On farm

Backup Legumes for Stylos

01.07.92 to 30.06.96 (NAP2)
01.07.96 to 30.06.99 (NAP3)

Project number DAQ.083

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Final Report on Project DAQ.083
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An interim final report (Backup Legumes for Stylos, MLA NAP2 Project DAQ.083) was published in October 1996 covering results for first four years 1992-96. This current document is the final report on Backup Legumes for Stylos. It incorporates data recorded over an additional three years (MLA NAP3, 1996-99) and discusses legume performance over the full seven years duration of the project. Although finalising and publishing this report has been delayed, it does contain relevant and useful information on performance of current legume cultivars. It also updates performance data on many promising legume accessions that did not, for various reasons explained in this report, reach release status. It also documents site-specific data and information that may be useful to future research and extension activities. Project leader Harry Bishop and project team member Terry Hilder compiled this report. Final formatting and publishing was handled by Stephen Smith and Tonia Grundy, DPI&F Rockhampton and Biloela respectively.

1. Abstract

The north Australian beef industry is heavily reliant on stylo legumes for sown pasture development. Alternative well adapted legumes are good insurance against the ever-present threat from diseases and pests to current stylo cultivars. The backup legumes for stylos project evaluated 50 non-stylo legumes at a network of sites on soils suitable for growing stylos and with-in the 650 to 1000mm average annual rainfall zone in Queensland and the Northern Territory. Five stylo cultivars were included as standards. Sowings took place in 1992-93, 1993-94 and 1994-95 in large grazed sward plots with two replications of each sowing. Grazing acceptance, liveweight gain and response to phosphorus was evaluated for key legumes.

The project contributed valuable information supporting the release of Reid and Kretschmer cultivars of Villose jointvetch (*Aeschynomene villosa*) for coastal spear grass communities receiving greater than 900 mm (36”) rainfall. Adaptation and production information on 14 current legume cultivars, including 5 stylos, was updated by this project. Eleven potential new cultivars were further characterised. On-going drought at some key sites restricted recording of liveweight gain and phosphorus response for some legumes. Several potential cultivars were not released commercially because of low palatability at some sites and in the absence of specific animal liveweight gain data to back up their adaptation performance.

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2. Executive Summary

Background

The backup legumes for stylos project was developed to identify, evaluate and release well adapted non-stylo legumes in response to the north Australian beef industry's almost total reliance on stylo legumes for sown pasture development. Alternative legumes, with adaptation to a similar target area as the stylos, are good insurance against the ever-present threat of diseases and pests devastating current stylo cultivars.

A total of 55 legumes (14 cultivars plus advanced evaluation accessions) were planted in a network of sites on soils suitable for growing stylos with-in the 650 to 1000mm average annual rainfall zone in Queensland and the Northern Territory. Sowings took place in 1992-93, 1993-94 and 1994-95 in large grazed sward plots with two replications of each sowing. Five sites were sown to selected legumes to record grazing acceptance and liveweight gain and nine legumes were evaluated for response to phosphorus at three sites.

An interim final report (Bishop *et al.* 1996) presented the results for the first four years, 1992-93 to 1995-96. MLA extended the project for another three years of recording (no new plantings) under NAP 3 and using carry-over funds. The final report presents results for this extra period and discusses results for the full project period, 1992-93 to 1998-1999.

Success in achieving objectives

This project contributed valuable information supporting the release of Reid and Kretschmer villose jointvetch (*Aeschynomene villosa* CPI 91209 and CPI 93621) for coastal spear grass communities receiving greater than 900 mm (36") rainfall. Approximately 200 kg of seed of each of Reid and Kretschmer went to the commercial licensee for seed increase during 1996-97. Seed production packages for Reid and Kretschmer jointvetch were commercially tested and involve a combination of direct and suction harvesting. Commercial seed was first sold as "Villomix" (a mixture of the two cultivars) in 1997-98 at $12 / kg.

No new cultivars were released as a result of the extended three years of monitoring existing evaluation sites. One reason for this was the implementation of the precautionary principle as a result of increasing Community, Industry, Government and R&D agencies awareness and concern about the potential treat of environmental weeds resulting from sown pasture research and development. However this project made positive progress in further characterising potential new cultivars and further characterised adaptation and performance of current cultivars.

Adaptation and production information on 14 current legume cultivars, including 5 stylos, has been updated. The yield response to applied phosphorus, relative to Seca stylo, has been documented for American jointvetch cultivars Glenn and Lee plus Villose jointvetch cultivar Reid. Glenn, Lee and Reid require higher soil phosphorus for optimum growth than does Seca stylo but this also means the jointvetches have potential for greater yield (this project), quality and digestibility (Jones *et al.* 2000) in higher input systems. Monitoring of soil seed reserves clarified and highlighted the relationship between times of flowering, actual seed set, seedling regeneration, legume persistence and the importance of pasture grazing management practices to encourage seed set and regeneration. The good adaptation and persistence displayed by Bargoo jointvetch (*Aeschynomene falcate)* to variable conditions has further stimulated interest in evaluating more recent *A. falcate* accessions for better anthracnose disease resistance and therefore better seed production.

During the term of this project 11 accessions were nominated and accepted for pre-release by the Queensland Herbage Plant Liaison Committee (QHPLC). These included *Aeschynomene americana* CPI 93624*, A. brasiliana* CPI 92519*, A. histrix* CPI 93599 / 93636 / 93638*, A. villosa* CPI 37235*, Chamaecrista rotundifolia* CPI 85836 / 86172*, Desmanthus tatuhyensis* var. *tatuhyensis* CPI 37538 *and D. spp. (*unidentified) selections AC 10 / AC 11. However all these accessions have now been withdrawn from per-release (during the period 1998 to 2000) pending further characterisation of various attributes such as palatability, earlier flowering and weed potential. Some accessions have been referred to other evaluation projects, including evaluation of *A. histrix* lines to improve on the persistence of current material.

Drought severely restricted measurement of liveweight gain and response to added phosphorus from *A. brasiliana* CPI 92519 (at "Sugarbag") and from *Chamaecrista rotundifolia* CPI 85836 / 86172 (at "Lamonds Lagoon"), both in the Mt Garnet area. These two sites were severely droughted in years 1 and

2 with year 3 only marginally wetter. Consequently these trial sites were reluctantly abandoned as recording sites. The lack of any liveweight gain data for *A. brasiliana* CPI 92519 was a definite impediment to its release as a cultivar given its reputation of low palatability to stock at some sites. Similarly the lack of liveweight gain data for *C. rotundifolia* CPI 85836 / 86172, together with data and observations from other evaluation sites indicating no significant advantage in palatability or perenniality over current cultivar Wynn, contributed to their withdraw from pre-release.

Benefits to landholders, industry and community

This and concurrent MLA NAP2 and NAP3 sown pasture programs have provided updated technologies on sown pasture development for use by landholders and the grazing industries. These technologies are allowing grazing land managers to produce and provide consumers with animal products that better meet market specifications and demands. Capturing current sown pasture technologies in user-friendly data base packages is a priority and much has already been achieved. Information is available from the Tropical Grassland Society of Australia (www.tropicalgrasslands.asn.au/pastures) and DPI&F (www.dpi.qld.gov.au/pastures) web sites. ACIAR has funded a project called "Selection of Forages for the Tropics" (SoFT) to create an international database of tropical sown pasture technologies which will be released as a CD in 2005 and subsequently placed on "the web". Information gained from this project has contributed to these databases.

This and concurrent regional and state wide evaluation programs lead to a subsequent project, based on increased awareness and new approaches to introduced plant evaluation, to reduce the risk of introduced plants contributing to environmental weed problems. The new project "Managing Old (discontinued) Plant Evaluation Sites" (MOPES) significantly contributed to a more responsible approach to the practices and processes associated with introduction, evaluation, release and development of new forage plant cultivars. The MOPES project (Bishop *et al.* 2004) final report contains a Draft Code of Practice for evaluation of future introduced forage plant cultivars. These evolving processes are further discussed by Cox and Cook (2003).

3. Background to Project

The majority of our beef production in northern Australia comes from native pastures but sown legumes are needed to augment these native pastures so current day market specifications can be met. These specifications include weight and age for consumption beef, growth rates for store and live export cattle and the starting point, breeder herd nutrition for high calving percentage and continued growth of weaners. Oversowing native pastures with introduced legumes is the most economical and therefore most widely used practice for improving animal performance. However management of such pastures for stable grass / legume balance is important to avoid legume dominance which can cause soil acidification (Cooksley 2003, Noble *et al.* 2000, Jones *et al.* 1997). Replacement pastures, using introduced grass/legume mixtures, is a common practice on higher fertility soils. Mineral and protein supplements are mainly fed for maintenance rations rather than for production, due to the higher labour and cost inputs involved.

Pasture development in the tropics and sub-tropics of northern Australia has increasingly been dominated by the legume genus *Stylosanthes* with a total of 15 stylo cultivars, plus common Townsville stylo, being released/used. Stylo cultivars make up 50% of all legume cultivars released between 1962 to 1996 (see appendix 12.1). Stylos also account for over 60% of all tropical pasture legume seed production (Walker *et al.* 1997). This dominance of stylo usage is much more pronounced in the below 1 000 mm average annual rainfall (AAR) zone. Stylos generally, and Seca in particular, are so well adapted to harsh conditions in Northern Australia they go very close to fulfilling grazier “wish lists” for a pasture legume (Miller *et al.* 1997).

However eight stylo cultivars have succumbed to the fungal disease anthracnose, caused by *Colletotrichum gloeosporioides*, and are no longer commercially available. Anthracnose will continue to be a threat to all current stylo cultivars (Chakraborty *et al* 1997). More recently additional threats have been identified including “Reversion” in Seca seed crops (Hopkinson 1998), the tendency towards stylo dominance (Jones *et al.* 1997) and its effects on soil acidification (Noble *et al* 2000) and biodiversity issues (McIvor and McIntyre 1997). In 1998 a 50 ha “kill” of Seca stylo from White Grub (*Rhopaea* spp) occurred in the St Lawrence area (CH Middleton, pers. comm.).

Although stylos have revolutionised sown pasture development in northern Australia they are best adapted to low input systems (Edye 1997) and may not meet expectations of higher input intensive production system. The Back-Up Legumes for Stylos (BULS) project aimed to identify alternative backup legumes emerging from early stage evaluation projects such as COPE (Pengelly and Staples 1996) that are well adapted to northern Australian conditions. Alternative legumes are good insurance against the threat of disease or pests devastating current stylo cultivars. Such an event would also dent industry confidence in, and production from sown pastures. There is also a need for legumes that produce higher quality forage and respond to improved fertility and higher input systems.

In general terms the area to which stylos are well adapted equates with the black spear grass zone in Queensland and includes the lighter clay loams such as blady grass and brigalow-blackbutt soils. The area receives a 650-1000 mm AAR. There is still vast potential for sown pasture development in northern Australia. The total area of black spear grass in Queensland is 25 m ha (Burrows *et al.* 1988) and Weston *et al.* (1981) estimated 13.1 m ha is classified as “well adapted” to stylos with net potential sown area of 9.7 m ha. Current estimates of the area sown to stylos vary from over 1 million ha (Partridge *et al.* 1996) to 600,000 ha of effective stylo pastures in north-eastern Australia (Miller *et al.* 1997). Excluding the leucaena (shrub legume) grazing system the range of alternative legumes currently available for sowing in this area is Wynn cassia, Aztec atro and Glenn, Lee and Bargoo jointvetch. Most of these alternatives have only been evaluated in the wetter end of this rainfall range and none are as well adapted as the stylos to variable soil and rainfall conditions. Current annual seed production in mid 1990’s was Glenn/Lee 50 tonne, Wynn 10 tonne, Aztec atro 10 to 20 tonne and Bargoo nil.

An interim final report (Backup Legumes for Stylos, MLA NAP2 Project DAQ.083) was published in October 1996 covering results for first four years 1992-96. The current document is the final report on Backup Legumes for Stylos. It incorporates data recorded over another three years (MLA NAP3, 1996-99) and discusses legume performance over the full seven years duration of the project, including completion of herbicide and plant forage quality studies.

4. Project Objectives

Project objectives under NAP 2 were:

1. By July 1995, to study and understand the general agronomy and ecology of three well adapted legume cultivars (particularly from *Aeschynomene* and *Chamaecrista* (previously *Cassia* species) and develop commercial management practices to speed their integration into the commercial grazing industry.
2. By July 1995, to demonstrate the animal production potential of the three new cultivars.
3. By October 1995, to produce a minimum of 100kg of seed of the three new cultivars for time of release.
4. By October 1995, to determine field nutrition requirements and responses and develop appropriate seed technology packages for each new cultivar.
5. By June 1996, to release the three cultivars to complement and back-up currently used legume cultivars (particularly for the *Stylosanthes* species.
6. By June 1996, to select five new legumes for pre-release.

Project objectives under NAP3 were revised as follows:

1. By July 1998, to provide sufficient agronomic details to the Queensland Herbage Plant Liaison Committee to allow for the release of *Aeschynomene brasiliana* CPI 92519.
2. By July 1998, to provide sufficient agronomic details to the Queensland Herbage Plant Liaison Committee to allow for the release of at least one further *Chamaecrista rotundifolia* accession (i.e., in addition to Wynn cassia).
3. By July 1998, evaluate the potential of a number of accessions from *Aeschynomene americana, A. histrix, A. villosa, Macroptilium, Atylosia, Alysicarpus,* and *Desmanthus,* to select five legumes for pre-release (new entries or confirmation of current pre-release legumes).

5. Methodology

Under MLA NAP2 the project consisted of 13 pasture legume adaptation sites, three liveweight gain sites and three phosphorus response sites established across northern Australia from Gayndah in south-east Queensland to Katherine in the Northern Territory. Target soils were the lighter textured soils most suitable for stylo growth with target rainfall 650 to 1000 mm (26” to 40”). A total of 55 legumes were sown over the three summers, 1992/93,1993/94 and 1994/95. Main performance indicators recorded were persistence (annual plant counts) and dry matter yield. Soil seed reserves, plant quality analysis, response to added phosphorus, contribution to LWG and resistance/susceptibility to herbicides were measured for selected legumes.

During the MLA NAP3 (1996-1999) phase, eight of the original 13 adaptation sites were recorded for legume persistence (annual plant counts) with some sites recording legume quality, soil seed reserves and palatability under grazing. At one site (“Glensfield” Sarina) cages were erected to compare dry matter yield (grazed and ungrazed) for *A. brasiliana* 92519 and Wynn cassia. Soil cores were collected in May 1998 and analysed for nutrients (4 sites) and seed reserves (6 sites). However grazing evaluation sites, abandoned after the third dry year, failed to provide any additional information under NAP 3 recording.

Adaptation sites:

(The objective was to study and understand the general agronomy and ecology of promising legume material under grazing, relative to current cultivars).

Sites: Lighter acid to neutral soils in the 650 to 1000 mm AAR zones suitable for growing stylos were selected. Thirteen sites ranged from Gympie in the south up the Queensland coast to Mt Garnet in the north and Daly Waters and Katherine in the Northern Territory. Characteristics of each site are summarised in Table 5.1 and individual sites are described in the results section (6.2). Location of sites is shown in Figure 5.1.

Species sown: A total of 55 legumes were sown at these sites with sowings occurring in 1992/93 (series 1), 1993/94 (series 2) and 1994/95 (series 3). Table 5.2 lists species sown.

Methodology used: A disturbed seedbed was prepared prior to sowing. Sowing rate was 3 to 5 kg/ha of seed broadcast onto the surface. A minimum seed germination percentage of around 30% was attempted and all legumes were inoculated with the appropriate rhizobium. Pasture presentation yield and composition were recorded towards the end of each growing season using “BOTANAL” (Tothill *et al.* 1992). Legume population and other observations (palatability, disease, etc) were also recorded during the BOTANAL. All adaptation sites were grazed by cattle following the first winter, either in conjunction with an adjacent (small) paddock or with weaner steers locked on the site.

Grazing evaluation sites

(Objective was to demonstrate animal production potential of promising new legumes relative to current cultivars they will complement or replace).

Sites: Six sites were sown with site description and species summarised in Table 5.3 and location of sites is shown in Figure 5.1.

Design: The aim was to compare LWG from grazable areas of a promising legume in one paddock with a similar area sown of a standard cultivar, or pasture already established. Seed was sown at 3 to 5 kg/ha into a prepared seedbed. Stocking and weighing cattle at the Mt Garnet and Gympie sites were delayed by ongoing drought and subsequently abandoned.

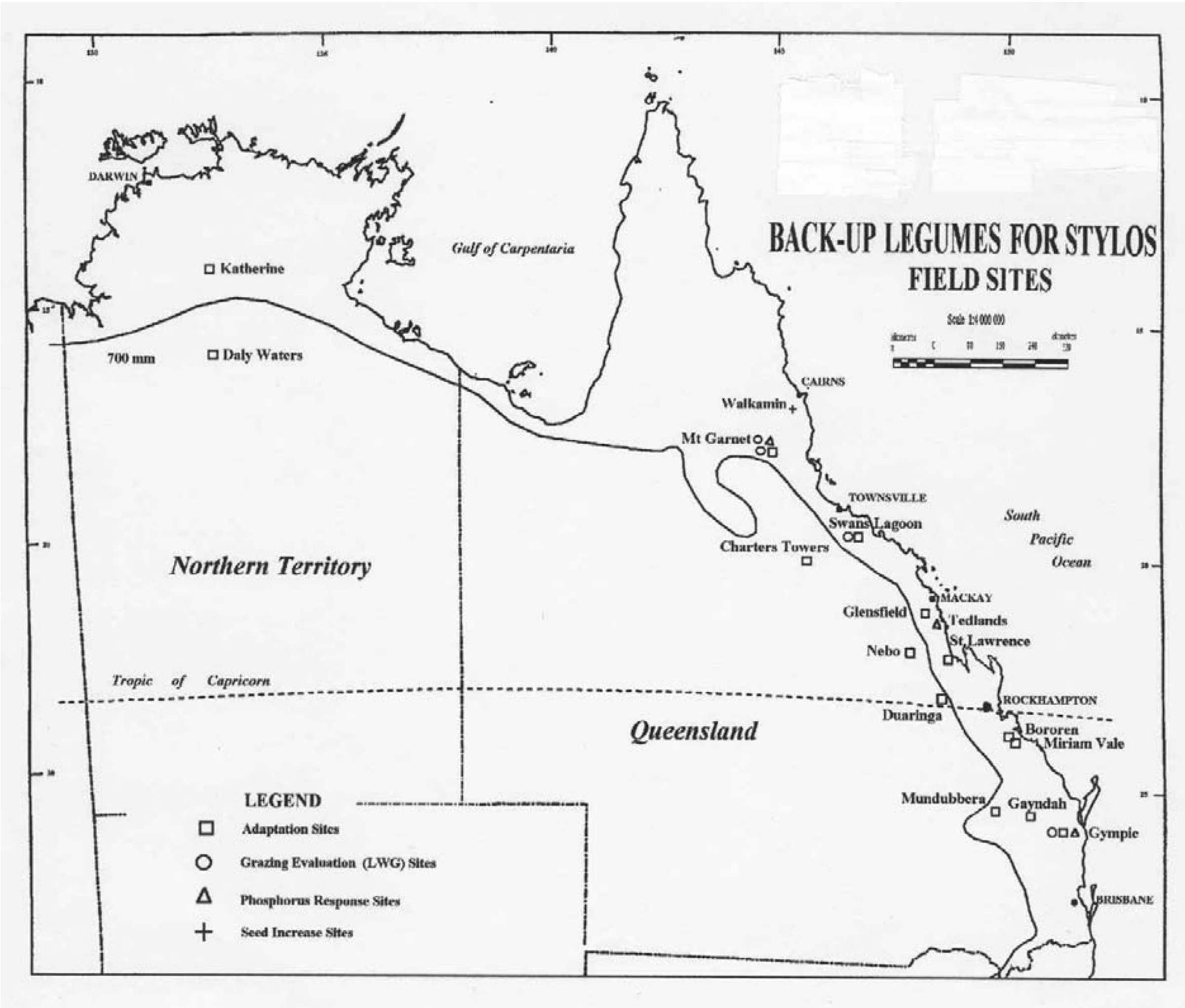


Figure 5.1 Map of field sites

Response to phosphorus

(Objective was to determine field response to applied phosphorus and measure the efficiency of use of varying levels of soil phosphorus).

Sites: Three sites were sown with details summarised in Table 5.4. Location of sites is shown in Figure 5.1.

Design: Randomised block with four replications at Mt Garnet and Mackay and three at Gympie.

Methodology: Plot size was 5 m x 2.5 m. Dry matter yields were recorded by mowing a 3 m x 0.9 m strip, sub-sampling, separating into legumes and other species and oven drying. At “Sugarbag” Mt Garnet, drought in the three years following sowing caused the site to be abandoned. Soil analysis was carried out for each plot using 10, 2.5 cm x 10 cm cores per plot, taken prior to each year’s growth, and bulked across reps. A base dressing of nutrients (Ca and S (as gypsum 417 g/plot), K (as KCL 250 g/plot), Cu (as $CuSO_4.5H_2O$ 10 G/plot), Zn (as $ZnSO_4.7H_20$ 10 g/plot), and Mo (as $Na_2MoO_4.2H_2O$ 0.6 g/plot)) was mixed with the various rates of phosphorus and spread onto the soil surface. Inoculated legume seed was sown at 10 kg/ha. Phosphorus rates were 0, 10, 20, 40, 60 and 80 kg P/ha as Triphos (20% P) at Mackay and Mt Garnet and as single superphosphate at Gympie.

Table 5.1. Adaptation sites and their characteristics

Site	**Lat.**	**Long.**	**AAR (mm)**	**Soil P_b (ppm)**	**Years* Sown**	**Fert. kg/ha P**	**Companion grass**
“Narrabri” Gympie	26º01	152º27’	991	9	1,2	20	Keppel Indian Bluegrass
“Brian Pastures” Gayndah	25º45’	151º46’	730	23	1,2,3	Nil	Black Spear
“Narayen” Mundubbera	25º41’	150º52’	716	6	2,3	10	Buffel
“Wadeleigh” Miriam Vale	24º15’	151º30’	1169	15	1	20	Signal Grass
“Bethome” Bororen	24º10’	151º25’	1169	4	3	18	Bisset
“Sorrell Hills” Duaringa	23º43’	149º40’	727	12	1,2,3	Nil	Keppel Indian Bluegrass
“Granite Vale” St Lawrence	22º25’	149º32’	1040	12	1,2,3	Nil	Black Spear
“Willunga” Nebo	22º20’	148º37’	646	12	2	Nil	Buffel
“Glensfield” Sarina	21º28’	145º58’	969	16	1,2,3	Nil	Callide/Bisset
“Braceborough” Charters Towers	20º29’	145º50’	656	2	2,3	Nil	Black Spear
“Swans Lagoon” Ayr	20º05’	147º15’	852	2	1,2,3	12	Black Spear
“Sugarbag” Mt Garnet	17º56’	145º00’	810	4	2,3	10	Bowen Indian Bluegrass
“Stillwaters” Daly Waters	16º10’	133º06’	657	7	1,2,3	9	Black Spear
Katherine Res Stn, Katherine	14º28’	132º19’	967	3	1,2,3	9	Buffel

* 1 = 1992-93, 2 = 1993-94, 3 = 1994-95

Table 5.2. List of legumes sown in adaptation site network and year of sowing, (Year 1 = 1992-93; Year 2 = 1993-94; Year 3 = 1994-95).

No.	**Genus/species**	**Accession/cultivar**	**Year Sown**	**No. of Sites**
1	*Aeschynomene americana*	56282	1	2
2	*Aeschynomene americana*	91235	1	9
3	*Aeschynomene americana*	93624	1	9
4	*Aeschynomene americana*	93661	1	2
5	*Aeschynomene americana*	Glenn	1	9
6	*Aeschynomene americana*	Lee	1 & 3	13
7	*Aeschynomene brasiliana*	92519	1,2 & 3	13
8	*Aeschynomene brasiliana*	93592	1 & 2	10
9	*Aeschynomene falcata*	Bargoo	2	12
10	*Aeschynomene histrix*	93599	2 & 3	12
11	*Aeschynomene histrix*	93636	1,2 & 3	14
12	*Aeschynomene histrix*	93638	2 & 3	12
13	*Aeschynomene paniculata*	93635	1	2
14	*Aeschynomene villosa*	37235	1 & 3	12
15	*Aeschynomene villosa*	91209	1 & 3	12
16	*Aeschynomene villosa*	93621	1 & 3	11
17	*Alysicarpus monilifer*	52343	3	10
18	*Alysicarpus rogusus*	51655	3	10
19	*Alysicarpus rogusus*	69487	3	9
20	*Atylosia sericea*	30042	3	7
21	*Chamaecrista pilosa*	57503	2	11
22	*Chamaecrista rotundifolia*	85836	1 & 2	11
23	*Chamaecrista rotundifolia*	86172	1 & 2	11
24	*Chamaecrista rotundifolia*	93094	2	11
25	*Chamaecrista rotundifolia*	Wynn	1,2 & 3	14
26	*Desmanthus pernambucanus*	30205	2	11
27	*Desmanthus pernambucanus*	33201	2	11
28	*Desmanthus virgatus*	37143	2	5
29	*Desmanthus tatuhyensis var tatuhyensis*	37538	2	11
30	*Desmanthus leptophyllus*	38351	2	12
31	*Desmanthus pernambucanus*	40071	2	11
32	*Desmanthus virgatus*	49728	2 & 3	7
33	*Desmanthus virgatus*	52401	2 & 3	8
34	*Desmanthus leptophyllus*	55719	2	12
35	*Desmanthus virgatus*	67643	2 & 3	5
36	*Desmanthus virgatus*	78372	2	5
37	*Desmanthus virgatus*	79653	2	12
38	*Desmanthus virgatus*	85178	2	11

39	*Desmanthus leptophyllus*	90754	2	12
40	*Desmanthus leptophyllus*	TQ90	2	11
41	*Desmanthus sp*	AC10	2 & 3	13
42	*Desmanthus sp*	AC11	2 & 3	13
43	*Desmanthus virgatus*	Marc	2	12
44	*Desmanthus leptophyllus*	Bayamo	2	11
45	*Desmanthus pubescens*	Uman	2	11
46	*Desmanthus spp*	Mixture	3	12
47	*Macroptilium atropurpureum*	84989	3	7
48	*Macroptilium atropurpureum*	Aztec	3	7
49	*Macrotyloma axillare*	52469	2	10
50	*Macrotyloma axillare*	Archer	2	10
51	*Stylosanthes hippocampoides*	Oxley	1	2
52	*Stylosanthes hamata*	Amigo	1	7
53	*Stylosanthes hamata*	Verano	1 & 3	14
54	*Stylosanthes scabra*	Seca	1, 2 & 3	14
55	*Stylosanthes scabra*	Siran	1	5

Table 5.3. Grazing evaluation sites

Site, Legume	Lat./Long	AAR (mm)	Soil P_b (ppm)	Date Sown	Legume Sown	Fert kg/ha P	Companion Grass
"Narrabri" Gympie (*Aeschynomene villosa*)	26º01'S/ 152º27'E	900	7	18/11/92	CPI 37235 2 ha CPI 91209 2 ha CPI 93621 2 ha Miles Lotononis 6 ha	20	Keppel Pertusa
"Gympie" (*A. villosa*)	26º09'S/ 152º45'E	1000	40	6/1/95	Reid/ Kretschmer 3 ha Shaw 3 ha	Nil	Naturalised mat grass
"Sugarbag" Mt Garnet (*A. .brasiliana)*	17º56'/ 145º	800	4	29/1/92	CPI 92519 20 ha	10	Bowen Indian Bluegrass
"Swans Lagoon" (*A. brasiliana*)	20º05'/ 147º15'	750	8	10/12/94	CPI 92519 4 ha	Nil	Bisset
"Lamonds Lagoon" Mt Garnet (*Chemacrista. rotundifolia*)	18º22'/ 145º08'	700	4	1/12/91	CPI 85836/ 86172 Wynn 40 ha	10	Bowen Indian Bluegrass
"Tedlands"* Mackay (*A. americana*)	21º36'/ 149º18'	1500	4	22/1/92	Glenn 10 ha Lee 10 ha	24 year 1 40 year 2	Callide and Tully

* Funded by MRC PDS Project rather than BULS Project.

Table 5.4. Response to applied phosphorus sites

Site	Lat./Long	AAR (mm)	Soil P_b ppm	Legumes Sown	Date Sown
"Sugarbag" Mt Garnet	17º56'S/ 145^{0}E	800	4	*A. bras.* 92519 *C. rot.* 85836 *C. rot.* Wynn *S. scab.* Seca	4/11/92
"Tedlands" Mackay	21º36'S/ 149º18'E	1500	4	*A. amer.* Glenn *A. amer.* Lee *A. vill.* 91209 *S. scab.* Seca	27/10/92
"Scotchy Pocket" Gympie*	26º01'S/ 152º31'E	900	7	*A. vill.* 91209 *A. vill.* 93621 *S. scab.* Seca*	30/10/93

*Three *Arachis* species/accessions were also sown in this experiment.

6. Results and Discussion

6.1 Rainfall

Below average and erratic summer rainfall, particularly in year 1 (1992/93), year 2 (1993/94) and year 3 (1994/95) adversely impacted on legume establishment at many sites. The year 4 (1995/96) wet season started well but January, February and March were very dry at most sites. All the Mt Garnet sites and the Charters Towers site were droughted each of first three years, receiving less than half average rainfall. Nebo was very dry in year 3. These sites plus the two NT sites were not recorded in years 5, 6 and 7. Duaringa and St Lawrence sites had poor summer rainfall in years 1, 2 and 3. Even those sites with better (near average) rainfall experienced dry periods and erratic summer rainfall in several years. Year 5 rainfall was close to or above average except for Gympie and Narayan. Year 6 was dry for Miriam Vale, St Lawrence and Glensfield while year 7 was near average or above for all sites. Monthly rainfall for years 1 to 4 is presented in Table 6.1.1 and years 5 to 7 in Table 6.1.2. Rainfall at the eight adaptation sites monitored for seven years is presented and discussed in results section 6.2.

Legumes which have established, persisted and yielded well have done so under harsher than normally expected conditions at most sites. Also the failure rate at many sites may be higher than would have occurred in more average conditions. Only at the Northern Territory sites of Daly Waters and Katherine where rainfall was near average, could it be said that performance of legumes was a true indication of their adaptation to those environments. However as variability is a feature of rainfall in northern Australia this project has greatly advanced knowledge of current and potential pasture legume adaptation and has highlighted the superiority and dominance of *Stylosanthes* cultivars, particularly *S. scabra* cv Seca, for augmenting both native and sown pastures in harsh environments.

Table 6.1.1 Monthly rainfall recorded at Backup Legumes for Stylo sites, (Year 1 starts December 1992).

AAR	991	730	716	1169	727	1040	646	969	656	852	810	657	967
	Gympie	Gayndah	Mundubbera	Miriam Vale	Duaringa	St Lawrence	Nebo	Sarina	Charters Towers	Ayr	Mt Garnet	Daly Waters	Katherine
	'Narrabri'	'Brian Pastures –	'Narayen'	'Wadeleigh'	'Sorrell Hills'	'Granite Vale'	'Wilunga'	'Glensfield'	'Braceborough	'Swans Lagoon'	'Sugarbag'		
Dec-92	73	108				94		120		93	74	108	137
Jan-93	183	135		88	56	172		344		121	26	110	371
Feb-93	84	68		78	36	36		125		55	115	253	240
Mar-93	28	32		96	3	77		19		0	64	23	39
Apr-93	3	0		4	0	0		44		0	0	0	0
May-93	18	8		37	15	0		24		0	0	0	0
Jun-93	21	27		5	9	11		24		0	0	0	0
Total	**564**	**463**		**308**	**119**	**432**		**711**		**284**	**314**	**523**	**916**
Jul-93	53	29		94	38	43		30		26	41	0	0
Aug-93	16	32		70	22	46		45		13	0	0	0
Sep-93	48	75	67	124	36	37	10	26		28	0	0	0
Oct-93	67	55	42	16	25	19	42	41		14	0	0	6
Nov-93	94	101	81	195	115	54	97	122		102	20	87	88
Dec-93	89	66	63	55	49	27	43	80		10	0	224	346
Jan-94	169	83	6	211	27	27	42	81	94	35	103	68	154
Feb-94	144	108	96	136	32	55	111	83	90	373	95	197	169
Mar-94	114	114	88	179	124	278	224	285	111	231	39	191	261
Apr-94	46	20	5	31	7	6	0	26	0	0	0	0	7
May-94	43	17	14	74	7	14	0	23	0	17	0	0	0
Jun-94	11	14	18	20	20	0	0	7	0	0	19	0	0
Total	**893**	**715**	**480**	**1205**	**502**	**605**	**569**	**849**	**295**	**849**	**317**	**766**	**1032**
Jul-94	21	22	7	17	5	7	0	19	0	0	21	0	0
Aug-94	9	0	0	0	0	0	0	5	0	0	0	0	0
Sep-94	9	3	12	11	14	0	0	3	0	5	0	0	0
Oct-94	24	65	67	63	16	48	59	36	0	10	0	20	18
Nov-94	18	49	19	32	0	45	26	13	0	0	0	26	141
Dec-94	52	29	27	87	46	52	19	96	17	51	67	123	141
Jan-95	29	68	58	159	44	36	45	151	30	48	60	122	389
Feb-95	293	117	113	107	44	82	66	219	167	184	163	213	140
Mar-95	47	137	17	17	67	56	47	27	0	43	79	182	135
Apr-95	24	70	24	30	0	40	4	19	6	0	0	5	42
May-95	39	47	57	60	41	48	70	52	29	10	36	13	0
Jun-95	0	12	18	20	0	10	0	26	0	0	12	0	0
Total	**565**	**619**	**419**	**603**	**277**	**424**	**336**	**666**	**249**	**351**	**437**	**704**	**1006**
Jul-95	0	4	4	11	8	0	0	3	0	0	0	0	0
Aug-95	11	10	4	58	65	78	59	142	52	92	76	0	0
Sep-95	12	27	25	29	0	0	2	0	0	0	0	12	20
Oct-95	56	82	165	85	93	80	105	69	20	77	21	5	51
Nov-95	139	153	171	155	44	194	51	112	55	67	85	101	55
Dec-95	125	178	107	139	88	105	29	119	21	86	85	109	147
Jan-96	356	178	106	391	214	339	81	236	117	401	218	152	199
Feb-96	52	47	5	12	19	0	0	53	0	0	83	33	57
Mar-96	7	34	10	11	0	0	0	42	0	29	75	186	92
Apr-96	53	19	19	188	106	241	50	171	13	27	56	42	121
May-96	153	136	123	114	8	0	22	9	0	13	0	0	0
Jun-96	21	10	5	11	42	29	0	48	29	37	11	0	0
Total	**986**	**878**	**744**	**1204**	**686**	**1066**	**399**	**1001**	**307**	**828**	**710**	**638**	**741**

Table 6.1.2. Monthly rainfall for the eight continuing adaptation sites from July 1996 to June 1999.

AAR	991	730	750	1100	700	875	1000	880
	Gympie	**Gayndah**	**Mundubbera**	**Miriam Vale**	**Duaringa**	**St. Lawrence**	**Sarina**	**Ayr**
	`Narrabri'	`Brian Pastures'	`Narayen'	`Wadeleigh'	`Sorrell Hills'	`Granite Vale'	`Glensfield'	`Swans Lagoon'
Jul-96	37	27	8	33	15	21	15	10
Aug-96	10	35	21	28	16	13	10	0
Sep-96	35	30	40	80	57	25	8	29
Oct-96	13	27	68	120	69	23	20	14
Nov-96	78	68	65	42	114	0	48	62
Dec-96	93	121	60	173	134	50	115	31
Jan-97	98	83	34	62	2	23	77	116
Feb-97	52	87	86	108	70	265	639	305
Mar-97	76	38	56	137	160	202	142	247
Apr-97	45	2	0	16	10	0	39	0
May-97	36	33	76	77	55	31	64	67
Jun-97	8	1	0	7	0	0	23	32
Total	**581**	**550**	**514**	**883**	**702**	**653**	**1200**	**913**
Jul-97	59.6	37.6	24	11.0	4.4	0.0	11	0
Aug-97	6.4	6.6	13	12.0	3.4	18.0	11	19
Sep-97	27.2	43.4	26	43.0	10.0	30.0	10	0
Oct-97	64.0	38.6	43	14.5	24.4	0.0	51	32
Nov-97	73.6	126.2	137	92.0	73.0	12.0	23	0
Dec-97	92.8	58	55	70.0	134.8	84.0	125	333
Jan-98	214.8	119.8	44	77.2	31.8	26.0	72	170
Feb-98	93.7	119.8	155	70.4	45.6	74.0	149	76
Mar-98	12.6	3.0	6	7.9	17.2	0.0	52	20
Apr-98	96.0	102.6	193	74.2	130.6	45.0	66	59
May-98	79.6	74.8	141	74.0	14.0	34.0	52	98
Jun-98	23.5	19.8	19	22.0	31.0	40.0	31	9
Total	**844**	**750**	**855**	**568**	**520**	**363**	**652**	**815**
Jul-98	27	22.2	13	10	7	4	7	30
Aug-98	62	26.4	21	114	117	191	251	275
Sep-98	106.5	118.8	141	169	164	0	33	13
Oct-98	21	21.4	40	55	191	121	105	45
Nov-98	63	106.8	119	157	63	166	141	161
Dec-98	75.5	90.2	49	64	179	52	207	58
Jan-99	193.5	35.2	89	115	71	88	114	225
Feb-99	287.5	51.2	62	155	247	185	293	220
Mar-99	116.5	49.4	27	80	109	45	133	120
Apr-99	23	4.6	4	6	5	0	163	39
May-99	80	30.1	8	26	0	9	27	15
Jun-99	80.5	37.1	41	49	56	0	12	3
Total	**1136**	**593**	**614**	**1000**	**1209**	**861**	**1482**	**1202**

6.2 Legume Adaptation by Sites

6.2.1 Gympie

Collaborators: Bruce Cook and Alan Salmon, DPI

Co-operator: Jan Cotter

Location: “Narrabri”, Sexton. 26°01’S, 152°27’E, alt 50m ASL

Soil description: Soloth, with sandy loam surface

Soil analysis (0-10 cm):

Year	pH	EC	Cl^-	P_b	$SO_4^{=}/S$	Ca	Mg	Na	K	ECEC
		(mS/cm)	(ppm)			(me/100g)				
1993	5.7	0.05	20	9	8	2.3	2.0	0.2	0.4	5
1998	5.2	0.09	57	27	16	1.6	1.7	0.3	0.3	-

Dates sown: Series 1, 26 January 1993; Series 2, 24 February 1994, Series 3 not sown due to drought.

Companion Grass: Series 1 *Bothriochloa pertusa* cv Keppel
Series 2 *B. bladhii* spp *glabra* cv Swann, B. Dahl

Results and Discussion:

Rainfall (mm):

Year	J	A	S	O	N	D	J	F	M	A	M	J	Tot	*Tc / Taar	**Tcw / Taw
1992/93				58	96	73	183	84	28	3	18	21	564		67%
1993/94	51	16	48	67	94	89	169	144	114	46	43	11	892	90%	94%
1994/95	21	9	9	24	18	52	28	293	47	24	39	0	564	57%	76%
1995/96	0	11	12	56	139	125	356	52	7	53	153	21	985	99%	98%
1996/97	37	10	35	13	78	93	98	52	76	45	36	8	581	59%	58%
1997/98	60	6	27	64	74	93	215	94	13	96	80	23	845	85%	75%
1998/99	27	62	107	21	63	76	194	288	117	23	80	81	1139	115%	123%
AAR	46	32	40	69	71	127	152	144	127	71	59	53	991		

*T_c/T_{aar} Total rainfall for the current year as a percentage of the average annual rainfall
**T_{cw}/T_{aw} Total rainfall for the wet season of the current year as a percentage of the average December to March wet season rainfall.

Conditions for establishment in series 1 (1993/94) were adequate but were much worse for series 2 (1994/95) with little follow-up rain. Year 4 (1996/97) was very dry with the following wet season again well below average.

Table 6.2.1.1. Plant counts for "Sexton", Gympie (Series 1)

Date Sown: 26-Jan-93		plts/m²				
		Year 1	Year 3	Year 4	Year 5	Year6
Species	**Acc./Cv.**	**25-Mar-93**	**10-May-95**	**17-Apr-96**	**01-May-97**	**20-May-98**
A. americana	56282	8.3	21.5(69)	48(2)	3	11
A. americana	91235	40.7	0.6(39)	0(0)	0	0.4
A. americana	93624	22.5	39.3(81)	170(6)	9.5	38
A. americana	93661	22.6	1.6(38)	15(0)	0.1	1
A. americana	Glenn	83.8	6.1(59)	3(0)	0.8	3
A. americana	Lee	77.8	1.2(45)	0(0)	0	0.75
A. brasiliana	92519	62	*	*	0*	0.4
A. brasiliana	93592	47.9	*	*	19*	26
A falcata	Bargoo	46.6	18.8(76)	114(5)	12.5	13
A histrix	93636	56.2	0.4(35)	21(1)	0	1
A. villosa	37235	44.6	19.7(83)	78(4)	2.5	28
A. villosa	91209	28.7	14.5(69)	57(3)	0.6	2
A. villosa	93621	71.5	13.4(62)	18(1)	0.3	1
C. rotundifolia	85836	4	3.4(48)	174(6)	14.8	27
C. rotundifolia	86172	9.4	2.8(52)	76(3)	1.7	2
C. rotundifolia	Wynn	55.9	6.7(64)	59(3)	5.5	14
S. hippocampoides	Oxley	29.3	1.3(48)	2(0)	0.7	1
S. hamata	Amiga	39	9.9(86)	93(5)	7.8	10
S. hamata	Verano	50.1	7.6(76)	77(4)	7.3	11
S. scabra	Seca	35.3	15.6(98)	3174(68)	24.2	27
S. scabra	Siran	48.5	9.8(91)	3624(76)	17.6	17

* = sprayed with herbicide following decision not to release due to doubtful palatability
( ) = seedlings

Table 6.2.1.2. Soil seed reserves for selected legumes (seeds/m²), "Sexton" Gympie, Series 1**.**

(sampled May 1998)		Mean	R1	R2
A. falcata	Bargoo	480	0	961
S. guianensis	Oxley	0	0	0
S. hamata	Amiga	0	0	0
S. hamata	Verano	0	0	0
S. scabra	Seca	208	78	338
S. scabra	Siran	91	156	26

Comments – Series 1: Early flowering *A. americana* accessions, CPI 93624 and CPI 56282 have persisted better than cultivars Glenn and Lee. Similarly early annual *A. villosa* CPI 37235 has persisted better than perennial, slightly later flowering, accessions CPI 91209/93621 (subsequently cultivars Reid and Kretschmer). Reid and Kretschmer maintained much higher plant populations than cultivars Glenn and Lee during years 3 and 4 but severe drought period during years 5 and 6 appear to have greatly reduced the populations of perennial plants. Bargoo jointvetch is well adapted to conditions at this site.

Wynn cassia has survived but later flowering *Chamaecrista rotundifolia* accession CPI 85836 has maintained a higher plant population at this site.

Both *Stylosanthes scabra* and *S. hamata* cultivars have persisted well but Oxley fine stem stylo is not adapted to this hard (surface) setting soil type.

The nil soil seed reserves for Verano and Amiga stylo is surprising and sampling inaccuracy is a possible reason.

Table 6.2.1.3. Plant Counts for “Sexton”, Gympie, (Series 2).

Date Sown: 02-Feb-1994		**plts/m^2**		
		Year 1	**Year 2**	**Year 3**
Species	**Acc./Cv.**	**27-May-94**	**10-May-95**	**17-Apr-96**
A falcata	Bargoo	15	23	11.6
C. pilosa	57503	7.8	11.7	7.4
C. rotundifolia	93094	10.8	5.9	10.9
C. rotundifolia	Wynn	6.4	7.1	10.7
D. pernambucanus	30205	18.8	3.2	0
D. pernambucanus	33201	4.8	4.5	0.4
D. tatuhyensis v. *tatu.*	37538	36.8	18.3	9.6
D. leptophyllus	38351	16.6	2.9	1.7
D. pernambucanus	40071	15.8	2.6	1.8
D. leptophyllus	55719	2	0.3	0.1
D. virgatus	79653	6	0	0
D. virgatus	85178	0.8	0	0
D. leptophyllus	90754	1	0.3	0.1
D. sp	121840	-	1.1	0
D. leptophyllus	TQ 90	2.6	0.1	0
D. sp	AC 10	5.8	0.8	0.2
D. sp	AC 11	9.6	0.7	0.1
D. leptophyllus	Bayamo	19.8	3.2	0.8
D. virgatus	Marc	4.6	0.6	0.6
D. pubescens	Uman	0.8	0	0
M. psammodes	39098	nr	0.8	0.6
Ma. axillare	52469	12.8	0.3	0
Ma. axillare	Archer	4	0.2	0
S scabra	Seca	16.2	3.7	5.1

Comment - Series 2: Due to low plant populations in the 1996 count, subsequent recordings involved observations only during a walk through the site. Bargoo and Seca cultivars continued to persist during 1997 and 1998. The small *Desmanthus tatuhyensis* var *tatuhyensis* accession CPI 37538 increased plant population.

6.2.2 Gayndah

Collaborators: Bob Clem, DPI

Co-operator: DPI (John Mullaly)

Location: The ‘Ridges’ block on Brian Pastures Research Station, 25 km SE Gayndah, $25^{0}45'$S, $151^{0}46'$E, alt 131 m ASL

Soil description: Rudimentary Podzoloc (Uc 2.22) with sandy loam surface (rep 2 of series 1 is on a solodic soil (Dd 1.43)

Soil analysis (0-10 cm):

			(mS/cm)	(ppm)			(me/100g)				
Year	**Rep**	**pH**	**EC**	**Cl^-**	**P(bicarb)**	**SO_4-s**	**Ca**	**Mg**	**Na**	**K**	**CEC**
1993	1	6.1	0.02	10	26.2	-	2.5	0.85	0.1	0.39	8
	2	6.5	0.07	60	15.3	-	6.9	6.2	0.5	0.58	27
1998	1	6.8	0.6	34	25	8	4.4	1.9	0.2	0.8	-
	2	6.7	0.8	58	21	9	3.8	2.63	0.9	0.63	-

Dates sown: Series 1, 4 December 1992; Series 2, 2 December 1993; Series 3, 17 January 1995.

Results and Discussion:

Rainfall (mm):

Year	J	A	S	O	N	D	J	F	M	A	M	J	Tot	*Tc / Taar	**Tcw / Taw
1992/93					85	108	135	68	32	0	8	27	463		75%
1993/94	29	32	75	55	101	61	83	108	114	20	17	14	709	100%	104%
1994/95	22	0	3	65	49	29	68	117	138	90	47	12	640	90%	132%
1995/96	4	10	27	84	155	178	204	47	34	19	136	10	908	128%	97%
1996/97	27	35	30	27	68	121	83	87	38	2	33	1	552	78%	67%
1997/98	38	7	43	39	126	58	120	120	3	103	75	23	755	107%	111%
1998/99	22	26	119	21	107	90	35	51	49	5	30	37	592	84%	45%
AAR	34	28	29	61	70	104	107	96	72	38	39	30	708		

*T_c/T_{aar} Total rainfall for the current year as a percentage of the average annual rainfall
**T_{cw}/T_{aw} Total rainfall for the wet season of the current year as a percentage of the average December to March wet season rainfall.

The establishment year wet season (1992/93) finished early but most years received near average rainfall with 1996/97 being driest.

Table 6.2.2.1. Plant counts (plants/m^2) Rep 1 (Dd 1.43 Soil) and Rep 2 (Uc 2.22 Soil) and Mean counts for "Brian Pastures", Gayndah, (Series 1.)

Date Sown: 04-Dec-92

Species	Acc./Cv.	Year 1 (R1) 12-May-93	Year 1 (R2) 12-May-93	Year 1 (Mean) 12-May-93	Year 2 (R1) 21-Apr-94	Year 2 (R1) 21-Apr-94	Year 2 (Mean) 21-Apr-94	Year 3 (R1) 11-May-95	Year 3 (R2) 11-May-95	Year 3 (Mean) 11-May-95
A. americana	91235	0	0	0	0	0	0	0	0	0
A. americana	93624	0.4	0	0.2	0.5	0.2	0.4	0	0	0
A. americana	Glenn	0.4	0	0.2	0.2	0.3	0.3	0	0	0
A. americana	Lee	0.7	0.5	0.6	2.5	2.7	2.6	0	0	0
A. brasiliana	92519	2.0	6.8	4.4	4.7	4.7	4.7	3.4	0	1.7
A. brasiliana	93592	15.0	1.5	8.3	12.7	0.7	6.7	0	0	0
A. histrix	93636	0.8	0.7	0.8	5.5	2.2	3.9	0	0	0
A. villosa	37235	2.5	0.4	1.5	0.7	0.2	0.5	0	0	0
A. villosa	91209	1.3	0.7	1.0	0	2.2	1.1	0	0	0
A. villosa	93621	0	0	0	2.5	1.8	2.2	0	0	0
C. rotundifolia	85836	5.2	4.2	4.7	8.7	5.5	7.1	2.2	2.8	2.5
C. rotundifolia	86172	3.2	2.0	2.6	9.5	5.5	7.5	28.4	10.0	19.2
C. rotundifolia	Wynn	17.8	0.3	9.1	21.3	0	10.7	24.0	0.2	12.1
S. hippocampoides	Oxley	1.8	0	0.9	5.0	0	2.5	6.9	1.0	4.0
S. hamata	Amiga	1.0	2.0	1.5	4.0	4.7	4.4	0.2	4.4	2.3

(Table 6.2.2.1. Continued) Plant counts (plants/m^2) for "Brian Pastures", Gayndah, (Series 1.)

Species	Acc./Cv.	Year 4 (R1) 18-Apr-96	Year 4 (R2) 18-Apr-96	Year 4 (Mean) 18-Apr-96	Year 5 (R1) 02-May-97	Year 5 (R2) 02-May-97	Year 5 (Mean) 02-May-97	Year 6 (R1) 22-May-98	Year 6 (R2) 22-May-98	Year 6 (Mean) 22-May-98
A. americana	91235	0	0	0	0	0	0	0	0	0
A. americana	93624	0	0	0	0	0	0	0	0	0
A. americana	Glenn	0	0	0	0	0	0	0	0	0
A. americana	Lee	0	0	0	0	0	0	0	0	0
A. brasiliana	92519	4.8	0.6	2.7	1.0	0	0.5	0.4	0.2	0.3
A. brasiliana	93592	13.9	1.3	7.6	0.6	0	0.3	17.0	9.5	13.3
A. histrix	93636	1.1	0.8	1.0	0	0	0	0	0	0
A. villosa	37235	0	0	0	0	0	0	0	0	0
A. villosa	91209	1.1	0.2	0.7	0	0	0	0	0	0
A. villosa	93621	0.4	0	0.2	0.2	2.2	1.2	0.6	0.3	0.5
C. rotundifolia	85836	2.9	1.1	2.0	3.0	1.0	2.0	12.2	8.1	10.2
C. rotundifolia	86172	23.0	8.2	15.6	4.0	1.0	2.5	33.4	30.9	32.2
C. rotundifolia	Wynn	12.8	0.4	6.6	12.2	0	6.1	27.4	13.7	20.6
S. hippocampoides	Oxley	5.9	0.4	3.2	10.2	0.4	5.3	62.4	34.0	48.2
S. hamata	Amiga	0.6	1.0	0.8	0	0	0	1.0	0.7	0.9

Table 6.2.2.2. Soil seed reserves for selected legumes (seeds/m^2) at "Brian Pastures", Gayndah. (Series 1)

May 1998		Rep 1 (seeds/m^2)
A. brasiliana	92519	286
A. brasiliana	93952	416

Comment – Series 1: Oxley fine stem stylo has demonstrated its adaptation and preference for sandy surface soil (as in rep. 1). Amiga has persisted but with low populations. All three *Chamaecrista* lines seem better adapted to the podsolic soil but the prolonged wet season in year (1997/98) has also produced good populations on the hard setting solodic soils. *Aeschynomene brasiliana* CPI 93592/92519 demonstrate adaptation to this site and environment. An early finish to the wet season in Year 1 probably contributed to the low establishment of *Aeschynomene americana* lines and prevented seed set for subsequent regeneration.

Table 6.2.2.3. Plant counts (plants/m^2) for "Brian Pastures", Gayndah, (Series 2.)

Date Sown: 02-Dec-1993		Year 1	Year 2	Year 3	Year 4	Year 5
Species	**Acc./cv**	**01-Jun-94**	**12-May-95**	**18-Apr-96**	**02-May-97**	**22-May-98**
A. falcata	Bargoo	24.7	15.3	4.9	3.4	5.8
C. pilosa	57503	16.5	7.3	16.7	1.6	47.5
C. rotundifolia	93094	11	12.3	24.2	14.6	55.9
C. rotundifolia	Wynn	20	10.6	29.7	22.7	35.2
D. leptophyllus	Bayamo	5.6	4.6	1.3	0.5	0
D. sp	AC 10	7	2.6	1.2	0.7	0.5
D. sp	AC 11	7.5	3.1	1.2	1.5	1.2
D. virgatus	30205	2.4	4	0.5	0	0
D. virgatus	33201	1	1.3	0.4	0	0.2
D. acuminatus	37538	10	11.9	8.6	12.9	10.6
D. leptophyllus	38351	3.4	3.1	1.7	0.8	0.3
D. virgatus	40071	3.2	1.1	0.5	0.2	0.1
D. leptophyllus	55719	2.2	1.6	0.3	0.1	0.2
D. virgatus	79653	3.6	3.1	0.8	0.1	0
D. virgatus	85178	0.3	1	0	0	0.2
D. leptophyllus	90754	1.4	1	0.8	0	0.2
D. virgatus	Marc	3.8	7.9	0.8	0.3	0.1
D. leptophyllus	TQ90	5.4	4.4	1.8	0.6	0.6
D. pubescens	Uman	0.6	0.4	0	0	0
M.axillare	Archer	1.9	0.4	0.6	0.3	0
M.axillare	52469	5.5	0.3	0.2	0	0
S. scabra	Seca	8.9	5.7	7.5	1.7	3.9

Table 6.2.2.4. Soil seed reserves for selected legumes (seeds/m^2) at "Brian Pastures", Gayndah, (Series 2).

Sampled May 1998		Mean	Rep 1	Rep 2
C. rotundifolia	Wynn	2389	441	4337
C. rotundifolia	93094	5597	8207	2987
C. pilosa	57503	8168	8155	8181
A. falcata	Bargoo	0	0	0
S. scabra	Seca	0	0	0

Comment – Series 2: On this sandy surfaced podsolic soil (Uc2.22) *Chamaecrista* lines persisted best with high soil seed reserves with Bargoo jointvetch and Seca stylo also well adapted. *Desmanthus tatuhyensis* var *tatuhyensis* CPI 37538 is the best adapted desmanthus accession but is very low yielding. AC11 maintained a steady but low population. The low seed reserves for Bargoo and Seca is surprising but is possibly sampling inaccuracy.

Table 6.2.2.5. Plant counts (plants/m^2) for "Brian Pastures", Gayndah, (Series 3.)

Date sown: 17-Jan-95		Year 1	Year 2	Year 3	Year 4
Species	**Acc./Cv.**	**04-Apr-95**	**18-Apr-96**	**02-May-97**	**22-May-98**
A. americana	Lee	28.3	2.7	0	0
A. brasiliana	92519	14.3	1.0	0	1
A. histrix	93599	4.3	1.4	0	0
A. histrix	93636	7.3	0.3	0	0
A. histrix	93638	4.7	0.7	0	0
A. villosa	37235	0	0	0	0
A. villosa	91209	0	0	0	0
A. villosa	93621	0	0	0	0
A. monilifer	52343	0.7	0	0	0
A. rugosus	51655	2.7	0	0	0
A. rugosus	69487	1.7	0	0	0
A. sericea	30042	5.0	1.1	0	0
C. brasilianum	55698	0	0	0	0
C. pascuorium	Cavalcade	0	0	0	0
C. rotundifolia	Wynn	7.7	14.6	1.7	23
D. tatuhyensis var *tatuhyensis*	37538	0	0	0	0
D. virgatus	49728	3.3	0.5	0	0
D. virgatus	52401	3.0	0	0	0
D. virgatus	67643	0.3	0	0	0
D. sp	AC 10	0	0	0	0
D. sp	AC 11	0	0	0	0
D. spp	Jaribu	9.0	0	0	0
M .atropurpureum	61232	0	0	0	0
M. atropurpureum	67647	0	0	0	0
M. atropurpureum	84989	0	0	0	0
M. atropurpureum	90748	0	0	0	0
M. atropurpureum	90776	0	0	0	0
M. atropurpureum	Aztec	0	0	0	0
M. bracteatum	53770	0	0	0	0
M. martii	55782	0	0	0	0
R. sublobata	52727	0	0	0	0
R. verdicourtii	52724	0	0	0	0
S. hamata	Verano	3.7	3.6	0.2	1
S. scabra	Seca	17.0	7.5	3.9	5

Comment – Series 3: On this site with loose sandy-surfaced soil, persistence of legumes sown was low. Many lines failed to establish, possibly due to a very short wet season (below average for most months although well above average in February), combined with the particularly loose sandy soil type at this trial site. Wynn cassia and Seca stylo persisted best. *A. brasiliana* CPI 92519 maintained 1 plant m^{-2}.

6.2.3 Mundubbera

Collaborators: Cam McDonald and Dick Jones, CSIRO

Co-operator: CSIRO (John Ogden)

Location: CSIRO Narayen Research Station. 25°41'S, 150°52'E, 60 km SW

Soil Description: Yellow podzolic with a sandy surface supporting narrow leaf ironbark
Duplex, 30-40 cm to hardplan.

Commencement soil analysis (0-10) cm:

	(ppm)	(me%)				
pH	**P_b**	**Ca**	**Mg**	**Na**	**K**	**ECEC**
6.2	7	3.9	1.8	0.09	0.54	9.9

Dates sown: Series 2, 10 December 1993; Series 3, 10 January 1995.

Companion Grass: Molopo buffel (series 2)
Gayndah buffel (series 3)

Results and Discussion:

Rainfall (mm):

Year	J	A	S	O	N	D	J	F	M	A	M	J	Tot	*Tc / Taar	**Tcw / Taw
1993/94			67	42	81	63	6	96	88	5	14	18	480		68%
1994/95	7	0	12	67	19	27	58	113	17	24	57	18	419	58%	57%
1995/96	4	4	25	165	171	107	106	5	10	19	123	5	744	104%	61%
1996/97	8	21	40	68	65	60	34	86	56	0	76	0	514	72%	63%
1997/98	24	13	26	43	137	55	44	155	6	193	141	19	856	119%	70%
1998/99	13	21	141	40	119	49	89	62	27	4	8	41	614	86%	61%
AAR	36	27	34	56	77	100	106	96	72	37	39	37	717		

*T_c/T_{aar} Total rainfall for the current year as a percentage of the average annual rainfall
**T_{cw}/T_{aw} Total rainfall for the wet season of the current year as a percentage of the average December to March wet season rainfall.

Comment: The wet season rainfall was considerably below average in all years.

Table 6.2.3.1. Plant counts (plant/m^2) for "Narayen", Mundubbera, (Series 2.)

Date Sown: 12-Dec-1993		**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5 (ve)**
Species	**Accession**	**11-May-94**	**26-Apr-95**	**01-Oct-96**	**24-Nov-97**	**03-Mar-98**
A. brasiliana	92519	15.4	1.8	0.8	1	0
A. brasiliana	93592	12	0	0	0	0
A. falcata	Bargoo	26.2	10.2	10.4	6	78
A. histrix	93638	2.6	0	0	0	0
C. pilosa	57503	5.8	0.8	5.8	25	356
C. rotundifolia	85836	9.4	0.8	0.6	1	trace
C. rotundifolia	86172	9.8	0.6	1.2	>1	10
C. rotundifolia	93094	18.4	7	3.8	4	41
C. rotundifolia	Wynn	17.2	3.4	1.8	4	39
D. sp	AC 10	5.8	2.6	2.2	2	380
D. sp	AC 11	6.6	0.6	0.2	>1	trace
D. leptophyllus	38351	4.4	0.4	0	0	0
D. leptophyllus	55719	3.6	1	0.2	0	trace
D. virgatus	79653	1.2	1	0.2	0	0
D. leptophyllus	90754	0.4	0.2	0	0	0
D. virgatus	Marc	3.4	1.6	0	0	0
M. axillare	Archer	3.2	0	0.4	0	0
M. axillare	52469	6.8	0	0.2	0	0
S. scabra	49834	12	13.6	17.6	0	99
S. scabra	Seca	9.6	5	7.6	8	143

ve visual estimation of legume dry matter yield.

Comment – Series 2: Seca stylo and Bargoo jointvetch cultivars show better persistence than Wynn cassia at this site. *Chamaecrista pilosa* CPI 57503 had the highest population while *Desmanthus* species selection AC10 and *S. scabra* CPI 49834 performed credibly.

Table 6.2.3.2. Plant counts (plants/m^2) for "Narayen", Mundubbera (Series 3.)

Date Sown: 12-Jan-95		**Plant count (plts/m^2)**		**Yield (kg/ha)**	**Plants count (plts/m^2)**			**Yield #(kg/ha)**
		Year 1	**Year 1**	**Year 1**	**Year 2**	**Year 2**	**Year 3**	**Year 4**
Species	**Acc./Cv.**	**01-Mar-95**	**17-Oct-95**	**26-Apr-95**	**25-Mar-96**	**01-Oct-96**	**24-Nov-97**	**03-Mar-98**
A. americana	Lee	0.6 (13.2)	0.6	trace	66	0	0	0
A. brasiliana	92519	26.8 (0.2)	16.8	304	240	6.2	4	*
A. histrix	93599	16.6 (0.4)	9.4	65	15	1	0	0
A. histrix	93636	31.8 (0.2)	11.6	76	25	0.4	0	8
A. histrix	93638	18.6 (0.6)	6.2	114	trace	0	0	0
A. villosa	37235	13.2 (0.4)	2.4	40	60	0.4	0	45
A. villosa	91209	5.6 (15.6)	5.4	trace	96	0.4	0	0
A. villosa	93621	3.6 (16)	2.2	trace	72	0.4	0	0
A. monilifer	52343	0 (1)	0	trace	0	0	0	0
A. rugosus	51655	0.8 (1.2)	0	trace	0	0	0	0
A. rugosus	69487	0.4 (2.4)	0	trace	0	0	0	0
A. sericea	30042	1 (0)	0	21	trace	0	<1	7
C. rotundifolia	Wynn	25.4 (0.4)	22.6	342	1120	2.2	32	228
D tatuhyensis var *atuhyensis*	37538	4.6 (2)	4.8	trace	25	0	6	0
D. spp	Jaribu	20 (3)	14.8	19	trace	0	0	0
M. atropurpureum	84989	1 (0.2)	0.4	24	trace	0.6	0	trace
M. atropurpureum	90748	0.8 (0.4)	trace	trace	trace	0	<1	10
M. atropurpureum	90776	4 (0)	0.4	40	52	0.2	<1	7
M. atropurpureum	Aztec	4.2 (0.4)	0.2	100	42	1.2	<1	2
S. hamata	Verano	18.4 (3.2)	2.4	129	124	0	0	trace
S. scabra	Seca	5.2 (31.6)	9.4	20	275	11.4	13	45

estimated legume yield
* sprayed out

Comment – Series 3: Wynn and Seca were best adapted to series 3 conditions with *A. brasiliana* CPI 92519 persisting well until "spray out" in 1997. Kangaroo Rat attack on roots of *Macroptilium atropurpureum* lines probably affected their regeneration.

6.2.4 Miriam Vale and Bororen

Collaborators: Harry Bishop and Terry Hilder

Co-operators: Bernie Scott and Allan and Fay Smallcombe

Location: "Wadeleigh", 24°15'S, 151°39'E. 5 km NE Miriam Vale
"Bethome", 24°10'S, 151°25'E. 15 km E Bororen

Soil description: Solodic (Dy 3.12) with sandy loam surface.

Soil analysis (0-10cm): "Wadeleigh" (1993 and 1998) and "Bethome" (1994**)**.

			(mS/cm)	**(ppm)**			**(me/100g)**			
Location	**Year**	**pH**	**EC**	**Cl^-**	**P(bicarb)**	**SO_4-s**	**Ca**	**Mg**	**Na**	**K**
Wadeleigh	1993	6.1	0.03	13	15	5	3.6	2.2	0.08	0.21
	1998	5.9	-	29	14	12	3.5	2.3	0.1	0.15
Bethome	1994	6.1	0.03	9	4	6	3.4	2.3	0.11	0.08

Dates sown: Series 1 25 January 1993; Series 3 16 January 1995.

Companion Grasses: Series 1 *Urochloa decumbens* cv Basilisk (signal grass)
Series 3 *Chloris gayana* cv Callide + *Bothriochloa insculpta* cv Bisset

Results and Discussion

Rainfall (mm):

MIRIAM VALE															
Year	**J**	**A**	**S**	**O**	**N**	**D**	**J**	**F**	**M**	**A**	**M**	**J**	**Tot**	*Tc / Taar	**Tcw / Taw
1992/93							88	78	96	4	37	5	308		47%
1993/94	94	70	124	16	195	55	88	78	96	4	37	5	862	74%	45%
1994/95	17	0	11	63	32	87	211	136	179	31	74	20	861	74%	87%
1995/96	11	58	29	85	155	139	159	107	17	30	60	20	870	75%	60%
1996/97	33	28	80	120	42	173	391	12	11	188	114	11	1203	103%	83%
1997/98	11	12	43	15	92	70	62	108	137	16	77	7	650	56%	54%
1998/99	10	114	169	55	157	64	77	70	8	74	74	22	894	77%	31%
AAR	49	31	35	67	85	140	212	207	144	77	62	56	1165		

*T_c/T_{aar} Total rainfall for the current year as a percentage of the average annual rainfall
**T_{cw}/T_{aw} Total rainfall for the wet season of the current year as a percentage of the average December to March wet season rainfall.

Comment: Wet season rainfall was below average in all years and very low in years 1, 2 and 6 (1997/98).

Table 6.2.4.1. Plant counts (plants/m^2) for "Wadeleigh", Miriam Vale, (Series 1.)

Date Sown:	**25-Jan-93**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**
Species	**Acc./Cv.**	**23-Mar-93**	**09-Jun-94**	**09-May-95**	**16-Apr-96**	**30-Apr-97**	**21-May-98**
A. americana	91235	10.4	4.4	0.2	0	0.4	0
A. americana	93624	6.2	19	6.6	5.4	6.4	39
A. americana	Glenn	8.8	29.6	6.5	1.6	4.2	5
A. americana	Lee	11.2	21.8	1.5	1.2	0.7	3
A. brasiliana	92519	20.6	*	*	*	*	*
A. brasiliana	93592	11.6	*	*	*	*	*
A. histrix	93636	13.2	6.8	3.5	0.7	0.2	1
A. villosa	37235	5.8	8.1	1.2	0	8.3	32
A. villosa	91209	15	20.9	4.7	0.5	3.9	7
A. villosa	93621	24.2	39.6	6.6	0.9	4.4	7
C. rotundifolia	85836	4.8	14.6	12.8	13.2	37.8	75
C. rotundifolia	86172	8.4	13.2	21.1	12.4	27.9	59
C. rotundifolia	Wynn	11.5	12.9	18	11.8	25.1	68
S. hamata	Verano	5	25	10.7	10.3	14.3	18
S. scabra	Seca	7.2	8.4	12.3	11.7	18.2	32

* sprayed out with herbicide

Table 6.2.4.2. Soil seed reserves (seeds/m^2) for "Wadeleigh", Miriam Vale. (Series 1)

Sampled May 1998		**Mean**	**Rep 1**	**Rep 2**
A. americana	93624	204	204	204
A. americana	Glenn	68	0	136
A. villosa	37235	781	611	950
A. villosa	91209	272	272	272
A. villosa	93621	238	204	272

Comment – Series 1: *Aeschynomene americana* annual accession CPI 93624 and *A. villosa* annual accession CPI 37235 both displayed better persistence and better soil seed reserves than their respective related cultivars Glenn and Lee American jointvetch, and Reid and Kretschmer villose jointvetch. However the new early flowering perennial cultivars Reid (CPI 91209) and Kretschmer (CPI 93621) persisted better than Glenn and Lee at this site. The run of below average wet seasons, particularly the establishment year, has no doubt influenced this result. There was little difference between Wynn and *Chamaecrista* accessions CPI 85836/86172 while Seca and Verano are both well adapted to this site.

Table 6.2.4.3. Plant counts (plants/m^2) for "Bethome", Bororen, (Series 3.)

Date Sown: 16-Jan-95		Year 1	Year 2	Year 3	Year 4
Species	**Acc./Cv.**	**08-May-95**	**15-Apr-96**	**30-May-97**	**20-May-98**
A. americana	Lee	17.7	7.6	0.6	2.0
A. histrix	93599	37	10.9	0.7	0
A. histrix	93636	55.6	7.8	0.3	0
A. histrix	93638	29.9	5.6	0.7	0
A .villosa	37235	40.5	2.2	7.0	36.0
A. villosa	91209	23.7	5.9	1.0	12.0
A. villosa	93621	38.6	11.6	2.0	5.0
A. monilifer	52343	0.4	0.5	2.3	0
A. rugosus	51655	0.6	0.8	0	0
A. rugosus	69487	0.7	0.2	0.1	0
C. rotundifolia	Wynn	28	33.3	35.9	77.0
D. virgatus	49728	5.1	1.2	0	0.2
D. virgatus	52401	5.2	0.7	0.2	1.0
D. sp	AC 10	14.9	1.2	1.1	5.0
D. sp	AC 11	24.1	0.3	0.8	2.0
D. spp	Jaribu	34.9	0	0	0
M. atropurpureum	84989	2.5	1.3	0	0.1
M. atropurpureum	Aztec	8.3	3.9	3.2	8.0
S. hamata	Verano	17.7	22	14.6	21.0
Stylosanthes scabra	Seca	19.7	16.1	22.3	38.0

Table 6.2.4.4. Soil seed reserves (seeds/m^2), for "Bethome", Bororen, (Series 3.)

Sampled May 1998		Mean	R1	R2
A. villosa	37235	1222	2036	407
A. villosa	91209	204	102	305
A. villosa	93621	407	204	611
A. histrix	93599	407	407	407
S. scabra	Seca	1374	0	2749

Comment – Series 3: Cultivars Seca, Verano, Wynn and Aztec (atro), plus new cultivars Reid (CPI 91209) and Kretschmer (CPI 93621), are all well adapted. *A. villosa* CPI 37235 has a higher plant population and soil seed count than new cultivars, Reid and Kretschmer, which themselves have a higher population of plants than *A. americana* cv Lee. *Desmanthus species* AC10 and AC11 have persisted better than Jaribu at this site. The soil seed reserves for *A. histrix* CPI 93599 is surprising given the low populations in years 3 and 4 and late flowering (end of April) in this accession. However this site was spelled from grazing until end of May each year allowing existing plants to seed.

6.2.5 Duaringa

Collaborators: Col Middleton, DPI

Co-operator: Col and Cathy Dunne

Location: "Sorrell Hills", 23^{0}43'S, 149^{0}40'E, alt 95 m ASL

Soil description: sandy surface duplex in poplar box woodland

Commencement soil analysis (0-10 cm):

	(mg/kg)		(meq%)				(mS/cm)
pH	**Cl**	**P_b**	**Ca**	**Mg**	**Na**	**K**	**EC**
6.4	10	16	1.90	0.84	0.03	0.21	0.02

Dates sown: Series 1, 10 February 1993 (resown 1 March 1994);
Series 2, 1 March 1994, Series 3, 25 January 1995

Results and Discussion:

Rainfall (mm):

Year	J	A	S	O	N	D	J	F	M	A	M	J	Tot	*Tc / Taar	**Tcw / Taw
1992/93						77	56	36	3	0	15	9	119		42%
1993/94	38	22	36	25	115	49	27	32	124	7	7	20	502	69%	56%
1994/95	5	0	14	16	0	46	44	44	67	0	41	0	277	38%	49%
1995/96	8	65	0	93	44	88	214	19	0	106	8	42	687	95%	78%
1996/97	15	16	57	69	114	134	2	70	160	10	55	0	702	97%	89%
1997/98	4	3	10	24	73	135	32	46	17	131	14	31	520	72%	56%
1998/99	7	117	164	191	63	179	71	247	109	5	0	56	1209	167%	147%
AAR	29	24	26	45	68	99	122	117	75	45	36	39	727		

*T_c/T_{aar} Total rainfall for the current year as a percentage of the average annual rainfall
**T_{cw}/T_{aw} Total rainfall for the wet season of the current year as a percentage of the average December to March wet season rainfall.

Year was very dry and establishment failed. Resowing of series 1 and sowing of series 2 also experienced well below average follow up rainfall. Rainfall for 1994/95 was again well below average for series 3 planting.

Table 6.2.5.1. Plant counts (plants/m^2) for “Sorrel Hills”, Duaringa, (Series 1.)

Date Sown: 10-Feb-1993
Resown: 01-Mar-1994

		plts/m^2		Yield (ve)	Yield Rating*
		Year 1	**Year 3**	**Year 3**	**Year 5**
Species	**Acc./Cv.**	**25-May-94**	**10-Oct-95**	**10-Oct-95**	**May-97**
A. americana	91235	0.1	0	0	0
A. americana	93624	0	0	0	0
A. americana	Glenn	0.2	0	0	0
A. americana	Lee	1.9	0	0	0
A. brasiliana	92519	2.6	4	293	6
A. histrix	93636	0.3	0.6	59	0
A. villosa	37235	1.6	0	0	0
A. villosa	91209	0.2	0	0	0
A. villosa	93621	0.2	0	0	0
C. rotundifolia	85836	5.3	0.8	12	2.5
C. rotundifolia	86172	3.9	0	0	1.5
C. rotundifolia	Wynn	7.3	4	216	3.5
S. hamata	Amiga	13.4	15.8	323	5.5
S. hamata	Verano	12.8	9.6	460	5
S. scabra	Seca	7.5	14	570	8
S. scabra	Siran	7.3	6.6	763	7.5

ve = visual estimation (kg/ha)
* = relative to Seca viz = 8

Comments – Series 1: Drought conditions in years 1 and 2 severely discriminated against all legumes sown. The only accession close to or better adapted than cultivars Seca/Siran, Verano/Amiga and Wynn cassia, to these harsh conditions and sandy soils, was *Aeschynomene brasiliana* CPI 92519.

Table 6.2.5.2. Plant counts (plants/m^2) for "Sorrel Hills", Duaringa, (Series 2.)

Date Sown: 03-Mar-1994

		plts/m^2		Yield ve	Yield Rating*
		Year 1	Year 2	Year 2	Year 4
Species	**Acc/Cv**	**25-May-94**	**10-Oct-95**	**10-Oct-95**	**May-1997**
A. falcata	*Bargoo*	*13.8*	*0.6*	*15*	*0*
C. pilosa	*57503*	*10*	*3.2*	*55*	*1.5*
C. pilosa (Col's)	*57503*	*4.7*	*1*	*24*	*1.5*
C. rotundifolia	*93094*	*22.4*	*9.2*	*195*	*3.5*
C. rotundifolia	*Wynn*	*5.2*	*3.2*	*100*	*3.0*
D. leptophyllus	*Bayamo*	*0.5*	*0.6*	*11*	*2.0*
D. sp	*AC 10*	*6.4*	*2.8*	*59*	*1.0*
D. sp	*AC 11*	*2.9*	*4.4*	*116*	*2.5*
D. pernambucanus	*30205*	*11.5*	*7.6*	*61*	*3.0*
D. pernambucanus	*33201*	*2.2*	*1.4*	*32*	*2.5*
D. tatuhyensis var *tatuhyensis*	*37538*	*2*	*0*	*0*	*0*
D. leptophyllus	*38351*	*1.2*	*0.25*	*5*	*0*
D. pernambucanus	*40071*	*2.8*	*2.2*	*64*	*3.0*
D. virgatus	*52401*	*6*	*3.6*	*48*	*2.5*
D. tatuhyensis var *tatuhyensis*	*55719*	*0.5*	*0*	*0*	*0.5*
D. virgatus	*79653*	*4.4*	*1.4*	*36*	*0.5*
D. virgatus	*85178*	*7*	*1.6*	*21*	*0*
D. leptophyllus	*90754*	*3.9*	*0.6*	*36*	*0*
D. virgatus	*Marc*	*12.4*	*11.6*	*62*	*1.0*
D. leptophyllus	*TQ90*	*3*	*0*	*0*	*1.5*
D. pubescens	*Uman*	*0.2*	*0*	*0*	*1.5*
M. axillare	*Archer*	*0.5*	*0*	*0*	*0*
M. axillare	*52469*	*6.2*	*0*	*0*	*0*
S. scabra	*Seca*	*0.8*	*1.6*	*37*	*2.0*

ve = visual estimation

* = relative to Seca = 8 in Series 1.

Comments – Series 2: In the fourth year (1997) six *Desmanthus* accessions had equal to or higher rating than cultivar Seca and two were equal to Wynn.

Table 6.2.5.3. Plant counts (plants/m^2) for "Sorrel Hills", Duaringa, (Series 3.)

Date Sown: 20-Jan-95

		plts/m^2		kg/ha ^{ve}	plts/m^2
		Year 1	Year 2	Year 2	Year 3
Species	**Acc./Cv.**	**21-Mar-95**	**10-Oct-95**	**10-Oct-95**	**01-May-97**
A. americana	Lee	0.2	0	0	1.0
A. brasiliana	92519	4.8	3.4	52	6.0
A. histrix	93599	1.2	2.0	24	0.0
A. histrix	93636	0.6	0.4	16	0.0
A. histrix	93638	2.0	1.4	8	1.5
A. monilifer	52343	2.8	0	0	0
A. rugosus	51655	0	0	0	0
A. rugosus	69487	0.4	0	0	0
A. sericea	30042	0	0.2	0	0
C. rotundifolia	Wynn	1.8	2.6	29	4.5
D. virgatus	49728	0	0.2	2	0
D. virgatus	52401	0	0	0	0
D. virgatus	67643	0.4	0.2	0	0
D. spp	Jaribu	2.4	0.8	19	3.0
M. atropurpureum	84989	0	0	0	3.0
M. atropurpureum	Aztec	0.2	0	0	3.0
S. hamata	Verano	5.2	17.0	33	7.0
Stylosanthes scabra	Seca	3.4	4.6	18	5.5

ve = visual estimation relative to Seca viz 8 in Series 1.

Comments – Series 3: *A. brasiliana* CPI 92519 was again close to or better adapted than cultivars Verano, Seca and Wynn. Jaribu desmanthus has persisted and the "rebirth" of *M. atropurpureum* lines must be the expression of a wetter 1996/97.

6.2.6 St Lawrence

Collaborators: Harry Bishop, Terry Hilder, DPI

Co-operator: Joe and V Olive

Location: "Granite Vale". 22^{0}25'S, 149^{0}32'E. 10 km S St Lawrence

Soil description: Solodic duplex with thin loamy surface; principal profile form Db 2.41

Commencement Soil Analysis:

Depth (cm)	pH	Cl (mg/kg)	P(bicarb) (mg/kg)	Ca (meq %)	Na (meq %)	K (meq %)	EC (mS/cm)
0-10 (bulk)	6.2	31	14	3.0	0.42	0.16	0.055
0-10	6.0	36	15			0.15	
10-20	6.4	62					
20-30	6.2	239					
30-50	6.9	663					
50-70	7.3	1200		1.7	9.8		
70-100	6.5	1316		1.1	8.7		

Soil Fractions (%):

Depth	c-sand	f-sand	silt	clay
0-10 (bulk)	16	42	21	25
20-30	10	25	17	50
50-70	11	26	29	40
70-100	12	28	31	34

Dates sown: Series 1, 3 December 1992; Series 2, 1 December 1993; Series 3, 12 January 1995.

Results and Discussion:

Rainfall (mm):

Year	J	A	S	O	N	D	J	F	M	A	M	J	Tot	*Tc / Taar	**Tcw / Taw
1992/93					44	94	172	36	77	0	0	11	434		55%
1993/94	43	46	37	19	54	27	27	55	278	6	14	0	606	58%	57%
1994/95	7	0	0	48	45	52	36	82	56	40	48	10	424	41%	33%
1995/96	0	78	0	80	194	105	339	0	0	241	0	29	1066	103%	65%
1996/97	21	13	25	23	0	50	23	265	202	0	31	0	653	63%	79%
1997/98	0	18	30	0	12	84	26	74	0	45	34	40	363	35%	27%
1998/99	4	191	0	121	166	52	88	185	45	0	9	0	861	83%	54%
AAR	33	21	27	45	69	125	214	201	143	61	48	51	1038		

*T_c/T_{aar} Total rainfall for the current year as a percentage of the average annual rainfall
**T_{cw}/T_{aw} Total rainfall for the wet season of the current year as a percentage of the average December to March wet season rainfall.

Comment: This has been a dry site throughout the project with the wet season below average each year. The worst years were 1994/95 and 1997/98. Year 1 was a very short wet season which resulted in poor or nil seed set in legumes being evaluated.

Table 6.2.6.1. Plant counts (plants/m^2) for "Granite Vale", St Lawrence, (Series 1.)

Date Sown: 03-Dec-92		**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**
Species	**Acc./Cv.**	**18-Feb-93**	**26-May-94**	**05-Apr-95**	**12-Jun-96**	**29-Apr-97**	**15-Apr-98**
A. americana	56282	10.1	0.3	0.9	0	0.2	0
A. americana	91235	6.4	0	0	1	0	0
A. americana	93624	3.8	1.4	0.2	0.6	1.4	0.9
A. americana	93661	9.5	2.4	2.9	9.6	1.5	0
A. americana	Glenn	15.8	1.2	0.2	0	0.3	3.6
A. americana	Lee	13.2	3.6	0.8	0.9	0.6	0
A. brasiliana	92519	18.1	8.9	16.4	9.6	9.5	8.7
A. brasiliana	93592	23	*	*	*	*	*
A. histrix	93636	13.1	4	1.5	0	0	0
A. villosa	37235	14.3	0.1	0	0	0	0
A. villosa	91209	4.8	0	0	1	0	0
A. villosa	93621	3	0.1	0	4.6	0	0
C. rotundifolia	85836	2.5	0.8	2.3	4.8	2.1	1.7
C. rotundifolia	86172	2.4	0.3	0.6	0	0	0.2
C. rotundifolia	Wynn	30.6	2.5	3	1	0.7	18.1
D. species	Bayamo+Uman	9.4	4.2	8.5	13.3	6.8	2.3
S. hamata	Amiga	11.2	16.1	27.9	53.2	13.5	27.4
S. hamata	Verano	5.7	15.3	20.9	43.5	15.5	20.1
S. scabra	Seca	5.8	14.5	14.9	27.2	17.2	8.9
S. scabra	Siran	15	15.8	13.9	33.8	20.6	30

***** Sprayed out

Table 6.2.6.2. Soil seed reserves (seeds/m^2) for "Granite Vale", St Lawrence. (Series 1)

Sampled May 1998		**Mean**	**Rep 1**	**Rep 2**
A. brasiliana	92519	305	305	305
C. rotundifolia	Wynn	51	0	102
D. virgatus	Bayamo/Uman	0	0	0
S. scabra	Seca	102	0	204

Comments – Series 1: This site demonstrates that *A. brasiliana* CPI 92519 was the best adapted non stylo legume sown, although Wynn population improved in year 6.

The *Chamaecrista rotundifolia* lines are not well adapted to this hardsetting duplex soil. *Desmanthus virgatus* is surprisingly well adapted and appears to be responding to the higher silt/clay fraction at this site than the duplex soil at "Glensfield" inland from Sarina, where *Desmanthus* lines performed poorly.

There was little difference in plant populations for Verano and Amiga but Siran was higher than Seca in year 6.

Table 6.2.6.3. Plant counts (plants/m^2) for "Granite Vale", St Lawrence, (Series 2.)

Date Sown: 01-Dec-1993		**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Species	**Acc/Cv**	**07-Feb-94**	**06-Apr-95**	**12-Jun-96**	**29-Apr-97**	**15-Apr-98**
A. falcata	Bargoo	10.7	9	0.5	1.3	0.7
C. pilosa	57503	4.3	8.6	4.8	0.2	0.2
C. rotundifolia	93094	6.6	37.2	14.0	21.3	27.0
C. rotundifolia	Wynn	7.9	32.3	10.3	2.1	2.0
D. leptophyllus	Bayamo	4.8	8.3	26.5	10.5	35.0
D. sp	AC 10	2.3	5.6	10.7	10.9	30.0
D. sp	AC 11	3.2	6.3	19.1	8.6	30.0
D. pernambucanus	30205	5.4	7.9	6.5	4.1	22.0
D. pernambucanus	33201	0.8	1.0	3.1	2.7	14.0
D. virgatus	37143	1.2	3.8	4.6	3.9	15.0
D. tatuhyensis var *tatuhyensis*	37538	4.0	3.6	1.1	0.0	5.0
D. leptophyllus	38351	3.1	9.8	28.1	8.6	33.0
D. pernambucanus	40071	2.9	5.1	5.3	10.4	28.0
D. virgatus	49728	4.4	3.6	4.8	2.2	27.0
D. virgatus	52401	5.3	8.1	15.6	8.5	29.0
D. leptophyllus	55719	1.3	4.1	3.1	1.7	16.0
D. virgatus	67643	3.6	5.5	5.9	2.8	25.0
D. virgatus	78372	3.5	9.9	11.0	4.8	33.0
D. virgatus	79653	3.9	6.9	3.4	3.4	27.0
D. virgatus	85178	1.1	2.0	0.9	0.2	8.0
D. leptophyllus	90754	0.3	0.4	0.5	0.2	5.0
D. virgatus	Marc	6.9	5.7	4.4	5.8	32.0
D. leptophyllus	TQ90	2.2	3.8	18.1	6.9	34.0
D. pubescens	Uman	0.8	2.2	1.5	0.8	7.0
M. axillare	Archer	0.9	0.1	0.0	0.0	0.0
M .axillare	52469	0.5	0.2	0.0	0.0	0.0
S. scabra	Seca	5.4	11.6	21.8	24.3	39.

Comment – Series 2: Series 2 data again demonstrates the good adaptation of *Desmanthus* lines to this soil type, with higher populations than Wynn cassia. The heavy seeding *C. rotundifolia* CPI 93094 accession has also regenerated better than Wynn.

Table 6.2.6.4. Plant counts (plants/m^2) for "Granite Vale", St Lawrence, (Series 3.)

Date Sown: 12-Jan-95		**Year 1**	**Year 2**	**Year 3**	**Year 4**
Species	**Acc./Cv.**	**06-Apr-95**	**12-Jun-96**	**29-Apr-97**	**15-Apr-98**
A. americana	Lee	1.4	26.0	0.1	0
A. brasiliana	92519	3.1	11.0	3.3	0.7
A. histrix	93599	0	0	0	0
A. histrix	93636	1.9	0	0	0
A. histrix	93638	3	1.0	0	0
A. monilifer	52343	0.3	0	0.4	0
A. rugosus	51655	0	1.0	0	0
A. rugosus	69487	0.1	2.0	0	0
A. sericea	30042	0.9	3.0	0	0
C. rotundifolia	Wynn	3.2	34.0	2.7	0.2
D. virgatus	49728	1.1	7.0	1.8	2.3
D. virgatus	52401	0.4	4.0	0.8	3.0
D. sp	AC 10	1.7	24.0	7.2	5.5
D. sp	AC 11	1.6	63.0	9.7	9.5
D. spp	Jaribu	2.9	12.0	4.6	3.6
M. atropurpureum	84989	0.5	3.0	1.2	0.1
M. atropurpureum	Aztec	2.3	16.0	0.9	0
St. hamata	Verano	3.5	111.0	38.8	73.0
S. scabra	Seca	2.9	30	23.1	23.0

Comment – Series 3: Verano and Seca had highest plant populations but Wynn performed poorly.

Desmanthus accessions showed good adaptation with good performance from Bob Burt's selected lines from Alligator Creek, Townsville (AC10/AC11). *A. brasiliana* CPI 92519 is again persisting but with a lower plant population than in Series 1.

6.2.7 Sarina

Collaborators: Harry Bishop, Terry Hilder, DPI

Co-operator: John and Rosalee Cox

Location: "Glensfield", Blue Mountain. $21^{0}28'$S, $145^{0}58'$E

Soil description: Solodic (Dy 3.43) with loamy sand surface

Soil analysis:

Depth (cm)	pH	Cl (mg/kg)	P(bicarb) (mg/kg)	Ca (meq %)	Na (meq %)	K (meq %)	ECEC (meq % OD)
0-10 (bulk)	6.2	10	9	2.9	0.10	0.09	5
0-10	5.8	13	8	3.2	0.11	0.08	5
10-20	6.1	10		2.6	0.09		4
20-30	6.4	10		3.0	0.11		4
30-50	6.7	10		4.6	0.38		8
50-70	6.8	34		6.3	0.65		11
70-100	7.4	114		8.1	1.6		16

Soil Fractions (%):

Depth	c-sand	f-sand	silt	clay
0-10 (bulk)	36	43	12	9
0-10	40	40	12	9
10-20	44	38	7	11
20-30	44	32	5	19
30-50	34	21	5	41
50-70	23	20	9	49
70-100	21	21	9	49

Dates sown: Series 1, 26 November 1992; Series 2, 16 November 1993; Series 3, 10 January 1995

Results and Discussion:

Rainfall (mm):

Year	J	A	S	O	N	D	J	F	M	A	M	J	Tot	*Tc / Taar	**Tcw / Taw
1992/93					11	120	344	125	19	44	24	24	711		90%
1993/94	30	45	26	41	122	80	81	83	285	26	23	7	849	88%	78%
1994/95	19	5	3	36	13	96	151	219	27	19	52	26	666	69%	73%
1995/96	3	142	0	69	112	119	236	53	42	171	9	48	1004	104%	67%
1996/97	15	10	8	20	48	115	77	639	142	39	64	23	1200	124%	144%
1997/98	11	11	10	51	23	125	72	149	52	66	52	31	653	67%	59%
1998/99	7	251	33	105	141	207	114	293	133	163	27	12	1486	153%	111%
AAR	27	20	20	33	49	105	221	192	157	68	40	37	969		

*T_c/T_{aar} Total rainfall for the current year as a percentage of the average annual rainfall
**T_{cw}/T_{aw} Total rainfall for the wet season of the current year as a percentage of the average December to March wet season rainfall.

The wet season in the establishment year finished early which would have affected seed set in some lines. The 1993/94, 1994/95, 1995/1996 and 1997/98 wet seasons were each considerably below average.

Table 6.2.7.1. Plant counts (plants/m^2) for "Glensfield", Sarina, (Series 1.)

Date Sown:	**26-Nov-92**	**plts/m^2**					
		Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**
Species	**Acc./Cv.**	**15-Jan-93**	**16-May-94**	**27-Apr-95**	**19-Mar-96**	**15-May-97**	**11-Mar-98**
A. americana	91235	2.1	9	1.9	0	11.2	3.5
A. americana	93624	17.8	0.1	0	0	7.2	0.8
A. americana	Glenn	23.1	12.9	1	0.2	9.6	1.1
A. americana	Lee	21.8	18.5	1.2	1.1	4.4	0.2
A. brasiliana	92519	47.8	13.7	22.3	22.6	40	9.2
A. brasiliana	93592	46.5	*	*	*	*	*
A. histrix	93636	53.4	11.7	5.3	8	2.4	1.1
A. villosa	37235	28.7	5.9	7.2	1	33.6	17.9
A. villosa	91209	28.8	9.9	7.7	4.5	8.8	8.1
A. villosa	93621	23.3	12.9	9.4	4.3	20.8	6.3
C. rotundifolia	85836	6.2	11.5	9.8	18.6	77.6	31.7
C. rotundifolia	86172	8.3	13.1	22	25.3	76.4	33.1
C. rotundifolia	Wynn	35.1	18.4	29.7	51.7	99.2	41.6
D. leptophyllus	Bayamo	19.8	0.7	1	0	1.2	0
D. virgatus	Marc	13.1	0.2	0.1	0	0	0
D. pubescens	Uman	8.4	0.3	0	0	0	0
S. hamata	Amiga	34.2	32.2	23.7	34.8	67.2	6.3
S. hamata	Verano	14.8	19	14.1	29.6	70	11.9
S. scabra	Seca	21.6	21.3	18.8	17.6	64.4	9.5
S. scabra	Siran	51.3	24.3	18.6	21.2	82.8	17.3

* sprayed out

Table 6.2.7.2. Soil seed reserves (seed/m^2) for "Glensfield", Sarina. (Series 1)

Sampled May 1998		**Mean**	**Rep 1**	**Rep 2**
A. americana	91235	458	916	0
A. americana	Glenn	305	204	407
A. americana	Lee	0	0	0
A. brasiliana	92519	3716	4582	2851
A. histrix	93636	305	204	407
A. villosa	37235	1731	2647	815
A. villosa	91209	865	1527	204
A. villosa	93621	815	815	815
C. rotundifolia	85836	1578	204	2953
C. rotundifolia	86172	5549	8858	2240
C. rotundifolia	Wynn	4785	7025	2545
S. hamata	Amiga	255	407	102
S. hamata	Verano	204	204	204
S. scabra	Seca	458	509	407
S. scabra	Siran	509	102	916

Comment – Series 1: New *A. villosa* cultivars Reid (CPI 91209) and Kretschmer (CPI 93621) are better adapted to conditions at this site than *A. americana* cultivars Glenn and Lee. The early flowering annual *A. villosa* CPI 37235 has regenerated well over the six years of recording and finished with higher population than Reid CPI 92109 and Kretschmer CPI 93621. *A. brasiliana* CPI 92519 is well adapted to this site as indicated by plant population and soil seed reserves. The soil seed reserves for *A. histrix* CPI 93636 are high relative to their plant population over the last 4 years.

There appears to be no significant advantage to the later flowering *Chamaecrista rotundifolia* accessions CPI 85836/86172 over cultivar Wynn, although they produce more dry matter in wet years.

There is no apparent significant performance difference between the stylo cultivars Seca/Siran or Verano/Amiga at this site.

Table 6.2.7.3. Plant counts (plants/m^2) for "Glensfield", Sarina, (Series 2.)

Date Sown: 16-Nov-1993		plts/m^2			
		Year 1	Year 2	Year 3	Year 4
Species	**Acc/Cv**	**05-Jan-94**	**04-May-95**	**19-Mar-96**	**15-May-97**
A. falcata	Bargoo	10	20.3	10.2	5.8
A. histrix	93599	19.3	11.1	13.3	2.7
A. histrix	93636	5.3	7.5	5.3	1.1
A. histrix	93638	9.5	6	2.4	0.4
C. pilosa	57503	18.8	16.5	21.6	24.9
C. rotundifolia	93094	17.3	26.4	34.7	49
C. rotundifolia	Wynn	21.5	20.3	39.4	38.7
D. leptophyllus	Bayamo	18	3.9	0	1
D. sp	AC 10	5.8	2.7	0	0
D. sp	AC 11	4.5	2.2	0.6	0.1
D. pernambucanus	30205	7.8	1	0	0
D. pernambucanus	33201	3	0.6	1	0.4
D. virgatus	37143	2.8	0.6	0	0
D. tatuhyensis var *tatuhyensis*	37538	3.5	0.3	0	0.8
D. leptophyllus	38351	5.8	1.4	0	0
D. pernambucanus	40071	4.8	2	0	0.4
D. virgatus	49728	11	3.1	0	0.2
D. virgatus	52401	5.5	2.6	0.6	0
D. leptophyllus	55719	1	0.7	0	0
D. virgatus	67643	3	1.4	0	0
D. virgatus	78372	3.8	1.4	0.2	0.6
D. virgatus	79653	1	0.3	0	0
D. virgatus	85178	0	0.2	0.2	0
D. leptophyllus	90754	2	1	0	0.1
D. virgatus	Marc	3.5	0.9	0	0
D. leptophyllus	TQ90	2.8	1.7	0.4	0
D. pubescens	Uman	0.3	0.5	0	0
M. axillare	Archer	8.3	1.3	1.4	2.7
M. axillare	52469	8	2.4	2.2	1.9
S. scabra	Seca	7	9.9	9.7	9.9

Table 6.2.7.4. Soil seed reserves (seed/m^2), for "Glensfield", Sarina (Series 2.)

Sampled May 1998		Mean	Rep 1	Rep 2
C. rotundifolia	Wynn	4276	4073	4480
C. rotundifolia	93094	18785	21891	15680
C. pilosa	57503	19651	28407	10894
S. scabra	Seca	0	0	0

Comment – Series 2: *Chamaecrista pilosa* CPI 57503 and *C. rotundifolia* CPI 93094 are both well adapted to this site but with no apparent significant advantage over cultivar Wynn.

Aeschynomene falcata cv Bargoo is well adapted but low yielding. *Macrotyloma axillare* accession CPI 52469 has no apparent advantage over cv Archer. Both have persisted but are not grazed until late autumn/winter.

A. histix accessions CPI 93599/93636/93638 have persisted sufficiently well to encourage further investigation of earlier flowering lines of this species.

The lack of soil seed reserves in Seca (relative to Series 1 Seca) may be the result of grass competition keeping plants smaller with (mainly) continuous grazing preventing good seed set.

Series 3 - Legume population in the second summer was best for Wynn (14 m^2), *A. brasiliana* CPI 92519 (9 m^2), *A. histrix* CPI 93599 (5 m ^{2}), Aztec (4 m^2) and Verano (8 m^2). *Alysicarpus, Atylosia* and Jaribu desmanthus failed while Lee and Seca had 2 and 1 plants/m^2 respectively.

6.2.8 Ayr

Collaborators: Harry Bishop, Terry Hilder, DPI

Co-operator: DPI (David Mims)

Location: Swans Lagoon Research Station, Millaroo. $20^0$05'S, $147^0$15'E

Soil description: Solodic (Dy 3.33). hard setting surface.

Soil analysis:

		(mg/kg)		(meq %)				(meq% OD)
Year	**pH**	**Cl^-**	**P(bicarb)**	**Ca**	**Mg**	**Na**	**K**	**ECEC**
1993	6.1	10	3	1.8	0.74	0.06	0.22	3.0
1998	6.4	32	11	1.7	0.66	0.50	0.21	-

Dates sown: Series 1, 7 January 1993, Series 2, 9 December 1993, Series 3, 21 February 1995

Results and Discussion:

Rainfall (mm):

Year	J	A	S	O	N	D	J	F	M	A	M	J	Tot	*Tc / Taar	**Tcw / Taw
1992/93					16	93	121	55	0	0	0	0	285		41%
1993/94	26	13	28	14	102	10	35	373	231	0	17	0	849	100%	98%
1994/95	0	0	5	10	0	51	48	184	43	0	10	0	351	41%	49%
1995/96	0	92	0	77	67	78	401	0	29	27	13	37	821	97%	77%
1996/97	4	10	0	29	14	62	31	116	305	247	0	67	885	104%	77%
1997/98	32	0	19	0	32	0	333	170	76	20	59	98	839	99%	87%
1998/99	9	30	275	13	45	161	58	225	220	120	39	15	1210	142%	100%
AAR	15	10	11	16	36	96	238	189	141	46	31	21	850		

*T_c/T_{aar} Total rainfall for the current year as a percentage of the average annual rainfall
**T_{cw}/T_{aw} Total rainfall for the wet season of the current year as a percentage of the average December to March wet season rainfall.

The establishment year wet season for Series 1 was very short and basically only *Stylosanthes, Chamaecrista* and *Aeschynomene brasiliana* lines established. Year 3 wet season was 50% of average and Year 4 was very wet in January but virtually no following rain.

Table 6.2.8.1. Plant counts (plants/m^2) for "Swans Lagoon", Ayr, (Series 1.**)**

Date Sown:	07-Jan-93	plts/m^2		% Freq.	plts/m^2		
		Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**
Species	**Acc./Cv.**	**10-Feb-93**	**11-May-94**	**20-Apr-95**	**09-Feb-1996**	**14-May-97**	**18-Mar-98**
A. americana	91235	3.9	0	0	0	-	-
A. americana	93624	5.6	0.1	0	0	-	-
A. americana	Glenn	4.9	0.4	0	0	-	-
A. americana	Lee	1.2	0.8	0	0	-	-
A. brasiliana	92519	10.2	11.6	95	11.2	7.7	15.5
A. brasiliana	93592	11.9	*	*	*	*	*
A. histrix	93636	0.3	0.6	0	0	-	-
A. villosa	91209	2.7	1.7	0	0	-	-
A. villosa	93621	5.6	0.3	0	0	-	-
C. rotund	85836	0.9	2.5	0	0	-	-
C. rotund	86172	0.7	6.5	83	18.4	17.4	190
C. rotund	Wynn	5.5	6.2	83	38.4	10.1	41.5
S. hamata	Amiga	6.4	8.1	68	58.8	15.4	34.7
S. hamata	Verano	8.2	8	95	88.9	32.1	41.4
S. scabra	Seca	4	8.3	93	30	15.9	41.1

* plots sprayed out - did not count

Table 6.2.8.2. Soil seed reserves (seeds/m^2) for "Swans Lagoon", Ayr. (Series 1)

Sampled May 1998		Mean	Rep 1	Rep 2
A. brasiliana	92519	1629	1425	1833
C. rotundifolia	86172	5244	6007	4480
C. rotundifolia	Wynn	2087	2240	1935
S. hamata	Amiga	713	815	611
S. hamata	Verano	509	815	204
S. scabra	Seca	102	204	0

Comments – Series 1: The four cultivars Seca, Verano/Amiga and Wynn are well adapted to this site. The early finish to the establishment year "wet season" dramatically separated the two *Chamaecrista* accessions. CPI 86172, which is about two weeks earlier flowering, regenerated very well, whereas CPI 85836 failed to regenerate. This suggests CPI 85836 set no seed in the establishment year.

A. brasiliana CPI 92519 has performed very well at this site (both plant population and soil seed reserves) indicating it has similar adaptation to harsh conditions as the stylos.

There appears to be no significant performance difference between Verano and Amiga stylo, or between Wynn and CPI 86172.

Table 6.2.8.3. Plant counts (plants/m^2) for "Swans Lagoon", Ayr, (Series 2.)

Date Sown: 09-Dec-1993

		Observation	**plts/m^2**		
		Year 1	**Year 2**	**Year 4**	**Year 5**
Species	**Accession**	**12-May-94**	**16-Apr-95**	**14-May-97**	**18-Mar-98**
A. falcata	Bargoo	fair	0.6	0	-
C. pilosa	57503	good	3.4	15	44
C. rotundifolia	93094	good	6	22	130
C. rotundifolia	Wynn	good	8.6	15	118
D. leptophyllus	Bayamo	few	0	-	-
D. sp	AC 10	few	0	-	-
D. sp	AC 11	few	0	-	-
D. pernambucanus	30205	few	0	-	-
D. pernambucanus	33201	few	0	-	-
D. virgatus	37143	few	0	-	-
D. tatuhyensis var *tatuhyensis*	37538	0	0	-	-
D. leptophyllus	38351	fair	0	-	-
D. pernambucanus	40071	few	0	-	-
D. virgatus	55719	few	0	-	-
D. virgatus	78372	few	0.8	-	-
D. leptophyllus	79653	fair	0.6	-	-
D. virgatus	85178	0	0	-	-
D. virgatus	90754	0	0	-	-
D. virgatus	Marc	fair	1.6	-	-
D. virgatus	TQ90	few	0	-	-
D. leptophyllus	Uman	0	0	-	-
M. axillare	Archer	few	0	0	-
M .axillare	52469	few	0	0	-
S. scabra	Seca	fair	1.8	5	25

- did not count

Comments – Series 2: Despite heavy competition from a naturalised *Indigofera* spp during establishment, this data confirms the adaptation of Seca and *Chamaecrista* lines at this site even under heavy competition. The competition certainly discriminated against Bargoo and *Desmanthus* lines.

Table 6.2.8.4. Plant counts (plants/m^2) for "Swans Lagoon", Ayr, (Series 3.)

Date Sown: 21-Feb-95

		plts/m^2			
		Year 1	**Year 2**	**Year 3**	**Year 4**
Species	**Acc./Cv.**	**16-Apr-95**	**09-Feb-96**	**14-May-97**	**18-Mar-98**
A. americana	Lee	1.6	8	0.0	0
A. brasiliana	92519	2.4	0	1.1	4
A. histrix	93599	0	11	0.1	0
A. histrix	93636	0.2	8	0.3	1
A. histrix	93638	0	6	0.2	1
A. monilifer	52343	0	1	0.0	0
A. rugosus	51655	0.2	1	0.0	0
A. rugosus	69487	0.6	0	0.0	0
A. sericea	30042	1.4	0	0.0	0
C. rotundifolia	Wynn	14.4	33	7.9	66
D. sp	AC 10	1.4	1	2.3	1
D. sp	AC 11	4	0	0.9	2
D. spp	Jaribu	14.8	0	5.5	2
S. hamata	Verano	15.2	22	5.8	13
S. scabra	Seca	4.8	16	10.3	20

Comments – Series 3: The series 3 counts confirm the adaptation of cultivars Seca, Verano and Wynn cassia with *A. brasiliana* CPI 92519 and *Desmanthus* species indicating consistent adaptation.

6.3 Grazing Evaluation

The grazing evaluation sites have not provided any further liveweight gain data during the extension period so results as presented in the interim final report are in appendix 12.2. Outcomes from the grazing sites for the extension period (1997 to 1999) were as follows. The relocated *Aeschynomene villosa* cvv Reid and Kretschmer (Cedar's Pocket, Gympie) site did not regenerate and no weight gain data was recorded. The original *Aeschynomene brasiliana* CPI 92519 (Sugarbag, Mt Garnet) site did eventually establish a reasonable but patchy stand of *A. brasiliana.* The paddock also contained significant areas of shrubby stylo so no weight gains were recorded. However the owner used this paddock for weaners and was quite pleased with the amount of legume grazed and the performance of the weaners.

6.4 Legume Grazing Acceptance

Adaptation sites are grazed by steers locked onto the site where possible or by animals in an adjacent restricted holding paddock. An attempt was made to rate grazing acceptability during the BOTANAL recordings but it was often difficult to assess each quadrat for amount of grazing and the data produced had limited application. Also animals are often initially reluctant to graze new legumes but grazing acceptability increases with animal familiarity with that legume. Palatability also seems to be affected by soil type and fertility and seasonal factors. Exclosure cages two metres square were used at the "Glensfield" adaptation site in the 1997/98 summer to gauge palatability of *A. brasiliana* and Wynn cassia (*Chamaecrista rotundifolia).* Visually it was obvious that both legumes were being eaten and the limited data presented in table 6.4.1 supports this observation.

Table 6.4.1. Grass and Legume yield (kg/ha) for ungrazed and grazed pasture at "Glensfield" (five years after sowing). Cages erected December 1997, drymatter yield recorded April 1998.

Treatment	Rep I	Rep II
***A. brasiliana* 92519 (Ungrazed)**		
Legume	542	74
Grass*	7838	10811
% legume	7%	1%
***A. brasiliana* 92519 (Grazed)**		
Legume	169	60
Grass	3445	2680
% legume	5%	2%
***C. rotundifolia* cv Wynn (Ungrazed)**		
Legume	2228	1080
Grass	4756	8682
% legume	47%	12%
***C. rotundifolia* cv Wynn (Grazed)**		
Legume	554	574
Grass	1890	2724
% legume	23%	17%

* Rep I mainly native grasses, Rep II colonised by Bisset creeping bluegrass

General observations across a series of sites over a number of years allows the legumes to be broadly ranked for grazing acceptability as in table 6.4.1.

Table 6.4.1. Ranking of legume grazing acceptability by steers across a range of sites and years as observed during data recording visits.

Legume	Grazing acceptability	
	Wet Season – active growth	Autumn – Winter
A histrix	high	high
A americana	moderate	high
A villosa	moderate	high
Verano/Amiga	moderate	high
Seca/Siran	light	mod-high
A brasiliana	light	moderate
Chamaecrista rotundifolia	light	moderate

6.5 Legume Response to Phosphorus

Three trials were initially established in 1992/93 to study the response of eight legumes (5 *Aeschynomene*, 2 *Chamaecrista rotundifolia* and Seca stylo as a standard), to six rates ((0, 10, 20, 40, 60, 80 kg/ha) of added phosphorus. As reported in the Interim Final Report the (*Aeschynomene villosa* cvv. Reid and Kretschmer) Gympie site had to be abandoned due to soil uniformity problems and the (*Chamaecrista rotundifolia* CPI 85836 and Wynn cassia) Mt Garnet site failed to establish due to drought.

Aeschynomene americana and A. villosa, Mackay

Collaborators: Harry Bishop, John Bushell, Terry Hilder, Mike Gilbert, George Rayment, Dennis Baker.

Co-operator: Les Bredden, Manager, "Tedlands".

Location: "Tedlands", Koumala, 65 km south of Mackay. $21^{0}36'$S, $149^{0}18'$E, 10 m ASL.

Soil description: Podzolic (Dy 3.31) with sandy loam surface.

Soil analysis (0-10 cm):

Depth	PH	P_b (ppm)	K (meq %)	SO_4S (mg/ kg)	Ca (meq %)	Na (meq %)	Cl (mg/ kg)	C/S (%)	f/s (%)	Silt (%)	Clay (%)
B0-10	6.0				1.0	0.35	75	11	64	22	11
0-10	5.9	2	0.06	6			32	10	59	26	13
10-20	5.4						22				
20-30	5.6				0.42	0.22	17	8	53	28	19
30-50	5.5						27				
50-70	5.6				0.94	1.50	34	8	32	31	14
70-100	5.5						59	6	31	30	37

Sowing date: 27 October 1992

Rainfall:

	J	A	S	O	N	D	J	F	M	A	M	J	Total
1992/93				9	22	174	336	132	41	117	55	15	
1993/94	22	70	36	51	35	146	176	131	389	69	33	30	1188
1994/95	4	0	0	63	34	120	128	182	0	109	87	21	748
Average	13	35	18	41	30	147	213	148	143	98	58.3	22	968
75 year AAR (Koumala)	44	25	26	51	94	166	325	332	236	98	67	46	1510

Three years of data from the (*Aeschynomene americana* cvv. Glenn and Lee, *A. villosa* cv Reid and Seca stylo) "Tedlands", via Mackay site are available.

Table 6.5.1 shows legume and total drymatter yields over three years and the response of the four legumes to the six rates of phosphorus is graphed in Figure 6.5.1.

Legume cultivar response

Glenn had significantly higher mean yield then Lee, Reid and Seca in first year and higher than Lee in second year (Table 6.5.1). Lee had higher mean yield than Reid and Seca in first year. Seca had significantly higher yield than the jointvetch legumes in second and third years. This is probably the result of its better adaptation to the below average rainfall. Glenn, Lee and Reid appear to require higher soil phosphorus for optimum growth than does Seca stylo but this also means the former have potential for greater yield, quality and digestibility in higher input systems/situations.

Legume response to phosphorus

In the first year 10 kg/ha P increased mean legume yield eight fold, 20 kg/ha P 13 fold and 40 kg/ha P 17 fold over the nill P rate (Table 6.5.1). By the third year the mean yield and the multipliers had declined but 40 kg/ha at establishment appears to provide the optimum yield.

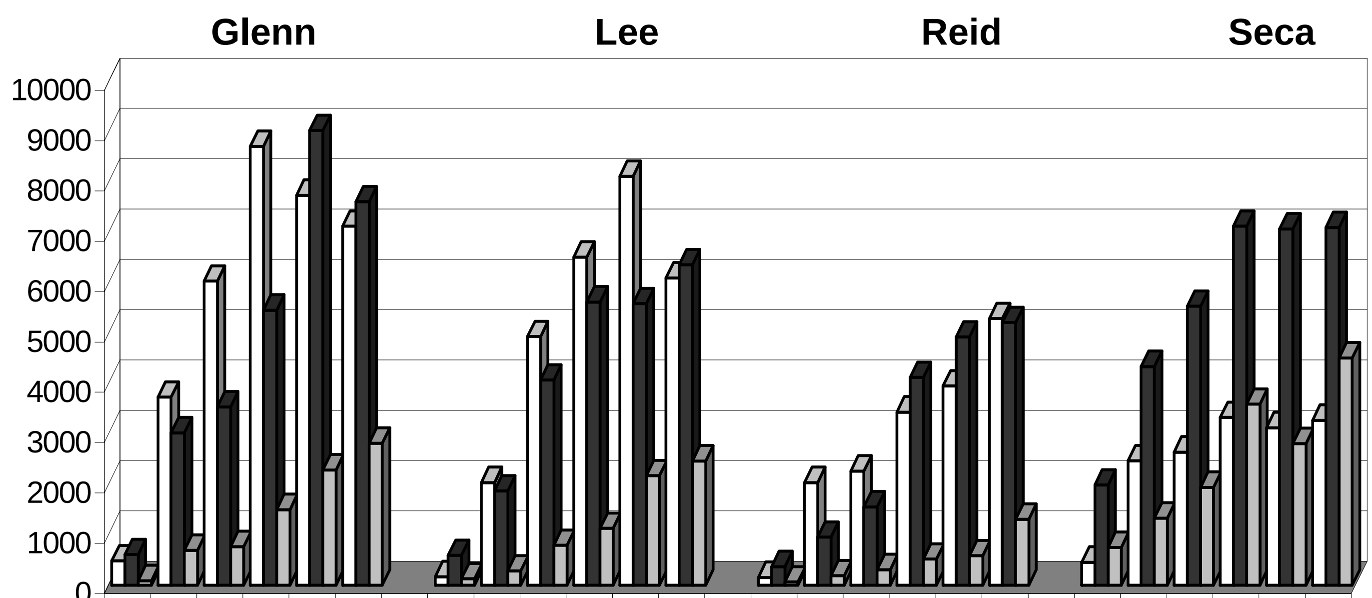
Legume x phosphorus interaction

Seca had higher yields (mean of three years) than the jointvetches at nill P, 1065 kg/ha verses 329 kg/ha for Glenn, 297 kg/ha for Lee and 194 kg/ha for Reid. In year one the jointvetches showed a greater response to applied P than did Seca; mean jointvetch yield multiplier between nill and 40 kg/ha P was 17 for Glenn, 38 for Lee, 22 for Reid and 7 for Seca. The well below average rainfall at Tedlands in year two and three of this trial has complicated direct yield comparisons as jointvetch yields were reduced relative to Seca stylo.

Table 6.5.1. Legume dry matter and total yield (kg/ha) over three years (1993-95) for cultivar means, P rate means and cultivar x P rate (two harvests in 1993 & 1994 and one mid-season in 1995).

	Legumes			Total Yield		
	1993	**1994**	**1995**	**1993**	**1994**	**1995**
Legume Cultivar (means**)**	***	***	***	***	***	***
Glenn	5643	4881	1359	6709	4944	1513
Lee	4648	4021	1162	6090	4042	1444
Reid	2859	2858	496	4729	2888	1000
Seca	2550	5532	2491	4921	5532	2512
lsd (5%)	605	495	410	551	490	425
P Rate (kg/ha) (means**)**	***	***	***	***	***	***
0	315	889	258	1810	937	434
10	2570	2548	624	4509	2583	975
20	3972	3678	952	5507	3745	1167
40	5502	5588	1686	7228	5608	1824
60	5739	6658	1966	7404	6658	2317
80	5453	6577	2777	7215	6577	2986
lsd (5%)	741	606	502	675	600	521
Cultivar X P Rate	***	***	*	***	***	n.s.
Glenn						
0	482	607	88	2054	690	321
10	3737	3024	693	4886	3084	1028
20	6042	3542	765	6887	3694	830
40	8719	5465	1500	8981	5543	1555
60	7749	9032	2290	9050	9032	2290
80	7131	7618	2818	8395	7618	3056
Lee						
0	170	593	129	1471	683	381
10	2038	1872	283	4052	1905	935
20	4938	4076	792	5937	4076	1406
40	6519	5628	1128	8094	5628	1245
60	8122	5592	2176	8914	5592	2212
80	6105	6366	2466	8072	6366	2486
Reid						
0	154	367	63	1836	385	283
10	2037	952	186	4018	998	604
20	2267	1554	309	4627	1669	491
40	3438	4127	519	5524	4127	901
60	3957	4930	585	6172	4930	1829
80	5299	5217	1312	6194	5217	1891
Seca						
0	454	1990	751	1879	1990	751
10	2469	4343	1334	5078	4343	1334
20	2642	5542	1943	4576	5542	1943
40	3331	7133	3596	6313	7133	3596
60	3129	7079	2813	5480	7079	2937
80	3278	7108	4512	6199	7108	4512
lsd (5%)	1482	1211	1005	1350	1201	1042

n.s. - not significant ($P>0.10$); * - $P<0.05$; ** - $P<0.01$; *** - $P<0.001$



	Glenn						Lee						Reid						Seca					
	0	10	20	40	60	80	0	10	20	40	60	80	0	10	20	40	60	80	0	10	20	40	60	80
1993	482	373	604	871	774	713	170	203	493	651	812	610	154	203	226	343	395	529	454	246	264	333	312	327
1994	607	302	354	546	903	761	593	187	407	562	559	636	367	952	155	412	493	521	199	434	554	713	707	710
1995	88	693	765	150	229	281	129	283	792	112	217	246	63	186	309	519	585	131	751	133	194	359	281	451

Figure 6.5.1. Dry matter yield (kg/ha) response of four legumes to six rates of phosphorus over three years (2 harvests in 1993 and 1994 and 1 mid-season harvest in 1995).

6.6 Legume Quality

Measurements of leaf and stem quality were taken from seven legumes at three sites over three years. The samples, taken after a period of active growth, were from the terminal 15 cm of shoots (as an approximation to the “grazed layer”). The leaf and stem components were analysed for acid detergent fibre (ADF), nitrogen (N) and phosphorus (P) as part of a separate study across five different multi-site experiments grazed by cattle. Results for the full study are reported by Jones *et al. (*2000).

Results of the BULS study are presented in Table 6.6.1.

Comment: There were consistent differences among legumes in the level of ADF, N and P, the differences usually being greater in the leaves than the stems.

Aeschynomene americana and *A. villosa* had consistently low ADF (ca. 20%) and high N levels (ca. 4%) in the leaves whereas *Stylosanthes scabra* cv. Seca had consistently higher ADF (ca. 25-30%) and lower N levels (ca. 3%). Levels of ADF in leaf were sometimes half of the levels in (new terminal) stem. *S. scabra* usually had the lowest % of leaf.

The major differences were between leaf and stem rather than among accessions or cultivars. For example, stem ADF, averaged over all series, was 74% higher than leaf ADF (range 52-101%).

There were significant differences among entries, which were consistent across sites or sampling dates. *A. americana* cv. Lee and *A. villosa* cv Kretschmer consistently had low ADF levels in leaves in Series 1 and 3.

These results suggest that measurements of leaf / stem ratio and quality of leaf and stem can enable legumes to be ranked for quality. Although ranking tended to be consistent across sites, the quality differences in leaves or stems of different species or accessions were less than the differences between leaf and stem. Analyses of legume quality are difficult to interpret or extrapolate unless the proportion of leaf in the sample is known. It seems that yield of readily accessible and acceptable leaf is a good index of quality for a legume in grazed pastures.

Table 6.6.1. Rankings (R) from highest (1) to lowest (7) nutritive value and percentages of N, P and ADF in the leaf and stem fractions in tip samples of 7 legume accessions, sampled at three sites during 1995-96, 1996-97 and 1997-98, plus % leaf in samples.

Accessions	Leaf						Stem						% leaf	
	N		P		ADF		N		P		ADF			
	R	%	R	%	R	%	R	%	R	%	R	%	R	%
Comparison of accessions														
Aeschynomene americana – Lee	1	4.04	2	0.21	1	17.3	1	1.62	4	0.13	1	45.0	3	73.3
A. brasiliana – CPI 92519	6	2.90	3	0.18	3	23.6	2	1.52	2	0.15	2	46.7	5	70.0
A. histrix – CPI 93636	4	3.15	4	0.17	7	28.4	5	1.29	7	0.09	5	49.3	6	66.0
A. villosa – Kretschmer	2	3.71	1	0.24	2	20.7	3	1.47	1	0.23	3	47.6	2	75.4
Chamaecrista rotundifolia – CPI 86172	3	3.27	7	0.16	5	25.1	6	1.09	4	0.13	5	49.3	1	75.7
C. rotundifolia – Wynn	5	2.95	4	0.17	6	27.9	6	1.09	6	0.11	7	49.6	4	72.7
Stylosanthes scabra – Seca	7	2.87	4	0.17	4	24.3	4	1.41	3	0.14	4	48.4	7	62.4
LSD														
P = 0.05		0.38		0.03		2.3		0.19		0.06		2.15		2.71
P = 0.01		0.52		0.04		3.2		0.25		0.08		ns		3.68
Sampling means														
Sarina 1995-96	5	2.88	6	0.16	4	24.5	5	1.25	2	0.15	1	44.6	1	72.4
Sarina 1996-97	6	2.70	4	0.17	2	22.9	6	1.23	3	0.14	6	50.8	2	72.2
Sarina 1997-98	2	3.64	1	0.23	1	21.1	2	1.42	1	0.19	3	47.0	5	70.1
Ayr 1996-97	4	3.15	3	0.18	6	26.5	3	1.40	5	0.12	4	48.4	4	70.2
Ayr 1997-98	1	3.70	4	0.17	2	22.9	1	1.47	6	0.11	2	46.6	6	69.3
St Lawrence 1996-97	3	3.54	2	0.20	5	25.3	4	1.36	4	0.13	5	50.4	3	71.1
Significance		***		***		***		*		*		***		ns
Mean		3.21		0.19		23.9		1.35		0.14		48.0		70.9

6.7 Soil Seed Reserves

In May 1998 four series 1 (1992-93) adaptation sites were sampled to 10cm for soil seed reserves. Three series 2 (1993-94) and two series 3 (1994-95) sites were also sampled.

Series 1 results (for May 1998 sampling, compared with September 1995 sampling), are presented in Table 6.7.1. Each result is the mean of two reps, with sample size shown in the table. Table 6.7.2 presents soil seed reserves for selected legumes at selected series 2 and series 3 sites.

Comment: The methodology for recording of soil seed reserves in this study (treatments and sites sampled, number of samples taken and personnel undertaking the soil seed counts and species seed identification) were too variable to allow detailed statistical analysis of results. However in general terms series 1 results follow expected trends, with early flowering and well adapted legumes having the highest soil seed reserves. At “Glensfield” Glenn jointvetch had higher reserves than Lee, Reid higher than CPI 93621 and early annual CPI 37235 higher than both. Results were similar at “Wadeleigh” in 1998 but with early *A. americana* CPI 93624 higher than Glenn. *A. brasiliana* CPI 92519 consistently had higher soil seed reserves than the stylos as did the *Chamaecrista rotundifolia* legumes.

Series 2 results confirm consistently high seed production from *C. rotundifolia* accession CPI 93094 and *C. pilosa* CPI 57503. Lack of soil seed reserves in Seca stylo at “Glensfield” and “Brian Pastures” are difficult to explain considering Seca plant counts presented in Table 6.2.7.3 and Table 6.2.2.3.

Table 6.7.1. Soil Seed Reserves (seeds/m^2) for series 1 sites sampled in September 1995 and May 1998. Series 1

		Glensfield		***Granite Vale***		***Wadleigh***		***Swan's Lagoon***	***Sexton***	***Brian Pastures***
		9/1995(*)	**5/1998(*)**	**9/1995(*)**	**5/1998(*)**	**9/1995***	**5/1998(**)**	**5/1998(*)**	**5/1998***	**5/1998***
A. americana	91235	-	458		-		-	-	-	-
A. americana	93624				-	1324	204	-	-	-
A. americana	Glenn	295	305		-	407	68	-	-	-
A. americana	Lee	51	0		-		-	-	-	-
A. brasiliana	92519	1182	3716	883	305		-	1629	-	143 (Rep I)
A. brasiliana	93952		-		-		-	-	-	208 (Rep I)
A. falcata	Bargoo				-		-	-	480	-
A. histrix	93636	519	305		-		-	-	-	-
A. villosa	37235	764	1731		-	-	781	-	-	-
A. villosa	Reid	731	865		-	-	272	-	-	-
A. villosa	Kretschmer	316	815		-	668	238	-	-	
C. rotundifolia	85836	1049	1578		-		-	-	-	-
C. rotundifolia	86172	2292	5549		-	4125	-	5244	-	-
C. rotundifolia	Wynn	3422	4785		51	6213	-	-	-	-
D. species	Bayamo/Uman		-	34	0		-	-	-	-
S. guianensis	Oxley		-		-		-	-	0	533 (I & II)
S. hamata	Amiga	-	225		-		-	2087	0	-
S. hamata	Verano	-	204		-		-	713	0	-
S. scabra	Seca	336	458	294	102	866	-	509	208	-
S. scabra	Siran	-	509		-		-	102	91	-

* 10 x 7 cm cores (**) 30 x 2.5 cm cores (*) 20 x 2.5 cm cores

Table 6.7.2. Soil seed reserves (seeds/m^2) for series 2 and series 3 sites. Sampled in May 1998**.**

Series 2		***Glensfield* (Sarina)**	***Brian Pastures* (Gayndah) ***	***Narayen* Munduberra**
A. falcata	Bargoo	**-**	0	**-**
C. pilosa	57503	18785	8168	3300
C. rotundifolia	85836	-	-	24
C. rotundifolia	86172	-	-	84
C. rotundifolia	93094	19651	5597	680
C. rotundifolia	Wynn	4276	2390	240
S. scabra	Seca	0	0	400

* 10 x 7 cm cores

Series 3		***Bethome* (*) (Miriam Vale)**	***Narayen* Mundubbera**
A. brasiliana	92519	-	48
A. histrix	93599	407	-
A. villosa	37235	1222	-
A. villosa	Reid	204	-
A. villosa	Kretschmer	407	-
C. rotundifolia	Wynn	-	850
S. scarba	Seca	1375	700

(*) 20 x 2.5 cm cores

6.8 Seed Multiplication and Seed Production

Evaluation accessions: Walkamin Research Station was chosen as the site for seed multiplication because of its demonstrated suitability with related legumes, and seed was multiplied as the need to service the evaluation programme developed. The objective in every case was to provide ample amounts of the required seed to satisfy every stage in the process up to the point of transfer to commercial production; and at the same time develop seed production methods appropriate to commercial enterprise.

Comments on early seed multiplication relevant to the BULS project are presented in the BULS Interim Final Report, pages 90 to 96.

6.9 Screening of Selective Post Emergence Herbicides

This work was conducted at Gympie by DPI’s Don Loch and Greg Harvey. The objective was to characterise promising legumes for survival following use of herbicides for selective weed control in seed crops and for control of legumes themselves in different situations. Their full report is in appendix 12.3.

Summary

Ten cultivars/accessions of six Aeschynomene species (*A. americana, A. brasiliana, A. falcata, A. histrix, A. paniculata, A. villosa*) and two of *Chamaecrista rotundifolia* were screened in a series of glasshouse experiments against 28 post-emergence herbicides for selective grass and broadleaf weed control. For each chemical, a standard recommended rate and double that rate were applied, and compared against an unsprayed control treatment in each experiment. Tolerance/susceptibility ratings are presented for every herbicide-accession combination based primarily on final plant numbers and dry matter yields relative to the unsprayed control in each experiment.

All species were tolerant of the five Group A herbicides screened for selective control of grass weeds, but there were significant differences between and even within species in terms of their tolerance of broadleaf herbicides.

The *Aeschynomene* spp. fell into two distinct groups, with *A. americana, A. villosa* and *A. paniculata* tolerant of commonly used hormone herbicides (2,4,-D, 2,4-DB and MCPA, but not fluroxypyr and dicamba) in contrast to *A. brasiliana, A. histrix* and *A. falcata* where virtually all the plants were killed by these chemicals. Dichlorprop could be used to remove *A. paniculata* from *A. americana* and *A. villosa* seed crops. Bentazone and imazethapyr were generally safe, except for *A. brasiliana* (bentazone only) and *A. americana* and *A. falcata* (both chemicals).

For *Chamaecrista rotundifolia*, the safest chemicals to use for broadleaf weed control were bentazone, bromoxynil, pyridate, imazethapyr, imazapic and imazaquin.

The most effective/widest spectrum chemicals for controlling unwanted legume plants were metsulfuron, clopyralid and dicamba.

6.10 Performance Review of All Legume Material in Project

6.10.1 Existing cultivars

Adaptation and production information on 14 current legume cultivars, including 5 stylos, have been updated by this project. This has contributed to better management packages for, and greater production from, sown pastures in northern Australia.

Despite the threats to the stylo cultivars, posed by the fungal disease anthracnose, stylos have remained the most used pasture legumes over the past 10 years for the below 1000mm rainfall zone in Northern Australia. Results from the BULS project sites across Northern Australia confirm Seca and Siran shrubby stylos as productive and the most persistent pasture legume over six years of variable rainfall on a range of soils.

Supported with better knowledge of the many threats to the current stylo cultivars (as outlined in Introduction section of this report) RD&E workers have developed new and better management practices to alleviate and overcome some of the threats stylo dominance may cause (Cooksley 2003, Partridge *et al.* 1998).

Seca and Siran stylo cultivars (*Stylosanthes scabra*) are being promoted and used more in the Northern Territory and the sites at Katherine and Daly Waters confirm their adaptation. Although the lowest rainfall sites were around 650 mm AAR, actual rainfall during the establishment years was often 50%, or less, of AAR. BULS results support Miller *et al* (1997) who say stylos are adapted to lighter-textured soils with AAR above 500 mm. In the southern spear grass zone Seca/Siran were well adapted at sites in the Bororen and Miriam Vale area south to Sexton, 20 km west of Gympie and at Brian Pastures, Gayndah.

Verano and Amiga cultivars (*Stylosanthes hamata*) are persisting at Sexton, Gympie, in year 6 and Verano has persisted well at Bororen and Miriam Vale areas. This is contrary to the adaptation map in “Stylos for better beef” (Partridge *et al*, 1996) which show their adaptation zone as north of Rockhampton. Data from Central and North Queensland sites plus Gympie, where both cultivars were planted, indicate little difference in persistence between cultivars. Although it seems to be generally accepted that Verano/Amiga are not as well adapted to dry and harsh conditions as are Seca/Siran, plant populations at "Swans Lagoon", "Glensfield", "Granite Vale", Duaringa, Miriam Vale and Gympie indicate both these *S. hamata* cultivars have persisted as well as the shrubby stylos. However Seca/Siran plants do remain perennial for considerably longer under harsh conditions than do Verano/Amiga plants.

Fine stem stylo (*Stylosanthes hippocampoides*) released as cv Oxley in 1965 (as *Stylosanthes guianensis var. intermedia)*, has performed well on a course sandy surfaced soil at Brian Pastures but is not adapted to the hard setting duplex soils at the Gympie site. Low levels of commercial seed production (2 to 5 tonne per year) could be the result of low demand, or shortage of seed may be causing low levels of adoption?

Glenn and Lee American jointvetch (*Aeschynomene americana* cv Glenn and Lee) “wax and wane” with rainfall but in many situations make a valuable contribution. At a producer demonstration site, “Tedlands”, 60km south of Mackay, steer weight gain slightly favoured Glenn jointvetch (0.49 kg/day) over Lee jointvetch (0.45 kg/day) over a 600 day period stocked at 1.5 steers/ha. ‘Villomix’ villose jointvetch will be more reliable for the 900 mm rainfall zone and indicates adaptation to 800 mm in the sub-tropics where winter rainfall component is more reliable. Glenn, Lee and Reid require higher soil phosphorus levels for optimum growth, than does seca stylo but this also means the former have potential for greater yield, quality and digestibility in high input systems.

Bargoo jointvetch (*Aeschynomene falcata* cv Bargoo) has proven a very persistent legume at Sarina, Gympie, Narayen and Brian Pastures sites. Unavailability of seed has been the main constraint to its commercial use. Recently introduced *A. falcata* lines may overcome the pod shattering and anthracnose disease problems with Bargoo seed production.

Wynn cassia (*Chamaecrista rotundifolia* cv Wynn) adaptation is now better defined. Palatability to stock seems to vary with site and age/class of animal and on some properties Wynn has dominated black spear grass pastures. It is not nearly as well adapted to harsh conditions as the stylos, particularly on hard setting soils.

***Desmanthus* species** cultivars Marc, Bayamo and Umnan (Jaribu) showed potential on duplex soils at St Lawrence and Brian Pastures and appear to have a limited role on some lighter, low to medium clay soils.

Aztec atro (*Macrotilium atropurpureum* cv Aztec) has persisted for four years at “Glensfield”, south west of Sarina and at Miriam Vale.

***Macrotyloma axillare* cv Archer** showed low persistence at most sites.

6.10.2 New Cultivars

***Aeschynomene villosa cvv* Reid and Kretschmer** (previously *CPI 91209 and 93621).*

This project contributed valuable information supporting the release of Reid and Kretschmer villose jointvetch for coastal spear grass communities receiving greater than 900 mm (36”) rainfall (endorsed as cultivars by QHPLC August 1995). These cultivars were given provisional protection under PBR (Southedge Seeds, Mareeba) and commencing 1997/98 summer were mixed 50/50 and retailed as “Villomix” at $12/kg. Reid and Kretschmer jointvetch are readily eaten by cattle but cattle weighing on two producer demonstrations near Gympie were interrupted by periods of drought and abandoned. Seed production packages for Reid and Kretschmer have now been commercially tested. A combination of direct and suction harvesting has yielded close to 1 tonne of clean naked seed per hectare.

In 1998 six tonne of Villomix seed was produced, retailing at $11.50/kg (QHPLC minutes 7/8/98). In 1999 production outstripped demand but both cultivars are performing well in SE and Central Queensland and Northern NSW while demonstrations and commercial plantings are giving encouraging results along the Queensland east coast and the NT (QHPLC minutes 5/6/99). It is anticipated seed demand will grow as larger commercial plantings develop into persistent productive pastures over the next couple of years.

In a multi-agency evaluation and development project, for persistent legumes in sub-tropical dairy pastures, cultivars Reid and Kretschmer rated fair to good persistence at Butcher’s Creek on Atherton Tablelands, Eungella west of Mackay, Marmor south of Rockhampton, Goomoorian and Kin Kin at Gympie, Muminbah south of Brisbane and Kyogle east of Lismore (DPI Report Q099005, 1999, p. 7-20). The same report (p. 55-59) presents encouraging results from a liveweight gain demonstration project at the CSIRO Samford Research Station north west of Brisbane although Reid and Kretschmer comprised only 13 to 18% of total drymatter.

Appendix 12.4 contains the Reid and Kretschmer cultivar registration statement (Bishop and Cook, 2000, AJEA, Vol 41/Issue 4). A property case study on performance of Villose jointvetch is in appendix 12.5.

6.10.3 Promising New Legumes (that reached pre-release status)

***Aeschynomene brasiliania* (CPI 92519)** is well adapted at a range of sites and to harsh conditions, as shown in table 6.10.3.1. Based on persistence and yield it is next best to Seca stylo. However it has a sticky exudate on the stems and leaves and at some sites has not been readily grazed. Although it is fairly well grazed at other sites, no liveweight gain data are available due to drought in the first 3 years at the Mt Garnet grazing evaluation site. Similarly due to drought at Mt Garnet no information is available for the response of *A. brasiliana* CPI 92519 to applied phosphorus. However performance at a range of evaluation sites indicate reasonable tolerance to low P soils. The stickiness of *A. brasiliana* CPI 92519 plants causes some difficulties with seed harvesting, as indicated by John Hopkinsons comments from BULS interim final report (p. 91); “Harvesting seed crops of *Aeschynomene* species presents few problems, except for the extremely sticky *A. brasiliana* CPI 92519, which blocks all machinery even in the form of dry windrows. However this accession, although well adapted to harsh conditions, has yet to demonstrate its contribution to animal liveweight gain. Viability of commercial seed production would have to be re-assessed in light of its contribution to animal production before considering cultivar status”. At Walkamin Research Station seed yields of 361 kg/ha in year 1 and 773 kg/ha in year 2 were achieved using direct and suction harvesting. Due to the lack of information on its contribution to cattle LWG plus some concern on its potential weediness, due to unpalatability at some sites, it was removed from pre-release at the August 1998 meeting of the QHPLC. However, if sometime in the future it needs to be re-examined as a potential cultivar, a current performance statement (based on BULS data) is presented in appendix 12.6.

***Chamaecrista rotundifolia* (*CPI* 85836, 86172)** are later flowering and potentially higher yielding alternatives to Wynn cassia. Although slower than Wynn to establish in this project, probably due to higher hardseed content of seed used in this project, they had equal or higher sward density (Table 6.10.3.1), drymatter yield and soil seed reserves by year 6. Palatability and adaptation to soils is similar to Wynn. Being higher yielding, particularly as rainfall increases, they have the capacity to “dominate” in native pasture situations. No phosphorus response data and no live weight gain data (comparative with Wynn) are available due to the grazing evaluation site at Mt Garnet being droughted. Due to this lack of information on contribution to cattle LWG, and no demonstrated significant advantages over Wynn, these accessions were removed from pre-release at the August 1998 meeting of the QHPLC.

***Aeschynomene americana* (CPI 93624)** is an early flowering annual with a lower growth habit than cv Glenn. It has shown better persistence and spread than “Glenn” or “Lee” in southern Queensland (Table 6.10.3.2) and should be tested further against both *A. americana* and *A. villosa* cultivars. It was put on pre-release at the August 1998 QHPLC meeting as there may be merit ultimately in marketing a mixture of “Glenn” and this variety in the same way as “Villomix” has covered maturity range in *A. villosa*. As it was subsequently included in a new legume evaluation project for the southern spear grass zone it was removed from pre-release at the August 4, 2000 QHPLC meeting.

***Aeschynomene villosa* (CPI 37235)** is an early flowering annual line showing superior regeneration/persistence than the perennial Villomix cultivars at the “Glensfield”, “Wadeleigh” and “Sexton” sites (Table 6.3.2). It has been withdrawn from pre-release while being further evaluated in a new legume evaluation project.

***Aeschynomene histrix* (CPI 93599, 93636, 93638)** are very palatable legumes with few environmental concerns but are late flowering with low soil seed reserves. Their agronomic performance has been sufficient to encourage further evaluation of recent introductions which are earlier flowering. As this earlier flowering material is now under evaluation, the above accessions were removed from pre-release at the August 6, 1999 QHPLC.

***Desmanthus* species (CPI 37538, AC 10, AC 10).** CPI 37538 is a very low growing perennial that has persisted well at Brian Pastures, Narayen and Gympie. AC 10 and AC 11 are selections from naturalised populations at Alligator Creek, Townsville (made by Bob Burt, formerly of CSIRO Davies Laboratory, Townsville). They have performed well at St Lawrence, "Narayen", "Brian Pastures", “Swans Lagoon” and Miriam Vale. All three have highlighted the fact that *Desmanthus* can grow on duplex soils and is not restricted to alkaline/calcareous situations. These lines were put on pre-release at the August 1998 QHPLC meeting to be included as standards in any continuing desmanthus evaluation project. As they were included in a new legume evaluation project for the southern spear grass zone they were removed from pre-release at the August 4, 2000 QHPLC meeting.

6.10.4 Other Legume Accessions

Alysicarpus lines sown at BULS series 3 sites showed lack of adaptation and persistence under prevailing conditions.

Chamaecrista pilosa CPI 57503 and *C. rotundifolia* 93094 both displayed high populations and soil seed reserves at sites to which *Chamaecrista* is well adapted but failed to exhibit any particular advantage (e.g., palatability) over existing cultivar Wynn.

Macroptilium atropurpureum CPI 84989 showed limited adaptation at “Bethome”, Bororen, “Granite Vale”, St Lawrence, “Glensfield”, Sarina, and Katherine NT but persistence and yield presented no advantage over Aztec atro.

Macrotyloma axillare cv Archer and CPI 52469 failed to persist at all sites except "Glensfield". There it maintained low populations of 2 to 3 plants/m2 but showed low palatability, with little difference between the two lines.

Rhynchosia lines failed to persist.

Table 6.10.4.1. Legume Counts (plants/m^{-2}) for *A. brasiliana* and *C. rotundifolia* lines in the 4th and 6th years at six BULS evaluation sites in Series 1, relevant to stylos

	Date Sown	26-Nov-92		3-Dec-92		7-Jan-93		27-Jan-93		4-Dec-92		10-Feb-93	
		Sarina *Glensfield*		St. Lawrence *Granite Vale*		Ayr *Swan's Lagoon*		Gympie *Sexton*		Gayndah *Brian Pastures*		Duaringa# *Sorrell Hills*	(Yield Rating
Species	**Acc./Cv.**	Year 4 19-Mar-96	Year 6 11-Mar-98	Year 4 12-Jun-96	Year 6 15-Apr-98	Year 4 9-Feb-96	Year 6 18-Mar-98	Year 4 17-Apr-96	Year 6 20-May-98	Year 4 18-Apr-96	Year 6 22-May-98	Year 3 10-Oct-95	Year 5 May-97
A. brasiliana	**92519**	**23**	**9**	**10**	**9**	**11**	**16**	**0.2**	**0.4**	**3**	**1**	**4**	**6**
A. brasiliana	93592	*	*	*	*	*	*	9	26	8	9	-	-
C. rotundifolia	85836	19	32	5	2	0		9	27	2	7	1	3
C. rotundifolia	86172	25	33	0	0	18	190	4	12	16	16	0	2
C. rotundifolia	Wynn	52	42	1	18	38	42	6	14	7	14	4	4
S. hamata	Verano	30	12	44	20	89	41	10	11	-	-	10	5
S. scabra	**Seca**	**18**	**10**	**30**	**9**	**30**	**41**	**16**	**27**	**-**	**-**	**14**	**8**

Legume Dry Matter Yield (kg/ha) at end of 4th growing season at above six BULS evaluation sites

		19-Mar-96	**12-June-96**	**20-April-96**	**17-Apr-96**	**18-Apr-96**	**10-Oct-95**
A. brasiliana	**92519**	**1144**	**300**	**2000**	**0**	**212**	**293**
A. brasiliana	93592	*	*	*	91	1007	*
C. rotundifolia	85836	1191	0	0	174	254	12
C. rotundifolia	86172	2297	0	1500	76	2537	0
C. rotundifolia	Wynn	2147	0	1600	59	885	216
S. hamata	Verano	381	300	1000	77	-	460
S. scabra	**Seca**	**1511**	**600**	**4000**	**3174**	**-**	**570**

* = sprayed out # sown 1 year later than other sites

Table 6.10.4.2. Persistence of American jointvetch and villose jointvetch legumes at four series 1 sites over six years, relative to stylos.

	Date Sown	**26-Nov-92**			**25-Jan-93**			**27-Jan-93**		
		Sarina (*Glensfield*)			**Miriam Vale (*Wadeleigh*)**			**Gympie (*Sexton*)**		
Species	**Acc./Cv.**	**Year 1 15-Jan-93**	**Year 4 19-Mar-96**	**Year 6 11-Mar-98**	**Year 1 23-Mar-93**	**Year 4 16-Apr-96**	**Year 6 21-May-98**	**Year 1 25-Mar-93**	**Year 4 17-Apr-96**	**Year 6 20-May-98**
A. americana	CPI 93624	18	0	1	6	5	39	23	10	38
A. americana	Glenn	23	0.2	1	9	2	5	84	0.1	3
A. americana	Lee	22	1	0.2	11	1	3	78	0	1
A. villosa	CPI 37235	29	1	18	6	0	32	45	11	28
A. villosa	Reid	29	5	8	15	1	7	29	6	2
A. villosa	Kretchmer	23	4	6	24	1	7	72	2	1
S. hamata	Verano	15	30	12	5	10	18	50	10	11
S. scabra	Seca	22	18	10	7	12	32	35	16	27

7. Success in Achieving Project Objectives

Objectives NAP 2 (1) *By July 1995, to study and understand the general agronomy and ecology of three well adapted legume cultivars (particularly from Aeschynomene and Chamaecrista (previously Cassia species) and develop commercial management practices to speed their integration into the commercial grazing industry.*

(Also Objectives NAP 2 (3) *By October 1995, to produce a minimum of 100kg of seed of the three new cultivars for time of release*, and Objectives NAP 2 (4) By October 1995, to determine field nutrition requirements and responses and develop appropriate seed technology packages for each new cultivar).

The early stages of this project contributed valuable information supporting the release of Reid and Kretschmer villose jointvetch (*Aeschynomene villosa*) for coastal spear grass communities receiving greater than 900 mm (36") rainfall. These cultivars have been successfully commercialised (Southedge Seeds, Mareeba) and for the 1997/98 summer were retailed as "Villomix" at $12/kg.

Objectives NAP 3 (1*)* *By July 1998, to provide sufficient agronomic details to the Queensland Herbage Plant Liaison Committee to allow for the release of Aeschynomene brasiliana* CPI 9251. Also covers part of NAP2 Objective (1).

An information statement for *Aeschynomene brasiliana* CPI 92519 has been prepared (appendix 12.6), as per release guidelines but CPI 92519 will not be released as a commercial cultivar. It will "lie in storage" for some possible future date when a legume with its characteristics may be needed. *A. brasiliana* CPI 92519 is well adapted to harsh conditions (next best to the stylos) but has a sticky exudate on the stems and leaves and at some sites has not been readily grazed. Although it is well grazed at some sites no liveweight gain data are available due to drought in the first 3 years at the Mt Garnet grazing evaluation site. As a result of some negative reports from some site managers and also some doubts from the Queensland Herbage Plant Liaison Committee (QHPLC) re its palatability to stock, and in the absence of any trial data on animal liveweight gain, the 1997 QHPLC meeting requested that it be withdrawn from pre-release and recommended it be eradicated from all evaluation sites.

Objectives NAP 3 (2) *By July 1998, to provide sufficient agronomic details to the Queensland Herbage Plant Liaison Committee to allow for the release of at least one further Chamaecrista rotundifolia accession (i.e., in addition to Wynn cassia).*

Also covers part of NAP 2 Objective (1).

Chamaecrista rotundifolia CPI 85836 / 86172, although slower to establish than Wynn cassia (probably due to higher hardseed content) soon developed equal or higher sward density, drymatter yield and soil seed reserves. Palatability is similar to Wynn and being higher yielding accessions they have the capacity to "dominate" in native pasture situations. Comparative weight gain data (to Wynn) are not available due to the grazing evaluation site at Mt Garnet being droughted. In view of no significant demonstrated performance advantage over cultivar Wynn CPI 85836 and CPI 86172 were withdrawn from pre-release in 1998.

Objective NAP2 (2) *By July 1995, to demonstrate the animal production potential of the three new cultivars.*

The grazing evaluation sites for *A. brasiliana* and *C. rotundifolia* ("Sugarbag" and "Lamonds Lagoon"), Mt Garnet, experienced drought in the first three years of this project and these sites where discontinued. Animals were successfully grazed on a small (4 ha) *A. brasiliana* CPI 92519 site at Swans Lagoon Research Station but there was no control treatment and no weights recorded.

Reid and Kretschmer jointvetch are readily eaten by cattle but cattle weighing at two producer demonstrations near Gympie were interrupted by periods of drought and no comparative data recorded. However both cultivars were readily grazed by cattle at all stages of growth. Plant quality studies indicated high N and P content and high digestibility.(Section 6.6).

At a producer demonstration site south of Mackay steer weight gain slightly favoured Glenn jointvetch (0.49 kg/day) over Lee jointvetch (0.45 kg/day) over a 600 day period stocked at 1.5 adult equivalents/ha.

Objective NAP2 (4) *By October 1995, to determine field nutrition requirements and responses and develop appropriate seed technology packages for each new cultivar.*

Response of Glenn, Lee and Reid to applied phosphorus, relative to Seca stylo, has been documented. Glenn, Lee and Reid require higher soil phosphorus for optimum growth than does Seca stylo but this also means the former have potential for greater yield, quality and digestibility in higher input situations. Less information is available for *A. brasiliana* CPI 92519 as the P rate response trial for it, *C. rotundifolia* CPI 85836 / 86172 and Wynn cassia was at "Sugarbag" Mt Garnet and was discontinued due to drought. Soil analysis of adaptation sites in year six of this project indicate that *A. brasiliana* CPI 92519 is adapted to low soil phosphorus.

Seed production packages for Reid and Kretschmer jointvetch have now been commercially tested and involve a combination of direct and suction harvesting. Although the stickiness of *A. brasiliana* CPI 92519 causes some difficulties with seed harvesting, commercial seed production is possible with backup from suction harvesting. Seed production for "cassia" legumes poses no problem (Section 6.8).

The results of a herbicide tolerance/susceptibility screening trial (for use by commercial seed producers or for control of legumes in weed situations) and conducted by Don Loch, Gympie, are presented in appendix 12.3 of this report.

Monitoring of soil seed reserves highlighted the relationship between legume persistence, seed set, seedling regeneration and the importance of management practices to encourage seed set. (Section 6.7)

Legume quality assessment of tip samples (% N, P and Acid Detergent Fibre) showed considerable variation between legumes and highlighted the productivity potential of certain legumes (Lee, Glenn, Villomix) due to their higher quality forage compared with that of Seca stylo (Section 6.6).

Additional results and achievements: Adaptation and production information on 14 current legume cultivars, including 5 stylos, has been updated by this project resulting in better management packages for, and greater use of and production from sown pastures in northern Australia. For example current stylo cultivars are being promoted and used more in the Northern Territory and in the southern spear grass zone in Queensland. Aztec atro has persisted for four years at Eton Range, Sarina and Miriam Vale, and Glenn/Lee jointvetch "wax and wane" with rainfall but in many situations make a valuable contribution. Bargoo jointvetch has proven a very persistent legume at Sarina, Gympie, Narayen and Brian Pastures. Seed production has been the main restraint to its commercial use. More recently introduced lines may overcome the pod shattering and anthracnose disease problems which affect Bargoo seed production. The adaptation of Wynn cassia is now better defined.

Objective NAP 3 (3) *By July 1998, evaluate the potential of a number of accessions from Aeschynomene americana, A. histrix, A. villosa, Macroptilium, Atylosia, Alysicarpus, and Desmanthus, to select five legumes for pre-release (new entries or confirmation of current pre-release legumes).*

Also covers objective NAP2 (6)

Aeschynomene histrix is very palatable with few potential environmental concerns. Performance of the mid-late flowering lines (CPI 93599/ 93636/ 93638) was sufficient for them to be placed on pre-release in 1998. However, due to a lack of seedling recruitment and thus persistence, these accessions were withdrawn from pre-release at the 1999 QHPLC meeting with a proposal they be compared with earlier flowering accessions, when available, in future evaluation trials.

The earlier flowering *A. americana* CPI 93624 has considerably better regeneration/persistence than Glenn at Miriam Vale and Gympie and this accession was placed on pre-release at the 1998 QHPLC meeting pending further monitoring of its performance and investigation of co-marketing arrangements with commercial production of Glenn seed. It was subsequently withdrawn from pre-release at the 2000 QHPLC meeting due to a lack of progress on co-marketing arrangements.

Good performance of *Desmanthus spp.* lines at "Granite Vale", St Lawrence, indicates that some accessions are adapted to some duplex soils. Selections AC 10 and AC 11, from naturalised desmanthus at Alligator Creek, Townsville (selected by Bob Burt, then of CSIRO Davies Lab, Townsville) performed well in series 2 plantings at "Granite Vale", Narayen and Brian Pastures and series 3 at "Granite Vale", "Swans Lagoon" and Miriam Vale. *D. tatuhyensis* var *tatuhyensis,* CPI 37538 has persisted well at Brian

Pastures, Narayen and Gympie but is a very small plant. These three accessions were placed on pre-release at the 1998 QHPLC meeting to stimulate wider evaluation and discussion. They were withdrawn from pre-release in 2000 following inclusion in an evaluation program for the southern spear grass zone.

Communication achievements- NAP2 (1)

Evaluation sites were established on 13 properties with valuable information exchange occurring during site selection, establishment and ongoing management. Property owners/managers vary, regarding interest and participation, but most keep abreast of progress results during recording visits and phone calls. The “Glensfield” owner increased his sown pasture development program during the latter stages of the BULS project sowing 250 ha to mixtures of legumes (and grasses) based on species performance at his site. The owners of “Wadeleigh” and “Bethome”, Bororen/Miriam Vale, have similarly developed areas based on performance at their sites. Seven properties volunteered demonstration sites for Reid and Kretschmer following an inspection of the BULS evaluation site by the Miriam Vale Rural Science and Landcare Society in May 1996 and several kilograms of seed was made available to each by the licensee for these new cultivars.

Communication with the wider rural and RD&E community was achieved via 11 “pasture walks” plus 3 inspections with producer/agri-business/RD&E interests. Many site owners and departmental collaborators have organised visits with neighbours and fellow workers. Four poster papers have been presented at conferences. Regular newspaper, newsletter and radio articles and talks have updated progress results.

The interim final report lists 27 principal investigators/technical collaborators plus 5 research stations involved in various aspects of the BULS project. These collaborators represented DPI, CSIRO, NT-DPI&F and James Cook University. Review and planning workshops in each of the first 3 years stimulated much interchange of ideas and techniques as well as progress reports. A direct request to the Northern Australian Pasture Plant Evaluation Committee (NAPPEC), to assist with developing guidelines for future management of discontinued evaluation sites, containing un-released legumes, led to one day of their 4 day 1998 field meeting being spent inspecting and discussing aspects of the BULS project. The 22 participants represented Queensland, NT and NSW Departments, Department of Environment, CSIRO, University of Queensland and the seed industry.

All publications, reports and field day handouts are listed in appendix 12.7.

8. Impact on Beef Industry

- The BULS project has confirmed/highlighted the north Australian beef industries reliance on the stylos for sown pasture development or for improving growth rates from native pastures. This has highlighted the need for land managers to maintain stable and productive stylo based pastures. Management guidelines (grazing and use of fire) to maintain a grass legume balance need to be followed to avoid potential environmental problems resulting from stylo dominance (Cooksley 2002, Noble *et al.* 2000, Partridge *et al.* 1998).
- Better information is now available on role and use of alternative legumes. Adaptation and production information on 14 current legume cultivars, including 5 stylos, has been updated. For example Glenn, Lee and Reid jointvetches require higher soil phosphorus for optimum growth than does Seca stylo but this also means the jointvetches have potential for greater yield (this project), quality and digestibility (Jones *et al.* 2000) in higher input systems. Monitoring of soil seed reserves clarified and highlighted the relationship between time of flowering, actual seed set, seedling regeneration, legume persistence and the importance of pasture grazing management practices to encourage seed set and regeneration of seedlings. The good adaptation and persistence displayed by Bargoo jointvetch (*Aeschynomene falcate)* to variable conditions has further stimulated interest in evaluating more recent *A. falcate* accessions for better anthracnose disease resistance and therefore better seed production. Desmanthus is adapted to some of the lighter clay soils (some poplar box and ironbark country) where it has performed as well as Shrubby stylos and the newer Caatinga stylos.
- The BULS project has been a catalyst for wide ranging communication of sown pasture technologies with landholders and managers providing trial sites and with the wider rural community through pasture walks, field days and media articles. Networking with RD&E colleagues from a range of departments, institutions and agribusiness was productive in forging strong and united approaches with problems and threats to sown pasture development in northern Australia. Updated sown pasture technologies have helped and allowed grazing land managers to produce and provide consumers with animal products that better meet market specifications and demands.
- This project and concurrent regional and state wide evaluation programs lead to a subsequent project to reduce the risk of introduced plants contributing to environmental weed problems. A new project “Managing Old (discontinued) Plant Evaluation Sites” (MOPES) has significantly contributed to a more responsible approach to the practices and processes associated with introduction, evaluation, release and development of new forage plant cultivars. A Draft Code of Practice for evaluation of future introduced forage plant cultivar has been developed (Cox and Cook 2003).

9. Recommendations and Conclusions

1. The role of sown pastures today is much more diverse than providing fodder for grazing animals. Examples include ley-pasture rotations in farming systems including organic agriculture, increasing management options for natural systems (strategic spelling of native pastures), stabilising landscapes against erosion and down-stream effects such as sediment and nutrient loads, amenity purposes in public parks and playing fields, and ground covers for horticulture and agroforestry. All these diverse systems require ongoing sown pasture RD&E.

2. The role of sown pastures in preventing land degradation needs to be highlighted and given ongoing promotion, particularly to catchment group coordinators as well as NHT, NLP and NAPSWQ policy "makers and minders". The positive role of sown pastures in sustainable production systems needs to be emphasised. A successful example of this approach is the recent Commonwealth Department of Agriculture, Fisheries and Forestry publication "Natural Heritage Trust and the National Action Plan for Salinity and Water Quality; Farm Forestry's Role" (www.affa.gov.au/forestry). A similar booklet encouraging implementation of sustainable grazing land management systems, as an eligible activity for NHT and NAP funding, would certainly help increase adoption and implementation of sustainable production system for the grazing lands. For example case studies prepared by landholders and land managers on the economic and environmental benefits from responsible use of sown pasture development and integration of sown pastures into whole enterprise, multiple land use production systems. Australia today is a multicultural society and we rely on introduced plants and animals to feed, cloth and house our Australian population. Sustainable production systems that integrate natural and introduced plants and animals need to be developed, implemented and continually monitored and improved.

3. Capturing current sown pasture technologies in user-friendly data packages is an ongoing priority and much has already been achieved. Information is available from the Tropical Grassland Society of Australia (www.tropicalgrasslands.asn.au/pastures) web site and DPI&F (www.dpi.qld.gov.au/pastures) web site and Prime notes. ACIAR has recently funded a project "Selection of Forages for the Tropics" (SoFT) to create an international database of tropical sown pasture technologies which will be released as a CD in 2005 and subsequently placed on the web. The BULS project has provided information for these databases.

4. Regional catchment groups, with (conditional) funds via Natural Heritage Trust (NHT) and National Action Plan for Salinity and Water Quality (NAP), will provide an opportunity to utilise and implement the vast resource of sown pasture technologies available, as one of the mechanisms (tools required) to meet the targets listed in the (soon to be accredited) regional (catchment) natural resource management plans across northern Australia. Sown pastures will play an important role in the implementation of sustainable production systems, within healthy, multiple land use, landscapes. The Grazing Land Management (Education) Package (MLA 2004) and the Stocktake Monitoring Package (Aisthorpe and Paton (2004) will be important vehicles in the delivery and implementation process for sown pasture technologies.

5. Linkages with Universities and Colleges via cooperative RD&E activities with student project work, need to be further developed and could provide new sown pasture technologies. The grazing industry and RD&E providers need to build proactive relationships with and participate in Regional / Community Catchment Group NRM Investment Plan processes and funding opportunities. This participation should also increase opportunities to leverage private investment to support ongoing development of appropriate RD&E technologies, as gaps appear.

6. The completion of this project, and similar concurrent sown pasture projects supported by MLA's NAP 2 program (Walker 1996), has coincided with a dramatic decline in sown pasture cultivar R&D resources, and therefore activities in northern Australia, by both CSIRO and DPI. Also in 2002 the Queensland Herbage Plant Liaison Committee (QHPLC) and the North Australian Pasture Plant Evaluation Committee (NAPPEC) were disbanded. An alternative release mechanism has been proposed but not yet progressed.

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John Bushell (1992-96) and Terry Hilder (1996-99) compiled and tabled field data. Christina Playford, DPI&F Rockhampton assisted with statistical analysis of the legume response to phosphorus trials. Tonia Grundy, DPI&F Biloela and Stephen Smith DPI&F Rockhampton carried out final formatting and preparation of this report.

12. Appendices

Appendix 12.1 List of tropical forage legume cultivars and release dates

Tropical forage legumes that may be adapted to 1000 mm AAR or below and released by the Queensland Pasture Liaison Committee and by the Queensland, New South Wales and Northern Territory Herbage Plant Liaison Committees 1962 to 1996.

Species	Cultivar Name	Common Name	Year of Release	Releasing Authority
Lotononis bainesii	Miles	lotononis	1962	Q
Macrotyloma uniflorum	Leichhardt	biflorus	1965	Q
Stylosanthes guianensis+	Oxley	fine-stem stylo	1965	Q
*Stylosanthes guianensis**	Schofield	stylo	1966	Q
Macrotyloma axillare+	Archer	axillaris	1966	Q
*Stylosanthes humilis**	Lawson	Townsville stylo	1968	Q
*Stylosanthes humilis**	Gordon	Townsville stylo	1968	Q
*Stylosanthes humilis**	Paterson	Townsville stylo	1969	Q
*Stylosanthes guianensis**	Endeavour	stylo	1971	Q
Stylosanthes guianensis	Cook	stylo	1971	Q
Aeschynomene falcata+	Bargoo	jointvetch	1973	NSW
Stylosanthes hamata+	Verano	caribbean stylo	1973	Q
Stylosanthes scabra+	Seca	shrubby stylo	1976	Q
*Stylosanthes guianensis**	Graham	stylo	1978	Q
*Stylosanthes scabra**	Fitzroy	shrubby stylo	1979	Q
Aeschynomene americana+	Glenn	jointvetch	1983	Q
Chamaecrista rotundifolia	Wynn	roundleaf cassia	1993	Q
Centrosema pascuorum	Cavalcade	centurion	1984	NT
Centrosema pascuorum	Bundey	centurion	1986	NT
Stylosanthes hamata+	Amiga	caribbean stylo	1988	Q
Stylosanthes scabra+	Siran	shrubby stylo	1990	Q
Desmanthus virgatus+	Marc	desmanthus	1991	Q
Desmanthus leptophyllus +	Bayamo	desmanthus	1991	Q
Desmanthus pubescens +	Uman	desmanthus	1991	Q
Aeschynomene americana+	Lee	American jointvetch	1991	Q
Macroptilium atropurpureum+	Aztec	atro	1993	Q
Aeschynomene villosa+	Reid	villose jointvetch	1995	Q
Aeschynomene villosa+	Kretschmer	villose jointvetch	1995	Q
Centrosema pubescens	Cardillo	centro	1995	Q
Stylosanthes sp. aff *S, scabra*	Primer	Caatinga stylo	1996	Q
Stylosanthes sp. aff. *S. scabra*	Unica	Caatinga stylo	1996	Q

Major introduced pasture plants which were either commercialised before 1961 or have not been registered by the HPLC'S.

Species	Common Name
Centrosema pubescens	centro
Macroptilium atropurpureum	Siratro (1960)
Macroptilium lathyroides	Murray phasey bean (1996)
*Stylosanthes humilis**	common Townsville stylo

* No longer available commercially due to susceptibility to anthracnose.

\+ Planted in the BULS project (as standards).

Appendix 12.2 Grazing Evaluation Sites (to record LWG); as per BULS 1996 interim final report.

Aeschynomene villosa CPI 37235, 91209 (cv Reid), 93621 (cv Kretschmer)

Objective: To assess productivity of pre-release accessions of *Aeschynomene villosa* relative to that of improved pasture in the area.

Collaborators: BG Cook and AG Salmon, DPI.

Co-operator: CV (the late) and JR Cotter.

Location: "Narrabri", Sexton, 31 km SW Gympie, 26^{0}01'S, 152^{0}27'E, 50 m ASL.

Areas sown: 2 ha of each. Soil description and analysis and rainfall is similar to adaptation sites.

Date sown: 18 November 1992.

Methodology: This was an unreplicated comparison, comprising two paddocks, each of about 6 ha. One was an established pasture of *Digitaria didactyla, D eriantha* spp *pentzii, Chloris gayana, Lotononis bainesii* and *Macroptilium atropurpureum*. This paddock had been established for some years and had been grazed heavily and continuously. The *Aeschynomene* paddock was cultivated in contour strips, leaving about 1 in 4 uncultivated to avoid erosion. The *A villosa* accessions (CPI 37235, CPI 91209 (now cv Reid) and CPI 93621 (now cv Kretschmer) were sown individually into 2 ha areas separated by a row of *Paspalum nicorae* CPI 27707 or 125877. *Bothriochloa pertusa* cv Keppel was sown with the 3 accessions. All seed was broadcast over the surface, and rolled with a fluted roller on 18.11.92. Fertiliser was applied at the equivalent of 200 kg/ha superphosphate to both paddocks.

Results and Discussion: The sown paddock established well, but in the absence of the legume developed considerable leaf area by the onset of dry condition. This exacerbated the effect of moisture stress adversely affecting flowering and seed set. Although a reasonable proportion of plants of the perennials survived, there was little recruitment of the annual, CPI 37235. This line was resown on 3 December 1993.

None of the *A villosa* accessions developed to their potential due to the continuing dry conditions and populations have gradually declined (Table 6.3.1.1). Both areas were intermittently grazed by farm stock in the interest of maintaining pasture condition in preparation for the change of season. Continuing unfavourable weather conditions, the inability to assess test cattle, and the untimely demise of the farmer, Mr Cotter, all contributed to the decision to relocate to an alternative site.

Population and Yield of *A villosa*, Sexton via Gympie

A villosa	**Legume population (plants/m^2)**		**Dry matter yield (kg/ha)**		**Total**
	8.6.94	**9.5.95**	**Legume 8.6.94**	**Grass***	
Reid	5.9	4.2	238	3032	3270
Kretschmer	8.9	3.2	894	2434	3328
CPI 37235	6.3	3.5	79	2988	3067

* *Bothriochloa pertusa* cv Keppel/*Digitaria didactyla*

Aeschynomene villosa cvv Reid and Kretschmer compared with *Vigna parkeri* cv Shaw in a producer demonstration site.

Collaborators: BG Cook and AG Salmon.

Co-operator: GP Lally.

Location: Wilton Road, Cedar Pocket, 26^{0}09'S, 152^{0}45'E, 9.5 km NE Gympie, 100 ASL.

Area sown: 4 ha x 2 paddocks.

Soil description: Red podzolic on phyllite with clay loam surface.

Soil analysis (0-10 cm):

Soil Analysis	pH	EC	Ca	Mg	Na	K	Cl	Pb	SO_4^-S	Cu	Zn	Mn
(0-10 cm)		(ms/cm)	(me/100 g)				(ppm)					
Shaw	5.7	0.08	4.8	3.4	0.27	0.48	33	40	28	2.0	5.8	165
Aes. (hill)	5.4	0.09	3.9	2.8	0.27	0.69	42	42	38	2.1	6.8	132
Aes. (old cult.)	5.9	0.07	4.2	3.7	0.27	0.44	34	34	30	2.0	3.2	209

Vegetation: Formerly wet sclerophyll with *Eucalyptus cloeziana* predominating. Currently a mixture of *Axonopus affinis* and *Paspalum dilatatum* with isolated areas of *Imperata cylindrica*, *Pennisetum clandestinum* and *Pteridiium esculentum*.

Date sown: 6 January 1996.

Methodology: Equal mixture of *Aeschynomene villosa* cvv. Reid (CPI 91209) and Kretschmer (CPI 91209), sown at 2.5 kg/ha on 6.1.96. *Vigna pakeri* cv Shaw sown at 2.5 kg/ha on 4.1.96. In both cases seed was pelleted with molybdenum trioxide at 300 g/ha incorporated into the pelleting lime. Seed was broadcast onto the surface of a well prepared seedbed and lightly harrowed to cover. No grass was sown, assuming mat grass and paspalum would regenerate. Each paddock is about 4 ha. Pasture Plus (15.1% P, 15.2% S) was broadcast at 125 kg/ha on 19.8.96.

Rainfall (mm):

	J	A	S	O	N	D	J	F	M	A	M	J	Tot
1995/96	12	27	41	76	219	140	271	22	28	55	122	28	1041
1996/97	21	14											
Mean (Gympie)	53	37	47	73	88	135	168	162	143	87	70	63	1143

Results and Discussion: Good rainfall was received at and soon after planting, but no good follow-up rain was received, the next substantial falls being in late April/early May. Despite this, adequate establishment was achieved, counts on 17 April, 1996 yielding values of 5.1 and 6.8 plants/m^2 for *A villosa* and *V parkeri* respectively. Before the onset of winter, all legumes were growing well. Frosts from June to August have killed legume tops, but will not have caused permanent damage. The area is being lightly grazed to condition the sward while two lines of paired weaner stock are being located in preparation to weigh onto the treatments.

Aeschynomene brasiliana CPI 92519

Collaborators: Kev Shaw, Col Webb, DPI.

Co-operator: Robert and Lorraine Henry, Sugarbag, Mt Garnet. Site details and rainfall as for Sugarbag adaptation site.

Area sown: Two paddock comparison between native (57 ha) and native pasture oversown with legume (42 ha).

Date sown: 29 January 1992, and additional area 23 December 1993.

Results and Discussion: Although designed as a grazing evaluation there has never been a sufficient area of legume to constitute a genuine comparison between the oversown and native pasture paddocks. CPI 92519 has established remarkably well despite an ongoing drought (until 1995/96). However, the area established was less than 10% of the paddock and, to date, natural spread has been slow.

Overall legume yields in each of 1994/95 and 1995/96 was 36 kg/ha which represented only 3% and 5% of total DM yield respectively. Legume was encountered in 11% and 7% of quadrats respectively. In spite of the low frequencies measured, the perception is that yield and plant numbers are increasing. In the areas of the paddock where it has been established the legume yields are approximately 60% of total yield and the companion grasses are often heavily grazed which may indicate that some nitrogen transfer is occurring. The paddocks are currently being grazed by a group of spayed heifers but weight responses are not yet available.

Aeschynomene brasiliana 92519

Collaborators: HG Bishop, JJ Bushell, TB Hilder.

Co-operator: DPI (Keith Jeppesen).

Location: Swans Lagoon Research Station, Millaroo, via Ayr, 20^{0}05'S, 147^{0}15'E.

Area sown: 4 ha in area of 8 ha.

Soil description: clay loam, area previously filled and levelled for cane.

Soil analysis (0-10 cm):

pH	EC ms/cm	Cl ppm	P (bicarb) ppm	Ca meq%	Mg meq%	Na meq%	K meq%
8.1	0.085	31	8	12	7.1	0.87	0.45

Date sown: 10 December 1993.

Rainfall (mm): (see "Swans Lagoon" adaptation site.

Results and Discussion: This site was established in 1994/95 because the Mt Garnet site had experienced drought in 1991/92, 1992/93 and 1993/94. The site established well but has proved inadequate for measuring LWG. It is too small, has variable soils and contains other legumes (*Sesbania*, Phasey bean and *Rhyncosia*) which has prevented *A brasiliana* CPI 92519 diet intake studies. Steers have grazed this site from April 1995 in conjunction with an adjacent 4 ha of woodland. They have grazed the *A brasiliana* quite readily and transfer of seed via the dung and establishment of CPI 92519 in the adjacent 4 ha woodland paddock will be monitored.

Population of the sown area has been monitored by frequency counts.

Pasture Components	% freq 21.3.94	% freq 19.4.95*	% freq 19.2.96
A brasiliana 92519	69 (9 plants/m^2)	92	56
Bisset and Sheda grass	NA	85	88
Other grasses	NA	53	NA
Broadleaf weeds	NA	32	NA
Other legumes	NA	11	20

* Visual estimate of drymatter yield on 19.4.95 when steers were introduced was *A brasiliana* CPI 92519 1500 kg/ha and total yield 6000 kg/ha.

Aeschynomene americana, comparative demonstration of cultivars Glenn and Lee jointvetch

This project was funded as a MRC PDS Project and ran from January 1992 to June 1996 at "Tedlands", Koumala, via Mackay. The outcomes from this project are presented in appendix 2.12.2 of the BULS 1996 interim final report.

Chamaecrista rotundifolia CPI 85836, 86172

Collaborators: Kev Shaw, Col Webb, DPI.

Co-operator: Mike and Helen Murdoch.

Location: "Lamonds Lagoon", 80 km S of Mt Garnet, 18^{0}22'S, 145^{0}08'E.

Soil description: Red earth/yellow earth with sandy loam surface and low P status.

Date sown: Paddock 1: 24 December 1991 and 9 January 1992. Paddock 2: 14 January 1993.

Methodology: Two paddocks comparison between (1) native pasture oversown with CPI's 85836 and 86172 (40 ha) and (2) Native pasture oversown with cv Wynn (10 ha).

Companion grass: *Bothriochloa pertusa* Bowen strain (20 kg sown over approximately 10 ha).

Rainfall:

	J	A	S	O	N	D	J	F	M	A	M	J	Total
91/92	0	0	0	10	16	138	54	258	6	6	40	2	530
92/93	0	0	18	0	74	81	40	44	12	0	0	14	283
93/94	81	2	0	11	24	2	74	40	106	14	3	11	368
94/95	7	0	0	5	33	55	59	112	91	0	29	0	391
95/96	4	70	0	56	108	34	213	88	159	56	36	6	830

Results and Discussions: Although designed as a grazing evaluation initial plant numbers were very low. Drought conditions over the entire property in 1993 and 1994 meant that these paddocks had to be utilised to the full and neither area had a good opportunity to establish. The paddocks were spelled over the 1996 wet season and establishment of most of the original sown areas is now complete with legume yields of approximately 800 kg/ha. That establishment occurred at all during the drought is surprising. In the extensive grazing lands of dry tropical north Queensland the normal time from sowing to established pasture is approximately 4 years and this has been achieved. Both of these legumes have a capacity to produce a large bulk of material. There is a concern about their acceptability to stock and this should be resolved before any progress on release.

Appendix 12.3 Screening of selected post emergence herbicides

Introduction

Legume seed crops are prone to competition from faster-growing weeds. This can reduce the yield of seed from legume seed crops and also shorten the life of a perennial stand. In addition, contaminated seed lots are more costly to clean, attract lower prices, and in extreme cases may not be marketable.

Research into selective herbicides for use with tropical pasture legumes began during the 1960s and was primarily directed towards plantation crops (Riepma, 1965) and grazed pastures (Bailey, 1969). However, the use of herbicides is more easily justified in pasture seed crops than in pastures *per se*, so Bailey's (1969) recommendations for six of the (then) main legume species were quickly adopted by seed growers. Veenstra and Boonman (1974) identified some alternatives for *Desmodium intortum*; but it was not until Hawton *et al.* (1990) summarised the results of herbicide screening experiments from several research programmes in Queensland that a comprehensive chart was available, showing the tolerance of >20 legumes to some commonly used herbicides. Since then, there has been relatively little published work, mainly directed towards the use of a limited range of post-emergence herbicides on one or perhaps a few legume species (e.g. Pratchett and Triglone, 1990: Argel and Valerio, 1992; Kachelreiss, 1993).

The control of grass weeds in the seedbed is generally met by trifluralin and related chemicals, which have been tested experimentally on only ten legumes (Hawton *et al*., 1990) and their use extended to a number of other species through trial and error. Weeds generally present greater problems in established perennial stands and in particular the less vigorous and less competitive species. The difficulty of maintaining a pure sward for seed production increases progressively in older legume stands as soil N levels build up and encourage the growth of both grass and broadleaf weeds in the absence of a companion grass. At the same time, other chemicals are required to control the different legumes should they, as can happen with any economic species, become a 'plant out of place' and hence a weed in other situations. The present series of experiments in which a range of promising and released *Aeschynomene* spp. and *Chamaecrista rotundifolia* were screened for post-emergence herbicide tolerance was therefore directed at these last two issues of tolerance and susceptibility to herbicides.

Materials and Methods

In glasshouse experiments, 28 herbicides (listed in Table 1) were applied post-emergence (21 days after sowing) to 10 accessions from six *Aeschynomene* species and two accessions of *Chamaecrista rotundifolia*. In each case, a standard recommended rate and double that rate were applied. Within each experiment, herbicide treatments were compared against an unsprayed control treatment.

A randomised block design with four replicates was used where only one accession of the species was screened (*Aeschynomene falcata*, *Aeschynomene paniculata*, *Aeschynomene histrix*). In the other species (*Aeschynomene americana, Aeschynomene brasiliana, Aeschynomene villosa, Chamaecrista rotundifolia*) where more than one accession was screened, a split-plot design (split for cultivar) with four overall replications was used.

Squat plastic pots (165 mm diameter) were filled with fumigated krasnozem soil from Amamoor over c. 1 cm depth of gravel for drainage. A basal application of nutrients (N, P and K at 75, 40 and 50 kg/ha, plus Ca, S, Mg, Cu, Zn and Mo) was made at planting. Maintenance nutrients (N, P and K at 50, 12 and 15 kg/ha, plus Ca and S) were then applied 28 days after sowing.

Pots were thinned after emergence to give equal numbers of seedlings per pot across each of the cultivars/accessions when sprayed 21 days after sowing. In each case, the growth stage at the time of spraying was recorded as follows:

- *Aeschynomene americana* - 3-7 leaves;
- *Aeschynomene brasiliana* - 1-4 leaves;
- *Aeschynomene falcata* - 1-4 leaves;
- *Aeschynomene histrix* - 1-4 leaves;

- *Aeschynomene paniculata* - 2-4 leaves;
- *Aeschynomene villosa* - 3-7 leaves; and
- *Chamaecrista rotundifolia* - 1-4 leaves.

Any visible effects of spraying were recorded at regular intervals throughout each experiment. Seven weeks after sowing, numbers of plants were recorded and each pot cut for dry matter yield (recorded after drying at c. 70°C). Responses of the different entries to individual herbicides were then rated according to the following scheme:

T (tolerant) – no significant reduction in plant population and dry matter yield;
MS (moderately susceptible) – significant reduction in plant population but not dry matter yield;
S (susceptible) - significant reduction in both plant population and dry matter yield;
C (controlled) – both plant population and dry matter yield not significantly different from zero.

As described, tolerance/susceptibility ratings were primarily based on statistical analyses of variance for final plant numbers and dry matter yields relative to the unsprayed control in each experiment. However, the previous experimental ‘diary’ of the effects of each treatment was also taken into account in these determinations, particularly in marginal cases where the final rating was not clear cut.

Results and Discussion

Herbicide tolerance ratings presented in Tables 2 and 3 are based on the standard application rate for each chemical. A rating shown in parenthesis indicates that tolerance dropped one level (i.e. T to MS, MS to S, S to C) at the double rate of application; similarly, double parentheses indicate a drop of two rating levels. Otherwise, the same rating applied at both standard and double rates for that particular chemical.

Five Group A herbicides (used for selective control of grass weeds) were screened. All entries showed good tolerance of these, with only minor stunting recorded in two species (*A. paniculata, A. villosa*).

There were, however, significant differences between and even within species in terms of their tolerance of broadleaf herbicides. The *Aeschynomene* spp. (Table 2) fell into two distinct groups in this respect. *A. americana, A. villosa* and *A. paniculata* showed good tolerance to commonly used hormone herbicides (2,4-D, 2,4-DB and MCPA, but not fluroxypyr and dicamba) in Group I, while virtually all of the plants of *A brasiliana, A. histrix* and *A. falcata* were killed by these chemicals. Within the former group, *A. paniculata* was highly susceptible to dichlorprop (also from Group I), in contrast to *A. americana* and *A. villosa* which were quite tolerant of this chemical. Bentazone, typically the safest broadleaf herbicide for use in legumes, caused some stunting with *A. americana* and more serious damage to *A. brasiliana* and *A. falcata*. Similarly, bromoxynil (Group C) was relatively safe except at high levels, but care would need to be taken in applying bromoxynil under field conditions because it can cause greater crop damage if sprayed under hot conditions (generally >20°C in temperate crops). Imazethapyr was the safest of the imidazolinones in Group B, causing some stunting to only *A. americana* and *A. falcata*. Other Group B herbicides were generally not safe for use with *Aeschynomene* spp., including flumetsulam which has recently been promoted for use on temperate legumes. Diflufenican (Group F) was generally safe to use with all *Aeschynomene* spp. and pyridate (Group C) with *A. americana, A. villosa* and *A. paniculata*; however, their effectiveness on the particular weeds in these seed crops would need to be established.

In the case of *Chamaecrista rotundifolia* (Table 3), the safest chemicals to use for broadleaf weed control were bentazone, bromoxynil and pyridate (Group C), and imazethapyr, imazapic and imazaquin (Group B - imidazolinones). Other Group B chemicals were generally less damaging than with the *Aeschynomene* spp., but in all cases there is the risk of stunting at the very least.

In both legume groups, the most effective/widest spectrum chemicals for controlling unwanted plants were metsulfuron, clopyralid and dicamba. Acifluorfen, while generally effective in killing young seedlings (particularly the *Aeschynomene* spp.), might not be so effective on larger plants because of the importance of contact in its mode of action.

The present results provide options for rotating herbicide groups while still being able to achieve satisfactory broadleaf weed control in the species investigated. This strategy is important to avoid the risk of developing herbicide-resistant populations of weeds by the repeated use of one or more herbicides with the same mode of action over a number of years.

The availability of particular chemicals also changes over time. Older products may be withdrawn where potential hazards to human health (e.g. dinoseb) or possible groundwater contamination are subsequently identified, or where the market does not justify the expense of developing environmental data (e.g. minimum residue levels) to maintain registration. In the meantime, new herbicides become available through on-going development programmes run by major agro-chemical companies. These invariably target major crops (e.g. cotton, soybeans) because of the high development costs involved. It is therefore important to maintain an on-going herbicide screening programme to keep herbicide technology and recommendations for tropical forage legumes up to date. The alternative of doing nothing can only result in the existing herbicide technology quickly becoming outdated. To illustrate this, we need only to look at the comprehensive work reported by Hawton *et al.* (1990) who used five of the 23 broadleaf herbicides and two of the five grass herbicides screened in the current work.

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Table 1. Details of herbicides and spray additives used in screening trials, together with standard rates of application.

Chemical	Product		Standard rate of application:		Herbicide group
	Name	Concentration (% a.i.)	Product	a.i. (g/ha)	
fluazifop-P[2]	Fusilade	21.2	500 ml/ha	106	A (aryloxyphenoxypropionic)
haloxyfop[2]	Verdict 104 (replaced by Verdict [13% a.i.])	10.4	750 ml/ha	78	A (aryloxyphenoxypropionic)
quizalofop-p-ethyl[1,3]	Targa	9.95	500 ml/ha	49.75	A (aryloxyphenoxypropionic)
sethoxydim[4]	Sertin 186 EC	18.68	1 L/ha	186.8	A (cyclohexene oxime)
clethodim[5]	Select	24	250 ml/ha	60	A (cyclohexene oxime)
metsulfuron-methyl[1]	Brush-Off	60	7.5 g/ha	4.5	B (sulfonylurea)
chlorimuron-ethyl[2]	Classic	25	50 g/ha	12.5	B (sulfonylurea)
tribenuron-methyl[1]	Express	75	25 g/ha	18.75	B (sulfonylurea)
flumetsulam[1]	Broadstrike	80	25 g/ha	20	B (triazolopyrimidine)
metosulam[1]	Eclipse	71.4	7.5 g/ha	5.355	B (triazolopyrimidine)
pyrithiobac-sodium[2]	Staple	85	60 g/ha	51	B (pyrimidinyl thiobenzoate)
imazaquin[2]	Scepter	15	1 L/ha	150	B (imidazolinone)
imazethapyr[2]	Spinnaker	24	400 ml/ha	96	B (imidazolinone)
imazapic[2]	AC 263,222 (released as Flame [26% a.i.])	24	200 ml/ha	48	B (imidazolinone)
AC 299,263[2]	(Cyanamid experimental)	12.48	250 ml/ha	31.2	B (imidazolinone)
bromoxynil	Buctril 200	20	1.5 L/ha	300	C (nitrile)
bentazone[1]	Basagran	48	3 L/ha	1440	C (benzothiadiazole)
pyridate	Tough 450 EC	45	2.5 L/ha	1125	C (phenyl-pyridazine)
diflufenican	Brodal	50	150 ml/ha	75	F (nicotinanilide)
acifluorfen[1]	Blazer	22.4	2 L/ha	448	G (nitrophenyl ether)
2,4-D amine	Amicide 500	50	1 L/ha	500	I (phenoxyacetic)
2,4-DB	Buticide	40	4 L/ha	1600	I (phenoxybutyric)
MCPA	MCPA Amine 500	50	1 L/ha	500	I (phenoxyacetic)
dicamba	Banvel 200	20	750 ml/ha	150	I (benzoic acid)
fluroxypyr	Starane 200	20	750 ml/ha	150	I (pyridine)
triclopyr[3]	Garlon 600	60	100 ml/ha	60	I (pyridine)
clopyralid	Lontrel L	30	150 ml/ha	45	I (picolinic acid)
dichlorprop	Lantana DP 600	60	3 L/ha	1800	I (phenoxypropionic)

[1] BS 1000 added at a rate of 1 ml/L of spray

[2] BS 1000 added at a rate of 2 ml/L of spray

[3] D-C-TRON added at a rate of 10 ml/L of spray

[4] D-C-TRON added at a rate of 20 ml/L of spray

D-C-TRATE added at a rate of 20 ml/L of spray

Table 2. Herbicide tolerance ratings for six *Aeschynomene* spp. as determined in glasshouse screening experiments. All herbicides were applied post-emergence (21 days after sowing). Rating codes are described in the accompanying text. Ratings shown in parenthesis indicate lower tolerance at the double rate of application (one set of brackets for each reduction in rating).

Herbicide	***A. americana***		***A. villosa***			***A. brasiliana***		***A. paniculata***	***A. histrix***	***A. falcata***
	'Glenn'	**'Lee'**	**CPI 37235**	**'Reid'**	**'Kretschmer'**	**CPI 92519**	**CPI 93592**	**CPI 93653**	**CPI 93636**	**'Bargoo'**
fluazifop-P	(T)	T	MS	T	T	T	T	MS	T	T
haloxyfop	(T)	T	MS	T	MS	T	T	MS	T	T
quizalofop-P	T	T	MS	T	MS	T	T	MS	T	T
sethoxydim	T	(T)	MS	(T)	(T)	T	T	MS	T	T
clethodim	T	T	MS	MS	(T)	T	T	MS	T	T
metsulfuron	C	C	S	C	(S)	C	C	C	C	C
chlorimuron	MS*	(MS)*	S*	(MS)*	(MS)*	((T))	C	S*	C	(T)
tribenuron	MS*	MS*	MS*	MS*	MS*	((T))	S	(MS)*	(S)	C
flumetsulam	MS*	(MS)*	S	S	S	MS	(T)	MS*	MS	S
metosulam	MS*	MS*	MS*	MS*	MS*	(MS)	S	MS*	MS*	S
pyrithiobac	(MS)*	(MS)*	(MS)*	S*	(MS)*	C	C	S*	(MS)*	C
imazaquin	MS*	MS*	MS	MS*	MS*	S	(S)	MS	(S)	S
imazethapyr	MS	MS	T	(T)	T	T	T	T	T	MS
imazapic	MS	MS	MS*	(MS)*	MS*	S	C	(T)	(S)	S*
AC 299,263	MS	MS	MS	MS*	MS	T	T	MS	T	T
bromoxynil	MS	((T))	((T))	((T))	((T))	T	T	T	T	((T))
bentazone	MS	MS	T	(T)	T	(MS)*	S	T	T	(S)
pyridate	T	T	T	T	T	((T))	T	T	((T))	S
diflufenican	MS	T	T	T	T	T	T	T	T	(T)
acifluorfen	C	C	C	C	C	C	C	(MS)	C	C
2,4-D	MS	MS	MS	MS	MS	C	C	MS	C	C
2,4-DB	MS	MS	MS	MS	MS	C	C	(MS)	C	C
MCPA	MS	(MS)	MS*	MS*	MS	C	C	(MS)	C	C
dicamba	S	S	MS*	S	MS*	C	C	S	C	C
fluroxypyr	(S)	C	(MS)*	(S)	S	C	C	(S)	C	C
triclopyr	S	(MS)	MS*	(MS)*	S	C	C	S	C	C
clopyralid	(MS)*	(MS)*	MS*	(S)	MS*	C	C	(S)	C	C
dichlorprop	(MS)	(MS)	((T))	(MS)	((T))	C	C	C	C	C

* Surviving plants very stunted

Table 3. Herbicide tolerance ratings for two *Chamaecrista rotundifolia* accessions as determined in glasshouse screening experiments. All herbicides were applied post-emergence (21 days after sowing). Rating codes are described in the accompanying text. Ratings shown in parenthesis indicate lower tolerance at the double rate of application (one set of brackets for each reduction in rating).

Herbicide	***Chamaecrista rotundifolia***	
	'Wynn'	**CPI 86172**
fluazifop-P	T	T
haloxyfop	T	T
quizalofop-P	T	T
sethoxydim	T	T
clethodim	T	T
metsulfuron	C	C
chlorimuron	MS	MS
tribenuron	MS	MS
flumetsulam	(MS)	S
metosulam	S	MS
pyrithiobac	MS	MS
imazaquin	(MS)	T
imazethapyr	T	T
imazapic	(T)	T
AC 299,263	T	T
bromoxynil	T	T
bentazone	T	MS
pyridate	T	((T))
diflufenican	((T))	S
acifluorfen	S	(S)
2,4-D	C	C
2,4-DB	(S)	C
MCPA	S	C
dicamba	C	C
fluroxypyr	S	S
triclopyr	(S)	(S)
clopyralid	C	C
dichlorprop	C	C

Appendix 12.4 Registration statement for *Aeschynomene villosa* cvv. Reid and Kretschmer

Register of Australian Herbage Plant Cultivars (also published in Australian Journal of Experimental Agriculture, 2001, **41,** 579-580).

B. Legumes

17. Aeschynomene

(c) *Aeschynomene villosa* Poir. (villose jointvetch) cvv. Reid and Kretschmer

Reg. No. B - 17c - 1, B - 17c - 2

Originators: Bishop, H.G.[A], Cook, B.G.[B]

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Origin

Aeschynomene villosa occurs from southern Arizona, through Mexico, Central America and the Caribbean to northwestern South America. It grows at elevations up to 2250 m, usually in dry areas, pine and oak forests, pastures and sometimes in wet places (Rudd 1955). The Australian collection of *A. villosa* comprises 58 accessions (Bishop *et al.* 1988) of which 11 are perennial. Two of these have been selected for release following classification, description and evaluation. CPI 91209 was collected by R. Reid at 22°26'N, 99°29'W in Mexico, 11.6 km east of Ciudad del Maiz, San Luis Potosi, at 1250 m above sea level (ASL), in an area receiving 650 mm average annual rainfall (AAR), (Anon 1983). CPI 93621 was collected by R. Reid and A.E. Kretschmer at 19°24'N, 96°36'W in Mexico near Corral Falso, Veracruz, at 1420 m ASL on a loamy clay/clay loam soil in an area receiving 1100 mm AAR (A.E. Kretschmer and R Reid, personal communication).

CPI 91209 and CPI 93621 were endorsed for release as cultivars Reid and Kretschmer respectively, by the Queensland Herbage Plant Liaison Committee, September 1995. Breeders' seed will be maintained at DPI Walkamin Research Station and the Australian Tropical Forages Genetic Resource Centre.

Morphological description

A. villosa is described by Rudd (1955) as follows:

“Stem to about 1 m long, prostrate to weakly erect, hispid; stipules (5-) 10-15 mm long, 1-1.5 mm wide, subglabrous, ciliate, usually somewhat hispid at the point of attachment; leaves about 2-7 cm long, 20-50 foliolate; leaflets 3-15 mm long, 1-3 mm wide; inflorescences 3-10 flowered, the peduncles and pedicels hispid like the stem, the bracts cordate, acuminate, 1.5-6 mm long, 1-2 mm wide, ciliate, the bracteoles ovate-lanceolate, acute to acuminate, 1-4 mm long, 0.5-1 mm wide, ciliate; flowers 3-9mm long; calyx 2-4 mm long, hispid; standard commonly 5-7 mm long, the claw 1-2 mm long, the blade suborbiculate, 4-5 mm in diameter, emarginate, entire; wings about as long as the standard, the blade 1-2 mm wide; keel about 4-5 mm long, the claws 1-1.5 mm long, the blades 3-4 mm long, 1-2 mm wide, sometimes ciliate along the free margin; stamens 4-5 mm long; fruit 3-7 (commonly 4-6) seeded, the articulations distinct or sometimes lacking, the articles 2.5-3 (- 4) mm in diameter, villous-hispid, the tuberculate bases of the hairs often dark, in contrast to the otherwise straw-coloured or light brown fruits, the venation inconspicuous, the margins often breaking away from the body of the articles; seeds 2-2.5 mm long, 1.5-2 mm wide, blackish.”

Reid is more prostrate and has darker seeds than Kretschmer. Dense stands of the former have reached 30 cm tall and of the latter, about 60 cm in trials at Gympie. Plant diameters at Mackay reached 150 cm and 230 cm respectively. There are 420 000 and 480 000 seeds/kg in the respective lines. Gametic chromosome number is n = 10 (Bielig 1997).

Agronomic characters

Both accessions fall into Group 7, one of two groups of perennial *A. villosa* in a morphological/agronomic classification (Bishop *et al.*1988), many plants living for three or more years under ideal conditions.

Reid and Kretschmer are maintained as separate cultivars for seed production, equal portions being mixed and marketed commercially as “Villomix”, by Southedge Seeds Pty Ltd, Mareeba, to take advantage of the variation in plant maturity and growth habit between cultivars.

Adaptation

Reid and Kretschmer appear to be well adapted to environments receiving 1000 mm AAR and above. However in subtropical areas receiving a winter rainfall component and where spring and early summer rainfall is more reliable, they can persist in areas down to 900mm AAR. At a range of sites in coastal Queensland both accessions have persisted better than Glenn and Lee american jointvetch under variable rainfall conditions. Both display moderate cold tolerance.

They have been grown successfully on soils ranging in texture from sandy loams to heavy cracking clays. Both have performed well in Queensland in dairy pasture evaluation sites at Rockhampton, Gympie and on the Atherton Tableland and in NSW at Kyogle. The commercial “Villomix” has persisted on heavy clay soil downs country in a 700 mm rainfall zone of central Queensland. Both lines tolerate waterlogging but not to the same extent as does *A. americana*. They combine well with companion grasses including competitive species such as *Brachiaria humidicola* (Bishop *et al*. 1997).

Growth and Production

Kretschmer grew well and spread in a coastal lowland situation near Gympie, in comparison with a limited set of *A. americana* and *A. villosa* lines. Despite frequent dry conditions, heavy grazing and little fertiliser, this line persisted in a dense mat of *Axonopus affinis* on a red duplex soil (B.G. Cook, unpublished data). In evaluation sites near Mackay and Gympie both lines have persisted better and yielded more than Glenn and Lee jointvetch (Bishop *et al.* 1997). At Mackay yield of Reid, receiving 10 kg/ha applied P, was >2000 kg/ha, in year 1, >600 kg/ha in year 2, and >500 kg/ha in year 3. DM yield at nil applied P was around 150 kg/ha (Bishop, unpublished data). Leaf and stem material is readily eaten by cattle, but no specific liveweight gain data for *A. villosa* are yet available. Experience at a range of sites indicates villose jointvetch nodulates effectively with native rhizobia, but it is recommended that jointvetch inoculum (CB2312) be used when sowing new sites.

Nutritive value

Kretschmer was ranked second highest of seven legumes for nitrogen content in the leaf from plant tips (3.71%) compared with Lee jointvetch (highest at 4.04%) and Seca stylo (lowest at 2.87%). Using acid detergent fibre (ADF) as an indicator of digestibility, Kretschmer had second highest digestibility (ADF 20.70%) compared with Lee (highest at 17.30%) and Seca (4th at 24.30%) (Jones *et al.* 2000).

Seed production

At Mackay, flowering of Reid and Kretschmer commenced on 5 and 14 April respectively (Bishop *et al*. 1988) compared with 15 March and 10 April at Gympie (B.G. Cook, unpublished data). The difference in flowering time in Reid between the two centres is more likely the result of juvenility at Mackay, rather than the day length difference between the two sites. This is supported by flowering data from seed crops at Walkamin Research Station, North Queensland, where first flowers were recorded on 27 March and 10 April respectively.

A. villosa exhibits two types of dehiscence - one where the arcuate suture separates at maturity, dropping the seed, and the other similar to that of *A. americana* where the pod breaks into segments, the seed being retained within the segment. The latter is more easily commercially harvested. Reid and Kretschmer exhibit the first type, but a combination of direct and suction harvesting can produce seed yields approaching 1t/ha (Bishop et al., 1997). Commercial yields of this order have been achieved using this procedure (John Rains, personal communication).

Preliminary herbicide trials indicate *A. villosa* is relatively tolerant of 2, 4-D but not as tolerant as Glenn and Lee jointvetch. Reid and Kretschmer seedlings were killed by acifluorfen (Blazer® at 2L/ha), fluoroxypyr (Starane® at 750ml/ha) and metsulfuron (Ally® or Brushoff® at 7.5g/ha) (D.S. Loch, personal communication).

Disease

A. villosa is affected by powdery mildew in the autumn when growth slows although this is less of a problem in well-grazed stands. Reid and Kretschmer are less affected than is Glenn jointvetch. In seed crops *Sclerotinia-Botrytis* sometimes causes death of stems necessitating spraying with fungicides (J.M. Hopkinson, personal communication).

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Appendix 12.5 Case study on Villomix (*Aeschynomene villosa* cvv. Reid and Kretschmer)

Experience with Villomix in sown pastures at 'Glensfield', Blue Mountain Road 15 km SW of Sarina (written April, 2001 by owner John Cox).

The DPI conducted some legume evaluation trials on Glensfield over a number of years and one of the species tested and grown successfully was the villosa group. As a result of seeing this species growing in my conditions I decided to include some in my future pasture improvements.

Seed sown

I planted 20 kg of Villomix in 1999 to ascertain its suitability to my pasture program. Results to date are very encouraging. The seed was not sown separately, it was included in a "Shot Gun" mixture of grasses (Callide rhodes grass, Kaz, Humidicola, HiGane, Floren) and legumes (Verano, Wynn, Seca, Siratro). The actual rate of Villomix seed applied was in order of 1 kg per 3 acres. Total area seeded approx. 300 acres with 325 kg of grass seed and 210 kg of legume seed all mixed together. Ground was ploughed twice and seeded using a fertiliser spreader.

Results

It is still early days yet, but indications are the Villomix has performed very well. Its germination rate was very good, as not a lot of seed was used yet the paddocks are covered with it. The cattle are certainly eating it along with other pastures in the paddock. It has a lot of bulk, forms a sort of clumpy mat, has long runners which don't node down but which cover large areas of ground. Although a different legume, it reminds me a lot of Wynn cassia having a lot of same characteristics including the way it grows and spreads. It looks as though it might be more palatable than Wynn. It appears to grow in most soil types although best results are occurring in the sandy loamy soils, not the heavier soils.

Conclusions

I will continue to monitor the stands of Villomix to ascertain its survival rate (cattle don't seem to be flogging it out which does occur with a lot of grasses), its continued palatability, how it performs in the winter months particularly with frosts and how it survives in drier times (we've had pretty good seasons since it was planted). Overall it appears to be a very welcome addition to the range and variety of legumes we now have at our disposal and I will certainly continue using Villomix in my pasture programs.

Appendix 12.6 *Aeschynomene brasiliana* (CPI 92519) - Description and Performance Statement

Aeschynomene brasiliana CPI 92519 has been highlighted in several evaluation projects as a promising legume for drier environments (Bishop and Hilder 1996). After 6 years evaluation in the Backup Legumes for Stylos project CPI 92519 is characterised as the legume closest to *Stylosanthes scabra* cvv Seca and Siran for adaptation to harsh conditions (Bishop 1998). However due to doubts about its palatability to cattle at some evaluation sites, and lack of comparative liveweight gain data, it was recommended that *A. brasiliana* CPI 92519 be taken off pre-release. Based on its performance in the BULS project this accession should be noted for possible future grazing evaluation trials, if and when an alternative to *S. scabra* cultivars is required. It was withdrawn from pre-release by the QHPLC in August 1998.

Origin

Aeschynomene brasiliana (Poir.) DC (CPI 92519)

Aeschynomene brasiliana CPI 92519 is native to central America between the Tropic of Cancer and the Tropic of Capricorn, closely approximating 24ºN and 24ºS. It mainly grows in bushland, savannas and open pine-oak woods at elevation of up to 3000 m. CPI 92519 was collected by Bob Reid (CIAT 8253) SW CAICO, RIO GRANDE DO NORTE, BRAZIL (rainfall 50 mm?, altitude 160 m, latitude 6ºS) growing in Caatinga scrub. The Australian collection comprises 10 accessions of *A. brasiliana* (Bishop *et al.* 1988) with CPI 92519 in a group of its own. Another accession CPI 93592 was included in some of the early comparative evaluation sites but was subsequently withdrawn on the grounds of stickiness of its foliage, early flowering and lack of palatability at some sites.

Morphological description

A. brasiliana is described by Rudd (1955) as follows:

Prostrate or decumbent herb; stems to about 1 m long, glandular-hispidulous and also crisp-pubescent; stipules ovate, acuminate, 3-4 mm long, about 1 mm wide at base, glandular-hispidulous, ciliolate; petiole and rachis with indument like the stem; leaves 2-3 cm long, 8-22-foliolate; leaflets obovate-elliptic to oblong, 5-15 mm long, 3-8 mm wide, obtuse, mucronulate, ciliate-denticulate, the upper surface sparsely pubescent or sometimes glabrous, the lower surface sparsely pubescent, reticulate; inflorescences usually 2-4 times the length of the subtending leaf, 1-8 flowered, the pedicels and peduncles pubescent like the stem; bracts broadly ovate, acute, 1-2 mm long, 1-1.5 mm wide, hispidulous; bracteoles ovate, acute, 2-2.5 mm long, about 1 mm wide; flowers 5-8 mm long; calyx 1.5-3 mm long, bispidulous, ciliolate; petals yellow; standard about 6 mm long, the claw 1-1.5 mm long, the blade suborbiculate, about 5 mm in diameter, pubescent on the outer face, retuse; winds and keel about as long as the standard, the wing blades about 2 mm wide, the keel blades 1.5 mm wide; stamens about 6 mm long; legume 2-5-articulate, the stipe 3-5 mm long, hispid, rarely subglabrous, the articles 2.5-3 mm long, 2-3 mm wide, moderately crisp-pubescent and also glandular hispidulous, occasionally 1 or more articles subglabrous; seeds about 2 mm long, 1-1.5 mm wide, dark brown.

CPI 92519 has a strong perennial crown with stems, growing from buds at or below ground level, trailing 1 to 2 m long. In the presence of companion grasses these stems can trail through and over the pasture canopy. Accessions in this species are early flowering (mid to late March) with CPI 92519 about 7-10 days later than CPI 93592 at Mackay (Bishop *et al.*). There are 204,000 and 303,000 seeds/kg in the respective lines. CPI 92519 has a gametic chromosome number of 10 (n=10) (Bielig 1997).

Agronomic characters

A. brasiliana CPI 92519 is well adapted to harsh conditions (low and variable rainfall and infertile sandy surfaced duplex soils) with adaptation next best to Seca stylo in the Backup Legumes for Stylos (BULS) project (Bishop 1998). Persistence over 6 years at a range of sites is close to that for Seca stylo (Table 12.3.1). Although the population of Wynn cassia was higher than CPI 92519, the performance rating for Wynn at most of these sites was lower than for CPI 92519.

After five years CPI 92519 had higher soil seed reserves than Seca at “Granite Vale”, St Lawrence (305 vs 102 seeds/m^2), “Glensfield”, Eton Range, via Mackay (3716 vs 458) and “Swans Lagoon”, Ayr (1629 vs 509).

A lack of palatability to stock, indicated at a number of the BULS project sites, is the main reason that CPI 92519 was not recommended for release. Cattle do eat this legume but it is sometimes not sought in the summer growing season. However where cattle have grazed it over the winter those same cattle do graze it moderately well over the following summer (Table 12.3.2).

During the summer growing season leaf and stem material becomes quite sticky and this stickiness is somewhat of an impediment to direct header harvesting of a seed crop. However with follow-up suction harvesting reasonable seed yields have been achieved (Table 12.3.3).

Preliminary herbicide trials at Gympie indicate that unlike *A. americana* material *A. brasiliana* CPI 92519 is susceptible to the commonly used hormone herbicides (2,4-D; 2,4-DB and MCPA) as well as to metsulfuron-methyl (Brush-Off), fluroxypyr (Starane 200) and dicamba (Banvel 200). Only bentazone (Basagran) is safe for controlling grass weeds in *A. brasiliana* seed crops.

At Nebo, “Swans Lagoon” Ayr, “Braceborough” Charters Towers and at Mt Garnet CPI 92519 dropped its leaf in the dry season. Steers on the “Swans Lagoon” site displayed an ability to “lick up” this leaf resulting in windrows of dry stem material following winter grazing of summer grown legume material of about 4000/kg/ha drymatter.

Measurements of leaf and stem forage quality (nitrogen, phosphorus and acid detergent fibre) and leaf/stem ratio for growing tips of CPI 92519 was slightly above or equal to that of Seca and Wynn but considerably below that of *A. americana/villosa* cultivars (Jones *et al*. 2000).

Disease

Apart from spraying with fungicides for control of Sclerotinia-Botrytis in seed crops (Bishop 1996) no disease problems have been noted during the 6 years evaluation in the BULS project.

A lack of any liveweight gain data from CPI 92519, indications of possible unpalatability to stock plus its wide adaptation and high soil seed reserves, resulted in the recommendation that it not be released as a cultivar. However this is a legume with many valuable attributes and should be held in storage for any future role that may develop for such a well-adapted legume.

Under Graduate and Post Graduate projects on response to phosphorus and palatability to stock would provide basic data to assist future decision making on its potential as a grazing legume.

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Rudd, VE (1955) American species of *Aeschynomene*. *US National Herbarium* **32:**1-72 (US National Museum, Smithsonian Institution, Washington, DC).

Table 12.3.1. Legume Counts (plants/m^{-2}) in the 4th and 6th years and at six Series 1 BULS evaluation sites

	Date Sown	26-Nov-92		3-Dec-92		7-Jan-93		27-Jan-93		4-Dec-92		10-Feb-93	
		Sarina *Glensfield*		St. Lawrence *Granite Vale*		Ayr *Swan's Lagoon*		Gympie *Sexton*		Gayndah *Brian Pastures*		Duaringa# *Sorrell Hills*	(Yield Rating)
Species	**Acc./Cv.**	Year 4 19-Mar-96	Year 6 11-Mar-98	Year 4 12-Jun-96	Year 6 15-Apr-98	Year 4 9-Feb-96	Year 6 18-Mar-98	Year 4 17-Apr-96	Year 6 20-May-98	Year 4 18-Apr-96	Year 6 22-May-98	Year 3 10-Oct-95	Year 5 May-97
A. brasiliana	**92519**	**23**	**9**	**10**	**9**	**11**	**16**	**0.2**	**0.4**	**3**	**1**	**4**	**6**
A. brasiliana	93592	*	*	*	*	*	*	9	26	8	9	-	-
C. rotundifolia	85836	19	32	5	2	0		9	27	2	7	1	3
C. rotundifolia	86172	25	33	0	0	18	190	4	12	16	16	0	2
C. rotundifolia	Wynn	52	42	1	18	38	42	6	14	7	14	4	4
S. hamata	Verano	30	12	44	20	89	41	10	11	-	-	10	5
S. scabra	**Seca**	**18**	**10**	**30**	**9**	**30**	**41**	**16**	**27**	**-**	**-**	**14**	**8**

\# sown 1 year later than other sites

Legume Dry Matter Yield (kg/ha) at end of 4th growing season at the above six sites

		19-Mar-96	**12-June-96**	**20-April-96**	**17-Apr-96**	**18-Apr-96**	**10-Oct-95**
A. brasiliana	**92519**	**1144**	**300**	**2000**	**0**	**212**	**293**
A. brasiliana	93592	*	*	*	91	1007	*
C. rotundifolia	85836	1191	0	0	174	254	12
C. rotundifolia	86172	2297	0	1500	76	2537	0
C. rotundifolia	Wynn	2147	0	1600	59	885	216
S. hamata	Verano	381	300	1000	77	-	460
S. scabra	**Seca**	**1511**	**600**	**4000**	**3174**	**-**	**570**

* = sprayed out

Table 12.3.2. Grass and Legume drymatter yield (kg/ha) for ungrazed (cages) and grazed pasture at "Glensfield", Eton Range via Sarina (cages erected December 1997, yield recorded April 1998).

Treatment	Rep I	Rep II
***A. brasiliana* 92519**		
Ungrazed		
Legume	542	74
Grass*	7838	10811
% legume	6.9%	0.7%
Grazed		
Legume	169	60
Grass	3445	2680
% legume	4.9%	2.2%

* Rep I mainly native grasses, Rep II Bisset creeping bluegrass

Table 12.3.3. Record of seed production for *Aeschynomene brasiliana* at Walkamin RS (yield in kg/ha pure seed). "1st flr" records date at which flowering was first noted. "Harv." is date of harvest (if more than one, then the first).

Species	Accession	Year	Dates		Area	Prodn	Yield
			1st flr	Harv	(m^2)	(kg)	(kg/ha)
A. brasiliana	92519	1991	L/4	28/10	2720	98.1	361 +sb
	92519	1992	12/8	na	2720	210.2	773 rb+s
	93592	1987	M/3	7/8	760	31.0	404 b
	93592	1988	9/3	18/5	690	46.0	615 rb

b = Botrytis-Sclerotinia; l = late; r = ratoon crop; m = mid; +s = both headed and suctioned

Appendix 12.7 Project Publications, reports and field day handouts

1. Journal papers

Bielig, Leone M. (1997) Chromosome numbers in the forage legume genus *Aeschynomene* L. Sabrao-Journal **29(1):** 33-39.

Bishop, H.G. and Cook, B.G. (2001) Registration of Australian Herbage Plant Cultivars, *Aeschynomene villosa* Poir. (villose jointvetch) cvv. Reid and Kretschmer. Australian Journal of Experimental Agriculture, **41:** 579-580.

2. Conference poster papers

Bishop, H.G. (1994). Finding backup legumes for stylos. Australian Rangeland Society 8th Biennial Conference, working papers p 175-176, Katherine, NT, June 21-23, 1994.

Bishop, H.G., Bushell, J.J. and Hilder, T.B. (1996). Back-up legumes for stylos. Proceedings Fifth Tropical Pasture Conference, Atherton, Q'land, June 1995. In *Tropical Grasslands*, **30:**153.

Bishop, H.G., Cook, B.G., English, B.H., Bushell, J.J. and Hilder, T.B (1997). More *Aeschynomene* pasture legumes for the Tropics and Sub-tropics. Proceedings of XVIII International Grassland Congress, Volume 1, p 1-1, Canada, June 1997.

Bishop, H.G., Hilder, T.B. and Bushell, J.J. (1997). Pasture yield and animal performance from *Aeschynomene americana* cultivars Glenn and Lee. Proceedings of XVIII International Grassland Congress, Vol 1 Canada, June 1997.

3. Reports

Bishop, H.G. (1996). Interim final report on project DAQ.083, Backup legumes for stylos. Report to MRC, October 1996

Bishop, H.G and Hilder, T.B. (1996). *Aeschynomene* accessions evaluated in COPE plantings; in Development of new legumes and grasses for the cattle industry of Northern Australia, Final Report of MRC Projects CS 054/185 and DAQ 053/081 (compilers B.C Pengelly and I.B. Staples). Published by CSIRO and DPI, c/- CSIRO Cunningham Lab., St Lucia, Q 4067, p 155-165.

Report to DPI by Leone M. Bielig, Dept of Botany and Tropical Agriculture, James Cook University. "Chromosome numbers in the legume *Aeschynomene* L."

Report to QHPLC by H.G. Bishop and B.G. Cook (6 September 1995). "Proposal for release of *Aeschynomene villosa* CPI 91209 and 93621".

Cook, B. and Bishop, H. New 1995 pasture releases – Reid and Kretschmer villose jointvetch MRC/NAP news, Issue 2 Autumn 1996.

Villomix fact sheet, prepared for MRC Emerald Meat Profit Day, April 7, 1998.

4. Field days and pasture walks (handouts)

"Wadeleigh" and "Bethome", Miriam Vale Rural Science and Landcare Society inspected the adaptation sites on 4 May 1994 (100 people) and 1 May 1996 (50 people) as part of half day district tours. Also attended their AGM field meeting on 6 December 1996 and visited evaluation sites on 7 December 1996 with 3 producers and John Rains of Southedge Seeds, Mareeba.

"Granite Vale", St Lawrence. Inspected and discussed with the Marlborough Landcare group (30 people), 17 May 1995.

"Sugarbag", Mt Garnet. Grazing evaluation inspected and discussed by 16 people from 7 properties following a "Best Practice" group meeting on 14 March 1996.

"Sugarbag", Mt Garnet. Grazing evaluation of *A. brasiliana* CPI 92519 inspected and discussed with 60 people on the Atherton Tropical Grassland Conference Field Trip on 29 June 1996.

"Tedlands", Mackay. Phosphorus response trial and Glenn/Lee grazing demonstration site inspected and discussed with 25 people on a DPI/Mackay Rural Production Society field day on 22 July 1994, and with 40 people on 8 June 1996.

Cultivars of *A. villosa* (Reid and Kretschmer) in 5 year old plots at “Tedlands” were inspected by John Rains, Southedge Seeds, Mareeba, and John Hughes, Crokers/IAMA, Mackay, August 1996.

“Glensfield”, Sarina. Inspected by COPE/BULS/LCS workshop participants in October 1993 and October 1995. Also various student and DPI groups.

“Glensfield”, Sarina. Inspected by NAPPEC (20 members) and two producers on April 3, 1998.

“Glensfield”, Sarina. Inspected by 12 local producers and CQ DPI Rural Services Co-ordinator (Bob Miles) and Director-General (Roly Nieper) on 19/2/97.

Katherine Research Station, NT. The BULS site was inspected by NAPPEC group in May 1994.