



Potentially useful legume accessions persist 32 years on in abandoned subtropical coastal pasture evaluation site

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Key words: Legume; persistence; *Arachis*; *Desmanthus*

Abstract

Over the decades, hundreds of pasture evaluation trial sites have been established across northern Australia with the aim of discovering plant accessions suitably adapted to particular climatic and edaphic conditions. The majority of such sites now lie abandoned, despite the fact that they represent a valuable repository of potentially useful genotypes, that have often been thoroughly tested by droughts, floods, fire, grazing and insect attack.

One such site was a legume evaluation trial established in 1992, at the Veterinary Sciences Precinct at James Cook University in Townsville. The objective of the trial was to evaluate the agronomic and morphological characteristics of 13 tropical pasture legumes sown on a low fertility, mildly acidic (pH 6.5), coastal duplex soil, with an AAR of 1,143 mm. The trial included a range of accessions from the genera *Arachis*, *Centrosema*, *Desmanthus*, *Glycine*, *Neonotonia*, *Macroptilium* and *Stylosanthes*. Following establishment, the site was abandoned after one season and has since endured heavy crash-grazing by sheep, earthworks disturbance, regular slashing, continuous macropod grazing pressure, and has been exposed to periods of significant drought over the last 32 years.

This paper summarises the results of the most recent survey of the site. Of the 13 genotypes originally planted, a number of resilient legumes continue to survive including *Arachis paraguariensis* subsp. *capibarensis* (CPI 91419), *Desmanthus leptophyllus* (CPI 38351), *Stylosanthes hamata* cv. Verano and *Stylosanthes scabra* cv. Seca. These are persisting within a mixed sward dominated by *Chaemacrista rotundifolia*, *Bothriochloa pertusa*, and *Desmodium triflorum*. Additionally, *Centrosema brasilianum* (CPI 55698), and to a lesser degree *Macroptilium martii* (CPI 55782) were observed growing on a stream embankment, approximately 10 m from the site.

These surviving plants represent a potentially valuable collection of robust and persistent legumes, not only for northern Australia but similar climates across Africa, Asia and central and south America.

Introduction

Across northern Australia various institutions such as CSIRO, governmental agriculture departments, universities and seed companies have over the decades sown hundreds of pasture trials, consisting of multiple species and accessions with the aim of identifying new pasture plants that are well-adapted to particular edaphoclimatic

conditions. Such trials are very often located on private properties and only receive operational funding for relatively short periods of time (2-4 years), before being discontinued and abandoned. The value of such sites however, is very often not exhausted at the conclusion of the associated experimental period as in many cases, many of the planted accessions possess traits for hard-seededness, permitting them to persist for decades.

As a result, such sites represent a valuable repository of potentially useful genotypes, that have often been thoroughly tested by droughts, floods, fire, grazing and insect attack. Such plants are potentially valuable not only for northern Australia but similar climates across Africa, Asia and Central and South America.

In 1992, one such legume evaluation trial was sown at the James Cook University Veterinary Science Precinct with the aim of evaluating the agronomic and morphological characteristics of 13 tropical pasture legume accessions from the genera *Arachis*, *Centrosema*, *Desmanthus*, *Glycine*, *Neonotonia*, *Macroptilium* and *Stylosanthes* (Ossiya 1993). In 2024, a follow-up plant survey of the site was undertaken in order to identify persisting accessions. The results of this survey are summarised.

Methods

In 1992, a legume evaluation trial was sown at the James Cook University Veterinary Science Precinct (19° 19'S 146° 45'E) with the aim of evaluating the agronomic and morphological characteristics of the following 13 tropical pasture legume accessions:

- *Arachis paraguariensis* subsp. *capibarensis* (CPI 91419)
- *Arachis paraguariensis* subsp. *paraguariensis* (CPI 1780) (formerly *Arachis erectoides* (CQ1780))
- *Arachis triseminalis* (CPI 91423) (formerly *Arachis pusilla* (CPI 91423))
- *Centrosema brasilianum* (CPI 55698)
- *Centrosema pascuorum* (CPI 55697)
- *Desmanthus leptophyllus* (CPI 38351)
- *Desmanthus virgatus* (CPI 79653)
- *Glycine latifolia* (CQ 3368)
- *Macroptilium martii* (CPI 55782)
- *Macroptilium bracteatum* (CPI 55770)
- *Neonotonia wightii* cv. Cooper
- *Stylosanthes hamata* cv. Verano
- *Stylosanthes scabra* cv. Seca

A factorial completely randomised block design was applied and included three blocks with three plots nested within each block. Within each block, the nested plots were assigned one of three superphosphate treatment rates (0, 125 or 250 kg/ha). The plot dimensions were 9.95 m x 2 m, thus providing a buffer spacing of 0.75 m between rows. The spacing between plots within each block was 0.5 m and 1 m between blocks.

The site is characteristic of a coastal, seasonally dry tropic environment and the soil is described by Murtha (1982) as a soil with a light grey-brown sandy loam A1 overlying a highly bleached sandy loam A2 horizon which changes abruptly to a mottled brownish grey and yellow brown heavy clay B horizon. The pH of both the A and B horizons is mildly acidic (pH 6.5). Following establishment, the site was abandoned after one season and has since endured heavy crash-grazing by sheep, earthworks disturbance, regular slashing, continuous macropod grazing pressure, and has been exposed to periods of significant drought over the last 32 years.

In 2024, an approximate boundary of the old trial was demarcated using old photographs and satellite imagery for reference. Mowing was suspended for a period of three months from mid-January to permit sufficient regrowth for species identification, as well as an opportunity for surviving plants to flower and set seed. Following the

spelling period, the entire site (200 m²) was surveyed using a 1 m² quadrat. The top three dominant species (by visually estimated biomass) were recorded by two operators working in tandem for each quadrat. Individual plant counts were also performed for all occurrences of originally sown accessions present, with the exception of *S. hamata* and *scabra*, as these are naturalised and abundant within the local district. All sundry species present were also recorded.

Results

Of the 13 accessions originally sown, four were recorded persisting at the site 32 years after establishment including *A. paraguariensis* subsp. *capibarensis*, *D. leptophyllus*, *S. hamata* and *S. scabra*.

A total of 80 *A. paraguariensis* subsp. *capibarensis* plants were recorded across the site, equating to a plant density of 0.4 plants/m². Two *D. leptophyllus* plants were recorded, giving a density of 0.01 plants/m². As noted, *S. hamata* and *scabra* plants were not individually recorded.

Dominance rankings of all species are presented in Table 1. The most prevalent species was *C. rotundifolia*, which dominated 60% of quadrats followed *B. pertusa*, which dominated in 30% of quadrats. Both species ranked within the top three for dominance in 90% of quadrats. Other prevalent species recorded were *Sida rombigolia* and *Richardia brasiliensis*. Of the originally sown legumes, *S. hamata* ranked within the top three for dominance in 26% of quadrats, while *A. paraguariensis* subsp. *capibarensis* and *D. leptophyllus* only ranked for dominance in three and one quadrat respectively. No visible effect of the phosphorus treatments was observed

Table 1. Species dominance rankings recorded at the site from a total of 200 quadrats.

| Species | Number of times spp. recorded 1st dominant within a quadrat. | Number of times spp. recorded 2 nd dominant within a quadrat. | Number of times spp. recorded 3 rd dominant within a quadrat. | Weighted dominance score* |
|--|--|--|--|---------------------------|
| <i>Chamaecrista rotundifolia</i> | 154 | 64 | 23 | 613 |
| <i>Bothriochloa pertusa</i> | 81 | 129 | 29 | 530 |
| <i>Sida rombigolia</i> | 15 | 15 | 20 | 95 |
| <i>Richardia brasiliensis</i> | 7 | 20 | 31 | 92 |
| <i>Stylosanthes hamata</i> cv. Verano | 0 | 11 | 59 | 81 |
| <i>Eragrostis</i> spp. | 3 | 4 | 10 | 27 |
| <i>Alternanthera ficoidea</i> | 1 | 6 | 6 | 21 |
| <i>Corchorus olitorius</i> | 2 | 2 | 8 | 18 |
| <i>Alysicarpus vaginalis</i> | 1 | 3 | 5 | 14 |
| <i>Desmodium triflora</i> | 0 | 3 | 8 | 14 |
| <i>Ziziphus mauritiana</i> | 1 | 0 | 5 | 8 |
| <i>Desmodium scorpiurus</i> | 0 | 1 | 2 | 4 |
| <i>Arachis paraguariensis</i> subsp. <i>capibarensis</i> | 0 | 0 | 3 | 3 |
| <i>Desmanthus leptophyllus</i> | 0 | 1 | 0 | 2 |
| <i>Stylosanthes scabra</i> cv. Seca | 0 | 0 | 2 | 2 |
| <i>Asteraceae</i> spp. | 0 | 1 | 0 | 2 |
| <i>Sida cordifolia</i> | 0 | 0 | 2 | 2 |
| <i>Mimosa pudica</i> | 0 | 0 | 2 | 2 |
| <i>Ocimum americanum</i> | 0 | 0 | 1 | 1 |

* Species dominance records applied to weighting multipliers of 3, 2 and 1 for 1st, 2nd and 3rd dominance rankings respectively and summed.

Discussion

The most recent survey of the site indicates that of the 13 accessions originally sown, four were recorded persisting at the site 32 years after establishment including *A. paraguariensis* subsp. *capibarensis*, *D. leptophyllus*, *S. hamata* and *S. scabra*. This represents a further decline in species representation since the previous survey of the site conducted in 2017, in which Gardiner et al. (2017) additionally recorded *C. brasilianum* in abundance and to a lesser extent *M. martii*. *A. triseminalis*, *C. pascuorum*, *D. virgatus*, *G. latifolia*, *M. bracteatum* and *N. wightii* were not recorded in either the present study or the 2017 survey and thus appear to have failed the test of time under the combination of edaphoclimatic factors and prevailing patterns of disturbance particular to the site. *S. hamata* and *S. scabra* are naturalised in the local area and are known to be well adapted to the region.

While a total of 80 *A. paraguariensis* subsp. *capibarensis* plants were recorded, equating to an average plant density of 0.4 plants/m², it should be noted that these plants were not distributed uniformly across the site and tended to cluster in association with subterranean seeding from parent plants. These plants were also observed to be low yielding in comparison to *C. rotundifolia* and *S. hamata* and *scabra*, however it should be noted that analyses of other forage peanut accessions withing the *Arachis* genus have recorded nutritional values equivalent to Lucerne (Lascano 1994). Within the context of the seasonally dry tropics, any additional protein source within grass dominated pastures is potentially advantageous to livestock production. It is also interesting to note that while *A. triseminalis* has not persisted at this site, it continues to survive in harsher, lower rainfall inland sites such as Hillgrove Station, north of Charters Towers and at Redlands Station, west of Balfes Creek (Gardiner and Swan 2008, Gardiner, pers. comment).

D. leptophyllus has continued to persist at the site, despite not being as well adapted to the soil texture or the heavy grazing and mowing pressures characteristic of the site when compared to species such as *C. rotundifolia* and *S. hamata* and *scabra*. It is likely that its persistence is due to the existence of an accumulated seed bank with a high degree of hard-seededness.

The environmental and stressors exerted upon the site over the years are reflected in the dominant species recorded (Table 1). These represent species that are adapted to the seasonally dry environment, infertile soils and the continual pressure imposed by macropod grazing and mowing.

The original phosphorus treatment plots were not visibly discernible, however they may be influencing survival and plant dominance rankings, as phosphorus is known to be both critical for legume growth and persistence.

Of note is the observation that a number of the originally sown accessions were found persisting in an adjacent streamline at the time of the survey, including *C. brasilianum*, and to a lesser degree *M. martii*, and *D. leptophyllus*. *A. paraguariensis* subsp. *capibarensis* has also been observed growing well and spreading steadily at another local alluvial site, having spread approximately 1m from the original planted row over the course of four years.

The value of such abandoned sites cannot not be overstated as they represent potentially valuable repositories of accessions that have been thoroughly tested by droughts, floods, fire, grazing and insect attack. These robust and persistent pasture legumes are of potential utility not only for northern Australia but similar climates across Africa, Asia and central and south America. Indeed, the value of such sites has been underscored in recent years by the development of several new commercial lines of *Desmanthus* and *Stylosanthes* that were originally observed to be thriving at abandoned historical trial sites spread across Queensland, some planted over forty years ago (Gardiner 2016, Gardiner and Swan 2008, Peck et al. 2021). It is recommended that research organisations continue to invest in identifying persistent accessions at discontinued experimental sites as they may hold considerable value for grazing industries in the future.

Acknowledgements

The lead author wishes to acknowledge the efforts of Sarah Ossiya in establishing the site, the assistance of Chris Gardiner and other past students in recording and publishing data, and JCU Estate.

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