. It is worthy to note that at this cleared Gidgee clay soil site (with buffel grass and native grasses) in

the year after planting (1989), *Stylosanthes* was abundant but 28 years later of all the legume species originally sown only *Desmanthus* spp are present today, thus illustrating the necessity of long term trials and revisiting old trial sites.

James Cook University, Townsville, North Queensland, site 1

In 1992, a legume evaluation trial was sown at James Cook Universities Graduate School of Veterinary Science and Agriculture to evaluate the agronomic (including the response to Phosphorus) and morphological characteristics of thirteen tropical pasture legumes Ossiya (1993). The trial was having different accessions from *Arachis, Centrosema, Desmanthus, Glycine, Neonotonia, Macroptilium and Stylosanthes*. The site 1 at James Cook University is located at 19^0 19'S 146^0 45'E. The environmental conditions are coastal seasonally dry tropics and the soil is described by Murtha (1982) as a soil with a light grey brown sandy loam A_1 overlying a highly bleached sandy loam A_2 horizon which changes abruptly to a mottled brownish grey and yellow brown heavy clay B horizon. The pH of both A and B horizons is mildly acidic (pH 6.5). After planting and abandoning the trial in 1993, the site has been heavily crash grazed by sheep, abandoned, later disturbed as a potential building site, and recently regularly slashed as Indian couch is also abundant. The site was exposed to climate variability during the last 25 years, including periods of significant drought. Currently, of the 13 genotypes originally planted a number of resilient and persistent legumes have survived and flourished and are well worthy of note as potential species for this environment and similar ones elsewhere. *Stylosanthes hamata* cv Verano and *S. scabra* cv Seca are naturalised in the area and are extremely well adapted to the region. Other species still present and abundant today are *Centrosema brasilianum CPI 55698 and Arachis paraguanensis* CPI 91419 and to a lesser degree *Macroptilium martii* CPI 55782, *Arachis paraguanensis* CQ 1780 and *Desmanthus leptophyllus* CPI 38351. *Arachis pusilla* CPI 91423, *Centrosema pascuorum* CPI 55697, *Desmanthus virgatus* CPI 79653, *Glycine latifolia* CQ 3368, *Macroptilium bracteatum* CPI 55770 *and Neonotonia wightii* cv Cooper have failed the test of time in this environment and under the prevailing management systems and disturbance.

James Cook University, Townsville, North Queensland, site 2

In 1992, Rangel (2005) established a legume evaluation trial on a similar Healy association duplex soil as described above but in a *Eucalyptus crebra* open woodland adjacent to James Cook University Vet School. The purpose of the trial was to investigate the shade tolerance of *Desmanthus* accessions and their response to better soil conditions under the canopy compared to between canopies. The *Desmanthus* accessions sown were *D.bicornutus* CPI 91162, *D. leptophyllus* CPI 38351 and TQ88, *D. virgatus* CPI 78382 and CPI 79653, *D. pubescens* CPI 92803 cv Uman, *D.pernambucanus* CPI 40071. After 25 years of the research, *D. bicornutus* CPI 91162 is still present and thriving amongst the iron bark woodland (Photo 2). Selections of this genotype have been made for cultivar development. TQ 88 is also present, but far less prevalent. Interestingly, none of these accessions have persisted between the canopies at this site. The so called "forest country" across northern Australia lacks a sown legume, CPI 91162 or cultivars derived from it, may provide a useful legume for these semi shaded niches.

Photo 2. *Desmnanthus bicornutus* in an Iron bark woodland, Townsville.

Conclusions

The survey of and reevaluation of old abandoned and discontinued pasture trial sites can be a fruitful exercise and be a short cut to yielding potentially valuable genotypes. From the survey of the abandoned sites, several *Arachis* spp,, *Centrosema brasilianum*, *Macroptilium martii*, and *Desmanthus* accessions hold potential for development for the northern grazing industry. The survivors found in the old trials have been thoroughly tested by the environment (droughts, floods, fire, frosts, and regular long dry seasons), have been subjected to grazing, and also exposed from time to time to different pests such as army worms and locusts. These plants have traits which were outlined as critical for successful rangeland pastures (Whiteman 1980). The recent release of *Desmanthus* cultivars JCU 1-5, and the Progardes story (Gardiner 2016) are also proof of the value of exploring discontinued and abandoned pasture evaluation plots. Furthermore, surveys of discontinued trials can alert us to potentially weedy species that may also have thrived but may be unpalatable to livestock.

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