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Early stage evaluation of tropical legumes on clay soils at three sites in central and southern inland Queensland

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Abstract

Over 150 legume accessions were evaluated in small plots at three clay soil sites in south-central inland Queensland for use in either permanent or ley pastures. Legumes were either sown alone, or more usually with a companion grass, in 1992/93, 1993/94 and 1994/95 at sites near Mundubbera, Theodore and Emerald. Annual measurements of yield and density were made until May 1998. Summer/autumn rainfall was consistently below average in the three years of sowing.

Legumes best adapted for use in permanent pastures were *Desmanthus* spp. and *Stylosanthes seabrana*, both of which were released in the 1990s, and *Indigofera schimperi*. While *I. schimperi* showed outstanding persistence and productivity, it has not been released for commercial use, as it was often not adequately grazed. It has been eliminated from the trial sites. Some accessions of desmanthus showed some promise as alternatives to the three lines currently mixed together in the commercially released "Jaribu" desmanthus.

None of the annual species tested was superior to *Lablab purpureus* for use as an annual legume in leys, but *Macroptilium bracteatum* showed some promise as a short term perennial for use in ley pastures.

Introduction

Studies to evaluate the suitability of legumes for clay soils in southern inland Queensland have been reported by Conway *et al.* (1988), Rees *et al.* (1995), Jones and Rees (1997) and Jones (1998) and, for central inland Queensland, by Clem and Hall (1994). Results from row trials on two clay soil sites have also been reported by Pengelly and Staples (1996).

These trials were a response to the problem of declining fertility of clay soils on cropping land, due to a run-down in total and hence available soil N (Dalal *et al.* 1991), and to the declining productivity of permanent or long-term pastures. In the latter case, the problem is related to decreased available N rather than decreased total N (Myers and Robbins 1991), but the end result is a drop in pasture and animal production (Jones *et al.* 1995).

The promising legume species for permanent pastures, based on these and other earlier trials, were *Desmanthus* spp. and *Indigofera schimperi.* This led to the release of "Jaribu" desmanthus, a composite of three different cultivars (Marc, Bayamo and Uman).

Commencing in 1992, a project on legumes for clay soils was initiated at three levels. Firstly, on-farm and research station demonstrations and trials were commenced to document the effect of the recently released desmanthus on pasture and animal production (R.L. Clem, unpublished data). Studies were also undertaken on desmanthus establishment (Brandon and Jones 1998), nodulation (e.g., Brandon *et al.* 1998), nutrition (e.g., Spies *et al.* 1998) and management (Jones and Brandon 1998). Secondly, some 15 legume accessions that previously showed promise for use in either ley or permanent pastures were established at 11 "on-farm" sites (M.J. Conway, unpublished data). Thirdly, a wider range of legume accessions was evaluated in small plots at three sites. The results from screening of 17 accessions of cool season annual *Medicago* spp. have been reported elsewhere (Conway *et al.* 2000). This publication reports the results from the early stage evaluation of a wider range of tropical legumes.

Materials and Methods

Sites and sowing procedures

One hundred and fifty-two legumes were sown over three years (1992-1995) on clay soils at three research stations, near Theodore and Emerald in Central Queensland and near Mundubbera in Southern Queensland. Details of the experimental sites are given in Table 1. Usually the same accessions were planted at each site in each year, although there were rare instances of where substitutions were required because of limiting seed supplies. About 50-60 accessions were sown at each site in each year, with some accessions being sown in every year, as listed in Table 2. The *Desmanthus* species listed as *D. leptophyllus* (e.g., cv. Bayamo) and *D. pubescens* (e.g., cv. Uman) were originally sown as *D. virgatus* in 1993-1995. Accessions planted in the first year comprised more perennial species whereas sowings in the third year included more annual or short-term perennial species and also more native Australian legumes.

Table 1. Some long term climatic and soil data of the three experimental sites.

Attribute	Site		
	Mundubbera	Theodore	Emerald
Site			
Location	Narayen Res. Stn.	Brigalow Res. Stn	Emerald Res. Stn.
Latitude S	27° 21'	24°50'	23°34'
Longitude E	152° 53'	149°46'	148°11'
Climate			
Av. annual rainfall (mm)	715	670	620
December maximum (°C)	32.0	33.0	34.4
July minimum (°C)	6.0	6.3	7.3
Soils (0-10 cm)			
pH (1:5 H_2O)	6.5	8.1	7.3
EC (1:5 H_2O)	0.14	0.19	0.06
Organic C (%)	3.3	1.5	1.2
Available P (bicarbonate ext)	62	14	8
Soil (40-50 cm)			
pH (1:5 H_2O)	8.1	8.4	7.7
EC (1:5 H_2O)	0.22	0.69	0.17
Soil type			
Great soil group	cracking clay	black earth	black earth
Northcote (1977) class	Gn3.13	Ug5.16	Ug5.12

Table 2. Species, accessions and rhizobia strains (Rh) used on legumes sown at Narayen Research Station near Mundubbera (M), Brigalow Research Station near Theodore (T) and Emerald Research Station (E) in 1992/93, 1993/94 and 1994/95. Within each sowing a dash indicates failure to adequately establish, a rating of 1 indicates no promise in that sowing, a rating of 3 indicates some promise (based only on productivity and, where appropriate, persistence) and a rating of 2 indicates an intermediate status. A dot indicates "not sown"..

Genus	Species	Accession	(Rh)	92/93		93/94			94/95		
				M	E	M	T	E	M	T	E
Aeschynomene	*americana*	Lee	2312	1	1	1	-	1	.	.	.
Aeschynomene	*americana*	91235	2312	1	-	.	.	.	.	.	.
Aeschynomene	*americana*	93624	2312	1	1	.	.	.	.	.	.
Aeschynomene	*villosa*	37235	2312	1	1	.	.	.	.	.	.
Aeschynomene	*villosa*	Reid	2312	1	1	1	1	1	.	.	.
Alysicarpus	*longifolius*	94490	1024	.	.	.	.	.	1	1	.
Alysicarpus	*monilifer*	52343	756	1	1	1	1	1	.	.	.
Alysicarpus	*rugosus*	51655	756/1024	.	.	.	.	.	1	1	2
Alysicarpus	*rugosus*	69487	756/1024	.	.	.	.	.	1	1	1
Alysicarpus	*rugosus*	52351	756	1	1	.	.	.	.	.	.
Alysicarpus	*rugosus*	84470	756/1024			.	.	.	1	1	.
Alysicarpus	*rugosus*	94489	756	1	2	.	.	.	.	.	.
Arachis	*paraguariensis*	91419	756	-	1	.	.	.	.	.	.
Arachis	*triseminata*	91423	756	-	.	.	.	.	.	.	.
Arachis	sp.	58109	756	-	-	.	.	.	.	.	.
Arachis	sp.	58121	756	-	-	.	.	.	1	.	.
Atylosia	*scarabaeoides*	52372	756	.	.	.	.	.	1	2	1
Cajanus	*cajan*	Jay	1024	1	1	.	.	.	1	1	1
Cajanus	*cajan*	Royes	1024	1	2	.	.	.	.	.	.
Cajanus	*cajan*	Quest	1024	.	.	.	.	.	-	-	1
Centrosema	*brasilianum*	55698	2949	.	.	.	.	.	1	1	1
Centrosema	*schottii*	65967	1923	.	.	.	.	.	1	2	1
Clitoria	*ternatea*	Milgarra	756	1	3	1	2	2	1	2	2
Desmanthus	*illinoensis*	Sabine	3126	.	.	1	-	1	.	.	.
Desmanthus	*bicornutus*	90857	3126	.	.	.	.	.	2	2	3
Desmanthus	*leptophyllus*	Bayamo	1397/312	3	2	3	2	1	2	1	2
Desmanthus	*pubescens*	Uman	1397/312	2	1	2	2	2	2	-	1
Desmanthus	*virgatus*	Marc	1397/312	3	2	3	2	2	3	1	2
Desmanthus	*leptophyllus*	TQ90	3126	.	.	3	3	1	.	.	.
Desmanthus	*pernambucanus*	40071	3126	.	.	3	3	1	.	.	.
Desmanthus	*leptophyllus*	55719	3126	.	.	3	3	1	2	2	2
Desmanthus	*covillei*	84972	3126	.	.	.	.	.	2	2	2
Desmanthus	*virgatus*	85172	3126	.	.	.	.	.	2	2	3
Desmanthus	*virgatus*	85177	3126	.	.	.	.	.	2	2	2
Desmanthus	*virgatus*	85178	1397/312	2	2	2	1	1			
Desmanthus	*virgatus*	89197	3126	.	.	.	.	.	2	2	2
Desmanthus	*virgatus*	90750	3126	.	.	.	.	.	3	2	2
Desmodium	*dichotomum*	47186	627	1	2	2	3	1	1	1	2
Desmodium	*scorpiurus*	89707	627	.	.	.	.	.	1	.	.
Desmodium	*setigerum*	52431	627	.	.	.	.	.	-	-	-
Galactia	*spp.*	67646	756	.	.	.	.	.	1	1	1
Galactia	*spp.*	82294	756/1024	.	.	1	-	-	.	.	.
Galactia	*striata*	49740	756	.	.	.	.	.	1	2	1
Glycine	*latifolia*	CQ3368	1024	2	2	2	1	2	1	2	1
Glycine	*latifolia*	line 6	1024	.	.	.	.	.	1	.	1
Heylandia	*latebrosa*	31951		.	.	.	.	.	1	.	.
Indigofera	*schimperi*	16055	1024/101	.	.	3	3	3	3	3	3
Indigofera	*schimperi*	52621	1024/101	3	3	.	.	.	3	3	3
Indigofera	*schimperi*	69495	1024/101	3	3	3	3	3	.	.	.
Indigofera	*schimperi*	73608	1024/101	3	2	3	3	2	3	3	3
Lablab	*purpureus*	Highworth	756/1024	3	3	2	3	2	3	2	3
Lablab	*purpureus*	24973	756/1024	.	1	2	1	1	.	.	.
Lablab	*purpureus*	28701	756/1024	1	1	1	1	1	.	.	.
Lablab	*purpureus*	51564	756/1024	2	1	2	1	1	.	.	.
Lablab	*purpureus*	52437	1024	.	.	2	1	1	.	.	.
Macroptilium	*atropurpureum*	Aztec	756	.	.	.	.	.	3	3	2
Macroptilium	*atropurpureum*	Siratro	756/1024	3	2	3	2	2	.	.	.
Macroptilium	*atropurpureum*	84989	756/1024	.	.	2	1	2	2	3	3
Macroptilium	*atropurpureum*	87506	756	.	.	.	.	.		3	1
Macroptilium	*atropurpureum*	90338	756	3	3	.	.	.		3	2
Macroptilium	*atropurpureum*	90748	756	.	.	.	.	.	2	2	2

Genus	Species	Accession	Rh	92/93 M	92/93 E	93/94 M	93/94 T	93/94 E	94/95 M	94/95 T	94/95 E
Macroptilium	*atropurpureum*	90776	756	.	.	.	.	.	2	3	2
Macroptilium	*atropurpureum*	90844	756/1024	3	2	2	1	1	.	.	.
Macroptilium	*atropurpureum*	90905	756	.	.	.	.	.	3	3	2
Macroptilium	*bracteatum*	27404	756/1024	3	2	2	2	1	2	2	2
Macroptilium	*bracteatum*	55755	756/1024	.	.	2	1	1	.	.	.
Macroptilium	*bracteatum*	55758	1024	.	.	.	.	.	1	2	2
Macroptilium	*bracteatum*	55769	1024	.	.	.	.	.	3	3	2
Macroptilium	*bracteatum*	81724	1024	.	.	.	.	.	.	-	2
Macroptilium	*gracile*	84999	756	.	.	.	.	.	.	2	.
Macroptilium	*gracile*	93084	756/1024	.	.	2	1	1	2	.	.
Macroptilium	*lathyroides*	Murray	756/1024	.	.	3	2	2	2	3	2
Macroptilium	*lathyroides*	49771	756/1024	.	.	3	3	1	3	3	2
Macroptilium	*martii*	49780	1717	.	.	.	.	.	2	2	2
Macroptilium	*psammodes*	39098	756	1	1	.	.	.	.	.	.
Macrotyloma	*axillare*	52469	1024	.	.	1	1	-	.	.	.
Macrotyloma	*daltonii*	60303	756/1024	2	1	2	1	1	.	.	.
Macrotyloma	*uniflorum*	Leichardt	1024	.	.	1	1	1	.	.	.
Medicago	*sativa*	Trifecta	3061/A1	2	1	2	1	-	1	-	-
Neptunia	*dimorphantha*	CQ1839	3126	.	.	.	.	.	1	1	2
Neptunia	*gracilis*	CQ1849	3126	.	.	.	.	.	2	2	3
Neptunia	*gracilis*	CQ3226	3126	.	.	.	.	.	2	2	2
Neptunia	*gracilis*	CQ3227	3126	.	.	.	.	.	2	2	2
Neptunia	*monosperma*	CQ2082	3126	.	.	.	.	.	1	1	1
Neptunia	*plena*	46380	3126	.	.	.	.	.	1	2	1
Neptunia	*sp.*	CQ1842	3126	.	.	.	.	.	1	2	2
Psoralea	*spp.*	CQ2973	2056/205	.	.	2	1	1	.	.	.
Psoralea	*tenax*	CN55	2056/205	.	.	2	1	1	.	.	.
Rhynchosia	*minima*	52704	756	.	.	.	.	.	1	1	1
Rhynchosia	*minima*	81386	756/1024	2	1	2	2	2	.	.	.
Rhynchosia	*minima*	60335	756	.	.	.	.	.	2	2	1
Rhynchosia	*sublobata*	52727	756	.	.	.	1	2	1	1	1
Rhynchosia	*verdcourtii*	34133	756	.	.	.	.	.	.	3	.
Rhynchosia	*verdcourtii*	52724	756/1024	.	.	2	2	.	.	.	.
Stylosanthes	*seabrana*	92828b	2126/305	.	.	.	.	.	3	2	3
Stylosanthes	*seabrana*	104710	2126/315	3	3	.	.	.	.	.	.
Stylosanthes	*seabrana*	105546b	2126/315	3	3	.	.	.	.	.	.
Stylosanthes	*seabrana*	110343	2126/315	3	3	.	.	.	.	.	.
Stylosanthes	*seabrana*	110361	2126/315	3	3	3	3	2	3	2	2
Stylosanthes	*seabrana*	110370b	2126/315	3	2		.	.	.	.	.
Stylosanthes	*seabrana*	110370c	2126/315	.	.	3	3	2	.	.	.
Stylosanthes	*seabrana*	110372	2126/315	3	3	.	.	.	.	.	.
Stylosanthes	*seabrana*	115994	2126/315	.	.	3	3	2	3	2	2
Stylosanthes	*seabrana*	115995	2126/315	3	3	.	.	.	3	2	2
Stylosanthes	*scabra*	Seca	2126/315	2	1	2	-	1	.	.	.
Stylosanthes	*sympodialis*	67704	2126/315	.	.	2	.	1	.	.	.
Teramnus	*labialis*	60371	756	-	1	.	.	.	.	.	.
Vigna	*decipiens*	52835b	1015	.	.	.	.	.	1	2	1
Vigna	*decipiens*	52839	1015	.	.	.	.	.	3	3	1
Vigna	*decipiens*	73602	1015	.	.	.	.	.	1	1	1
Vigna	*luteola*	Dalrymple	1015	.	.	2	1	1	.	.	.
Vigna	*oblongifolia*	28763	1015	.	.	.	.	.	1	1	1
Vigna	*oblongifolia*	43799	1015	.	.	.	.	.	1	1	.
Vigna	*oblongifolia*	57524	1015	.	.	.	.	.	1	1	1
Vigna	*oblongifolia*	60430	1015	.	.	3	1	1	.	1	.
Vigna	*oblongifolia*	60433	1015	.	.	.	.	.	2	3	1
Vigna	*trilobata*	13671	1015	1	3	2	2	2	2	3	2
Vigna	*vexillata*	CQ3044	1015	.	.	.	.	.	1	2	.
Vigna	*vexillata*	15463	1015	.	.	.	.	.	1	1	1
Vigna	*vexillata*	43799	1015	.	.	.	.	.	1	1	-
Vigna	*vexillata*	69030	1015	.	.	.	.	.	1	1	1
Vigna	*unguiculata*	R.caloona	1015	.	..	3	2	2	.	.	.

All accession numbers are CPI (Commonwealth Plant Introduction) numbers unless otherwise indicated.

All *Rhizobium*/*Bradyrhizobium* strains are CB strains.

In the first two sowings, 12 selected legumes were sown with and without one or two perennial grasses to ascertain how legume yields and persistence were affected by the associated grasses. The remaining accessions were all sown with a grass. In the final sowings (1994/95), all accessions were sown with a grass and none without grass. Details of the grass species used are given in Table 3. Three replicates were used throughout. Plots in the first two sowings were laid out in a split plot design with grass treatments as the main plot. Plots in the third sowing were in a randomised block layout.

Table 3. Number of legume accessions associated with various grass treatments used in small sward studies at three sites. Letters in brackets indicate that accessions were sown without grass (nil) or with one or more companion grass species (Cc = *Cenchrus ciliaris* [buffel grass], Cg = *Chloris gayana* [rhodes grass], Si = *Setaria incrassata* [purple pigeon grass], Ds= *Dichanthium sericeum* [queensland bluegrass]).

Year	Grass treatment	Number of accessions in each treatment at each site		
		Mundubbera	Theodore	Emerald
1992/93	1 grass	36 (Cc)	36 (Cc)	36 (Si)
	2 grasses & no grass	12 (Cc,Cg & nil)	12 (Cc, Cg & nil)	12 (Cc, Si & nil)
1993/94	1 grass	24 (Ds)	24 (Ds)	24 (Ds)
	1 grass & no grass	12 (Ds and nil)	12 (Ds and nil)	12 (Ds and nil)
	no grass	12 (nil)	12 (nil)	12 (nil)
1994/95	1 grass	60 (Ds)	60 (Ds)	60 (Ds)

Legume seed was tested for germination, scarified if required to give 60-80% germination, and inoculated with the appropriate *Rhizobium/Bradyrhizobium* (Table 2) prior to sowing. Sowing rates were usually 5-8 kg/ha for small-medium sized seed but were increased for larger seed, up to 20 kg/ha for *Lablab purpureus*. Legume seed and the companion grass seed, sown at 2 kg/ha, was broadcast on to plots of 4 x 4 m laid out on a prepared seed-bed. After sowing, the plots were either rolled or lightly harrowed. Irrigation was used at Emerald to aid establishment in the 1992/1993 sowing.

Plot maintenance and measurements

All sowings at Mundubbera and Theodore were grazed at the end of autumn in the first year and then every two to five months in subsequent years depending on growth. Plots were not grazed for 2-3 months prior to measuring yield. There was no grazing at Emerald where plots were occasionally mown. In the establishment year, herbicide was used to control common (*Portulaca oleracea*) and black pigweed (*Trianthema portulacastrum*) at Mundubbera. The main weed at Theodore (*Sesbania cannabina*) was partially controlled by slashing in the year of establishment. The main invading species were *Urochloa panicoides* at Mundubbera, buffel grass (*Cenchrus ciliaris*) at Theodore, and Queensland bluegrass (*Dichanthium sericeum*) at Emerald.

Measurements of seedling density after sowing, annual plant density (excluding seedlings that emerged during that growing season) and annual end-of-season yield were made at each site, with observations of flowering, seed production, insect damage, etc. The last measurements were taken in 1998.

Survival of individual plants of 5 legume accessions in the 1992/93 sowing at Mundubbera, listed in Table 5, was measured by tagging 30 plants and recording their survival at approximately four-monthly intervals. This was expressed as their half-life over a four year period from spring 1993 to spring 1997, ignoring the first six months when conditions would have been more favourable due to sowing in a prepared seedbed.

The reserves of seed in the soil from 13 accessions in the 1993/94 sowing at Mundubbera were measured in May 1997 using the method outlined by Jones and Bunch (1988).

Results

Rainfall

In the first two years (1992/93 and 1993/94), two of the three years when trials were sown, summer rainfall was below the median value at all sites (Table 4). At Mundubbera, summer rainfall was below the median in all years. Autumn rainfall was mostly below the median in the first three years. Where it was not, the main rainfall events occurred in May, which was too late to be of any benefit to tropical legumes.

Table 4. Seasonal rainfall (mm) for summer (Dec, Jan, Feb), autumn (Mar Apr, May), winter (Jun Jul Aug) and spring (Sep, Oct, Nov) at three sites with corresponding long term median totals. **Bold** type indicates rainfall below the corresponding long-term median.

Site and Year	Summer	Autumn	Winter	Spring
Mundubbera				
1992				**126**
1993	**201**	**15**	**58**	**160**
1994	**230**	**108**	**21**	**83**
1995	**201**	**73**	**26**	377
1996	**188**	144	**35**	**142**
1997	**179**	132	**26**	195
1998	**254**	339		
median	281	128	90	149
Theodore				
1992				136
1993	**173**	**10**	**47**	171
1994	**179**	218	**30**	152
1995	293	236	**31**	200
1996	473	139	**44**	267
1997	392	202	**12**	221
1998	**194**	380	174	308
median	288	122	77	136
Emerald				
1992				**49**
1993	**171**	**21**	103	167
1994	**113**	400	**1**	**43**
1995	260	**73**	**34**	120
1996	363	159	**38**	216
1997	**194**	145	**12**	**100**
1998	**103**	166	181	376
median	257	114	70	112

Rainfall records were collected on the research stations. Mundubbera rainfall prior to 1996 was collected adjacent to the experimental site, but after that from 12 k away.

Effect of grass treatments

1992/93. At Mundubbera there was a good emergence of rhodes grass seedlings (20/m^2), but virtually all of these failed to develop secondary roots and died in the following dry conditions during autumn. The buffel grass strike was very poor (< 1/m^2) and so buffel grass had no effect on the legumes for at least three years.

In the last autumn yield sampling of this trial (1997), yield of the surviving legumes growing with buffel grass, excluding *I. schimperi*, were approximately half the yields of the same legume accessions growing without buffel grass. The autumn presentation yields of associated species were 5000kg/ha in the buffel grass treatment, 87% of this being buffel grass, and 1600 kg/ha of volunteer species in plots not sown to grass. *I. schimperi* yields were only reduced by some 30% in the presence of buffel grass. Yield of all grass (buffel and unsown) growing with *I. schimperi* CPI 52621 were only 850 kg/ha compared with the yields of *ca.* 5000 kg/ha for the remaining legume treatments.

The 1992/93 sowing at Theodore failed. While there was some emergence of purple pigeon grass at Emerald it remained sparse and had no effect on legume yield, particularly as plots were colonised by queensland bluegrass.

As the grass treatments had negligible effect until 1997 at Mundubbera, and no effect at Emerald, the legume density and yield data in Tables 6 and 7 have been pooled over grass treatments.

1993/94. The seedling emergence of bluegrass at Mundubbera was only 4 seedlings/m^2 and although it slowly thickened up, it had no effect on legume growth until 1997. In autumn 1997, bluegrass, when sown with species other than indigofera, yielded approximately 2500 kg/ha compared with unsown species yields of 320 kg/ha in plots not sown to bluegrass. In this sampling, the yield of *I. schimperi* CPI 69495 was not affected by the bluegrass that yielded only 320 kg/ha when grown with indigofera. In contrast, the yields of the other 3 surviving legumes, out of the 12 legumes sown with and without bluegrass, were three times higher in plots without bluegrass.

Buffel grass was the dominant grass at Theodore prior to cultivation and seedling and emergence from the soil seed bank largely over-rode the effect of the sown grass treatments that had little effect on legume yield. Similarly, recruitment of bluegrass seedlings over-rode the effect of the grass treatments at Emerald.

Consequently, as for 1992/93, the results from the grass treatments at the three sites have been pooled in Tables 8-10.

1994/95. There was good emergence of bluegrass at Mundubbera (22 seedlings/m^2) and in this trial, where all legumes were sown with a grass, there was strong competition from the sown grass throughout and negligible weed growth except for some patches of pigweed in the establishment year. At the 1997 sampling the bluegrass presentation yield was approximately 4300 kg/ha.

There was good establishment of buffel grass at Theodore, and in June 1995, the end of the first summer, grass yielded about 3000 kg/ha, some 70% of this being buffel grass. The sown bluegrass was slower to thicken up at Emerald and only formed a dense stand at the end of the second year.

Legume establishment

Establishment was variable across sites and the 1992/93 sowing at Theodore failed. The patchy and often low establishment is largely attributed to the low rainfall. However, the average emergence of legumes was over 7 seedlings/m^2 at Munduberra in all years and at Theodore in 1993/94 and at Emerald in 1994/95. The emergence of the large seeded *Lablab purpureus* tended to be poor in all sowings and this could reflect inadequate coverage of the seed following surface sowing and shallow burial.

Recruitment

The only perennial legume species with appreciable seedling recruitment was *Stylosanthes seabrana*, where up to 200 seedlings/m^2 were recorded at Emerald in the first and second years after sowing in 1992/93. Appreciable seedling recruitment of *S. seabrana* was also regularly observed at Mundubbera and Theodore. Although most of these seedlings died, the recruitment usually compensated for death of older plants, even if there was no major increase in plant numbers with time. In some sowings, density of *S. seabrana* increased with time. Fewer seedlings of *Desmanthus* spp. were recorded, often only 1-2 seedlings/m^2, and even fewer seedlings of *I. schimperi*. Although there was some seedling recruitment of the annuals *Vigna trilobata, Macrotyloma daltonii* and *Desmodium dichotomum,* it never compensated for the death of original plants and yield of all these species were low or negligible in the second and subsequent years after planting. There was also seedling recruitment of the annual/short term perennial *Macroptilium lathyroides*, but it also failed to compensate for death of the original plants.

Survival of tagged plants at Mundubbera

I. schimperi CPI 52621 had by far the highest survival over the four year period, followed by *I. schimperi* CPI 73608 and *Glycine latifolia* cv. Capella, and then *D. virgatus* cv. Bayamo with *D. virgatus cv. Marc* having the poorest survival (Table 5).

Table 5. Survival (%) of tagged plants and their half life, calculated from October 1993 to October 1997, of *Desmanthus virgatus* cv Marc, *D. leptophyllus cv.* Bayamo, *Indigofera schimperi* CPI 52621 and CPI 73608, and *Glycine latifolia* (CQ3368, formerly known as cv. Capella) in the 1992/93 sowing at Mundubbera.

Date	Survival of original plants				
	Marc	Bayamo	CPI 52621	CPI 73608	CQ 3368
			(%)		
11/6/93	100	100	100	100	100
5/10/93	100	100	100	100	97
2/11/94	90	100	93	93	83
28/9/95	50	90	93	83	63
12/3/96	17	70	93	81	60
4/10/96	17	40	93	62	60
22/4/97	3	16	93	53	47
30/10/97	3	3	90	50	47
Half-life (months) [1]	9	11	502	45	44

[1] Half-life values are the number of months required for half the population to die, based on a linear regression of log density (Y axis) on time (X axis)

Density and yield data

Mundubbera 1992/93. Data from this sowing are presented in Table 6. The outstanding species in terms of persistence and productivity was *Indigofera schimperi*. The next highest yielding species in the last year of sampling (1997) were *Stylosanthes seabrana* and *Macroptilium atropurpureum*. Yields of *Desmanthus* spp. were relatively high for two to four years but then declined. The highest yielding accessions in the first year were Highworth lablab and *M. bracteatum* CPI 27404. *M.bracteatum* CPI 27404 had the second highest yield, after Bayamo desmanthus in the second year.

Theodore 1992/93. This sowing failed completely, primarily due to very low rainfall.

Emerald 1992/93. The highest yielding and most persistent species was *I. schimperi*, followed by *S. seabrana* and *Clitoria ternatea* cv. Milgarra (Table 7). The highest yielding accession in the year of sowing was Highworth lablab. Two accessions of *M. atropurpureum* yielded well in the second year and persisted to May 1998. None of the *Desmanthus* spp. accessions was outstanding, with cv. Marc being the most persistent.

Mundubbera 1993/94. The highest yielding accessions in the first year were *D. virgatus* CPI 55719 and both accessions of *M. lathyroides* (Table 8). The poor yield of Highworth lablab is attributed to very poor establishment (Table 8). In the second year the highest yields came from accessions of *Desmanthus* spp., *I. schimperi, M. atropurpureum, M. gracile, M. lathyroides* and *S. seabrana*. However by the end of the fourth season the highest yielding accessions by far were those of *I. schimperi*, followed by *S. seabrana*. There had been a substantial decline in the yields of *Desmanthus* spp. and *M. atropurpureum* between years 3 and 4.

In May 1997, the highest seed reserve was recorded in *D. virgatus* cv. Marc (11,000 seeds/m^2), followed by *Psoralea* spp. CN55 (1940 seeds/m^2), *I. schimperi* CPI 69495 (1520 seeds/m^2) and *D. pernambucanus* CPI 40071 (1100 seeds/m^2).

Theodore 1993/94. The highest yielding accessions in the establishment year were *Desmodium dichotomum*, Highworth lablab and *Macroptilium lathyroides* CPI 49771, followed by *M. lathyroides* cv. Murray (Table 9). In the second year the highest yields were from the three accessions of *I. schimperi* and two accessions of *Desmanthus* spp., especially CPI 55719 which had a higher plant density. *I. schimperi* was by far the highest yielding species in the second and third years with a much more stable plant density than any other species. Densities of all three *S. seabrana* accessions were initially poor but generally increased with time. This species was the second highest yielding, after *I. schimperi*, in the third and fourth year. *D. pernambucanus* CPI 40071 and *D. leptophyllus* TQ90 also persisted but legume yields were low.

Emerald 1993/94. There was reasonable establishment in the year of sowing, but growth was very poor and survival was poor into the second year. Species with the highest density in the last two years, *I. schimperi, S. seabrana* and *C. ternatea,* had only 1-2 plants/m^2. These were also the most productive species with yields of some 300-1700 kg/ha in 1997 and 1998, with the highest yields from *I. schimperi*. (Table 10)

Table 6. Plant density, yield in autumn and seed production (s = some seeding and S = heavy seeding in at least one year) of legumes planted near Mundubbera in 1992/93. Full names of species are given in Table 2.

Accession	Plant density						Yield					Seed-
	3/93	10/93	11/94	9/95	10/96	11/97	4/93	4/94	2/95	2/96	4/97	set
	(plants/m^2)						(kg/ha)					
Aes. amer. (91235)	11.7	0	0	0	0	0	70	0	0	0	0	s
Aes. amer. (93624)	13.3	1.7	0	0	0	0	78	0	0	0	0	s
Aes. amer. (Lee)	2.0	0	0	0	0	0	36	0	0	0	0	s
Aes. vill. (37235)	12.3	1.7	0	0	0	0	198	0	0	0	0	s
Aes. vill. (Reid)	3.3	0	0	0	0	0	61	0	0	0	0	s
Ali. moni. (52343)	3.0	1.0	0	0	0	0	41	0	0	0	0	s
Ali. rugo. (52351)	14.8	1.0	0.3	0	0	0	94	0	0	0	0	s
Ali. rugo. (94489)	27.0	0	0	0	0	0	64	0	0	0	0	s
Ara. burk. (58109)	0	0	0	0	0	0	0	0	0	0	0	-
Ara. para. (91419)	0	0	0	0	0	0	0	0	0	0	0	-
Ara. pusi. (91423)	0	0	0	0	0	0	0	0	0	0	0	-
Ara. spp. (58121)	0	0	0	0	0	0	0	0	0	0	0	-
Caj. caja. (Jay)	3.0	1.3	0.3	0	0	0	58	0	0	0	0	s
Caj. caja. (Royes)	0.3	0.3	0	0.	0	0	15	0	0	0	0	s
Cli. tern. (Milg.)	0.7	1.0	0	0	0	0	0	5	0	0	7	s
Des. lept. (Bayamo)	12.4	12.2	8.8	9.0	7.8	4.9	316	2677	528	27	53	S
Des. pube. (Uman)	2.0	1.7	1.7	1.0	1.3	0	75	158	111	71	33	s
Des. virg. (Marc)	8.3	9.6	7.9	4.8	1.9	3.1	339	525	250	0	11	S
Des. virg. (85178)	17.7	15.3	10.8	8.2	2.6	3.7	265	229	138	0	5	S
Desm. dich. (47186)	2.3	0	0	0	0	0	5	0	0	0	0	s
Gly. lati. (CQ3368)	2.0	2.0	1.0	2.0	0	2.3	17	5	18	0	5	s
Ind. schi. (52621)	8.0	3.7	5.0	8.0	4.7	7.7	78	302	559	1120	797	S
Ind. schi. (69495)	12.8	12.4	8.4	11.0	10.1	8.0	227	1221	1689	1348	505	S
Ind. schi. (73608)	10.3	18.7	9.3	9.7	4.3	3.0	187	319	773	160	120	S
Lab. purp. (28701)	4.0	0.7	0	0	0	0	111	0	0	0	0	s
Lab. purp. (51564)	2.2	0.6	0.9	0.1	0	0	231	37	0	0	0	s
Lab. purp. (H'worth)	3.8	0.8	0	0	0	0	1238	227	0	0	0	s
Mac. atro. (90338)	12.3	9.3	4.7	3.3	1.7	3.3	638	632	150	155	45	s
Mac. atro. (90844)	5.0	3.7	3.0	2.3	1.7	3.3	212	481	225	273	76	s
Mac. atro. (Siratro)	13.7	6.4	4.1	1.2	1.7	2.4	529	501	287	355	101	s
Mac. brac. (27404)	18.0	13.9	5.0	2.6	1.2	0.3	1322	2384	201	234	14	s
Mac. psam. (39098)	7.0	1.0	0.3	0	0	0	109	19	0	0	0	s
Macr. dalt. (60303)	3.4	0.7	0	0	0	0	313	0	0	0	0	s
Med. sati. (Trifecta)	23.0	24.7	4.3	0.7	0	0.7	54	390	0	0	0	-
Rhy. mini. (81386)	9.3	4.7	3.0	2.3	0.7	0	212	232	47	88	0	s
Sty. seab. (104710)	17.7	17.7	17.0	13.7	17.3	4.3	222	680	357	377	70	S
Sty. seab. (105546b)	8.0	14.0	8.7	10.3	10.0	7.3	112	512	339	553	149	S
Sty. seab. (110343)	16.0	27.7	15.7	48.0	15.0	4.7	275	621	306	265	125	S
Sty. seab. (110361)	42.3	42.3	31.0	35.0	13.0	9.3	674	1219	476	235	79	S
Sty. seab. (110372)	11.3	17.3	9.3	7.7	4.7	1.6	249	739	160	172	22	S
Sty. seab. (11370b)	10.0	12.7	7.3	14.0	7.7	8.0	268	651	134	97	68	S
Sty. seab. (115995)	11.7	13.0	7.7	7.0	2.7	3.0	222	969	243	133	32	S
Sty. scab. (Seca)	2.0	1.3	1.3	0.3	0	0.3	18	40	0	33	0	s
Ter. labi. (60371)	0.1	0	0	0	0	0	0	0	0	0	0	s
Vig. tril. (13671)	4.1	0	0	0	0	0	13	0	0	0	0	s

All accession numbers are CPI (Commonwealth Plant Introduction) numbers unless otherwise stated.
Complete species names for all accessions in Tables 6-13 are given in Table 2.

Table 7. Plant density, yield in autumn and seed production (s= some seeding and S = heavy seeding in at least one year) of legumes planted at the Emerald Research Station in 1992/93. Yields from 1997-1999 are on a 1-9 rating scale where 9 is the highest. Full species names are given in Table 2.

Accession	Plant density						Yield						Seed
	4/93	7/94	3/95	2/96	5/97	5/98	6/93	7/94	6/95	2/96	5/97	5/98	set
	(plants/m^2)						(kg/ha)	(kg/ha)	(kg/ha)	(kg/ha)	(1-9)	(1-9)	
Aes. amer. (91235)	0.3	0	0	0	0	0	0	0	0	0	0	0	-
Aes. amer. (93624)	2.3	0.7	0	0	0	0	16	26	0	0	0	0	s
Aes. amer. (Lee)	0.7	0	0	0	0	0	65	0	0	0	0	0	-
Aes. vill. (37235)	1.0	0	0	0	0	0	0	0	0	0	0	0	-
Aes. vill. (Reid)	1.0	2.0	0	0	0	0	0	27	0	0	0	0	-
Ali. moni. (52343)	7.0	4.3	0	0	0	0	53	29	0	0	0	0	s
Ali. rugo. (52351)	1.3	0.9	0	0	0	0	5	6	0	0	0	0	s
Ali. rugo. (94489)	2.7	0	0	0	0	0	274	0	0	0	0	0	s
Ara. burk. (58109)	0	0	0.3	0	0		0	0	0	0	0	0	-
Ara. para. (91419)	0	1.0	4.0	0.3	0.3	0.7	40	10	7	15	70	0.3	-
Ara. spp. (58121)	0	0	0	0	0	0	0	0	0	0	0	0	-
Caj. caja. (Jay)	4.3	0	0.3	0	0	0	78	0	0	0	0	0	s
Caj. caja. (Royes)	1.3	0	0	0	0	0	343	0	0	0	0	0	s
Cli. tern. (Milg.)	2.0	4.3	5.7	1.0	4.3	4.3	25	320	235	430	1000	4.7	s
Des. lepto. (Bayamo)	3.44	3.8	0.9	0.2	0.1	0	31	732	26	19	0	0	s
Des. pube. (Uman)	1.0	0	0	0	0	0	12	0	5	0	0	0	-
Des. virg. (Marc)	7.0	3.4	1.9	1.1	0.2	1.2	55	90	108	170	30	1.0	S
Des. virg. (85178)	11.78	6.4	2.3	1.0	1.1	2.6	177	100	10	30	0	1.6	s
Desm. dich.(47186)	8.7	0	0	0	0	0	292	24	6	0	0	0	S
Gly. lati. (CQ3368)	5.0	10.7	8.3	4.7	5.7	1.0	78	514	70	260	70	1.0	s
Ind. schi. (52621)	0.7	3.3	2.0	3.0	4.0	3.3	118	1442	1229	2560	2870	6.3	S
Ind. schi. (69495)	7.2	4.6	3.8	3.8	4.7	4.3	261	960	2221	4600	2720	6.4	S
Ind. schi. (73608)	0.7	2.0	1.0	1.7	3.0	1.2	373	1330	567	2530	930	3.0	S
Lab. purp. (24973)	3.3	0	0	0	0	0	0	0	0	0	0	0	-
Lab. purp. (28701)	4.3	0	0	0	0	0	107	0	0	0	0	0	-
Lab. purp. (51564)	3.6	0.6	0	0	0	0	51	43	14	0	0	0	-
Lab. purp. (H'worth)	5.4	0.	0	0	0	0	496	0	0	0	0	0	s
Mac. atro. (90338)	2.0	6.3	4.0	0.7	0.2	1.7	143	1711	803	40	0	1.7	s
Mac. atro. (90844)	3.7	3.3	3.3	1.7	0.3	1.0	47	116	26	440	0	0.7	
Mac. atro. (Siratro)	8.0	6.9	2.6	0.7	0.6	0.7	99	744	232	180	133	1.5	s
Mac. brac. (27404)	5.8	2.4	1.0	0	0	0	211	65	9	0	0	0	-
Mac. psam. (39098)	0.7	0	0	0	0	0	5	0	0	0	0	0	-
Macr.dalt. (60303)	3.2	0.1	0.7	0	0	0	43	0	0	0	0	0	-
Med. sati. (Trifecta)	0.3	0	0	0	0	0	0	0	0	0	0	0	-
Rhy. mini. (81386)	1.0	3.0	25.7	0	0	0	5	38	0	0	0	0	s
Sty. seab. (104710)	3.3	8.3	7.0	2.7	5.7	4.3	327	973	868	590	700	2.7	S
Sty. seab. (105546b)	0.7	6.0	6.0	6.7	11.7	5.7	438	1257	795	1400	1730	4.7	S
Sty. seab. (110343)	3.0	11.3	9.0	2.3	12.7	5.0	167	1456	620	710	900	2.0	S
Sty. seab. (110361)	7.7	19.7	10.3	7.3	14.0	6.0	89	2114	297	710	930	4.3	S
Sty. seab. (110370b)	2.7	2.7	2.0	2.7	1.7	3.3	0	204	12	1300	200	2.7	S
Sty. seab. (110372)	4.7	9.7	10.7	8.0	6.3	6.0	44	1560	391	1300	1400	3.3	S
Sty. seab. (115995)	0	8.0	1.7	1.7	6.7	3.7	3.3	1027	177	810	630	1.7	S
Sty. scab. (Seca)	0	1.3	0	0	0	0	0	5	0	0	0	0	s
Ter. labi. (60371)	0.3	0.1	0.6	0	0	0	5	0	0	0	0	0	-
Vig. tril. (13671)	11.1	3.4	0.1	0	0	0	396	5	0	0	0	0	S

All accession numbers are CPI (Commonwealth Plant Introduction) unless otherwise stated
s= set a "small" amount of seed
S= set a "large" amount of seed

Table 8. Plant density and yield in autumn of legumes planted near Mundubbera in 1993/94. Full species names are given in Table 2.

Accession	Plant density					Yield			
	2/94	11/94	10/95	10/96	11/97	4/94	3/95	2/96	4/97
	(plants/m^2)					(kg/ha)			
Aes. amer. (Lee)	15.0	6.3	0	0	0	218	0	0	0
Aes. vill. (Reid)	42.0	17.7	0	0	0	353	0	0	0
Ali. mono. (52343)	22.3	5.0	1.3	0	0	167	5	0	0
Cli. tern. (Milgarra)	3.7	1.7	1.0	0.3	0.3	96	184	67	16
Des. illi. (Sabine)	8.3	3.7	0	0	0	64	0	0	0
Des. lept. (Bayamo)	16.3	17.8	17.3	6.2	2.4	568	1857	720	12
Des. pube. (Uman)	9.0	8.7	6.0	1.3	0.7	140	904	310	25
Des. virg. (Marc)	22.7	23.0	17.7	16.7	6.2	671	1406	223	47
Des. pern. (40071)	30.0	22.0	19.0	23.3	2.3	933	1882	597	0
Des. lept. (55719)	26.7	26.7	14.7	3.3	0	1333	1634	1007	0
Des. virg. (85178)	26.3	39.0	26.0	1.0	1.3	260	888	53	5
Des. lept. (TQ90)	32.0	20.7	23.7	13.0	9.0	353	2352	1723	73
Desm. dich. (47186)	21.3	0.3	0	0	0	202	5	0	0
Gal. spp. (82294)	1.3	0.7	0.3	0	0	66	5	0	0
Gly. lati. (CQ3368)	2.3	4.3	3.7	2.3	5.3	75	57	5	5
Ind. schi. (16055)	19.3	16.7	13.3	7.7	8.7	115	798	1227	812
Ind. schi. (69495)	20.3	28.7	21.5	15.3	14.7	209	1832	2027	1388
Ind. schi. (73608)	56.3	52.7	11.3	5.3	7.6	335	1210	780	485
Lab. purp. (24973)	2.3	2.7	0	0	0	101	0	0	0
Lab. purp. (28701)	2.0	0.7	0	0	0	65	5	0	0
Lab. purp. (51564)	4.2	1.8	0	0	0	581	24	0	0
Lab. purp. (52437)	3.3	1.3	0	0	0	228	0	0	0
Lab. purp. (H'worth)	0.2	0.0	0	0	0	337	0	0	0
Mac. atro. (84989)	7.7	6.7	2.7	1.0	2.3	796	370	83	37
Mac. atro. (90844)	10.3	5.0	4.7	1.3	7.0	220	279	277	149
Mac. atro (Siratro)	25.7	21.2	13.8	8.0	6.7	657	1128	792	113
Mac. brac. (27404)	14.8	5.7	3.2	1.0	0	190	171	102	0
Mac. brac. (55755)	19.7	4.7	2.3	0.3	0.7	113	152	137	12
Mac. grac. (93084)	25.0	18.8	5.2	0.3	0	995	1254	302	0
Mac. lath. (49771)	31.0	19.3	8.3	3.3	0.3	1031	1532	757	39
Mac. lath. (Murray)	13.3	15.3	5.7	2.7	0.3	1063	1492	470	66
Macr. axil. (52469)	4.0	1.7	0.3	0	0	67	26	17	0
Macr. dalt. (60303)	6.3	15.7	0.2	0	0	813	107	5	0
Macr. unif. (Leich.)	1.3	0	0	0	0	240	0	0	0
Med. sati. (Trifecta)	26.0	3.7	2.0	4.0	2.3	153	5	5	5
Pso. spp. (CQ2973)	35.0	33.0	37.7	11.3	3.3	336	98	5	5
Pso. tena. (CN55)	15.3	14.0	8.7	17.7	0.3	146	51	5	5
Rhy. mini. (81386)	8.0	10.3	4.0	0	0	220	444	43	0
Rhy. verd. (52724)	13.7	15.3	11.0	1.3	0.7	395	1535	150	27
Sty. seab. (110361)	66.3	60.3	33.3	46.0	10.7	512	1555	1437	322
Sty. seab. (110370C)	55.7	49.3	27.7	33.3	13.0	362	1220	910	345
Sty. seab. (115994)	65.7	58.0	46.0	35.3	20.3	959	2052	1300	566
Sty. scab. (Seca)	29.7	15.0	11.0	11.0	2.0	52	470	197	66
Sty. symp. (67704)	44.3	27.0	0.7	0	0	281	161	20	0
Vig. lute. (P1469)	3.5	0.3	0	0	0	494	0	0	0
Vig. oblo. (60430)	17.7	2.2	0	0	0	711	0	0	0
Vig. tril. (13671)	15.0	2.0	0	0	0	359	0	0	0
Vig. ungu. (R. Cal.)	3.0	0.0	0	0	0	874	0	0	0

All accession numbers are CPI (Commonwealth Plant Introduction) numbers unless otherwise stated.

Table 9. Plant density and yield of legumes planted at Brigalow Research Station near Theodore in 1993/94. Yields in 1997 and 1998 are on a 1-9 scale where 9 is the highest. Full names are given in Table 2.

Accession	Plant density						Yield				
	2/94	6/94	6/95	2/96	5/97	4/98	6/94	6/95	2/96	4/97	5/98
	(plants/m^2)						(kg/ha)	(kg/ha)	(kg/ha)	(1-9)	(1-9)
Aes. amer. (Lee)	0	0.3	0	0	0	0	0	0	0	0	0
Aes. vill. (Reid)	15.7	4.7	0	0	0	0	29	0	0	0	0
Ali. mono. (52343)	3.7	7.7	0	0	0	0	7	0	0	0	0
Cli. tern. (Milgarra)	5.3	4.0	3.7	3.8	2.0	2.3	40	221	0	3.7	2.3
Des. illi. (Sabine)	0	0	0	0	0	0	0	0	0	0	0
Des. lept. (Bayamo)	1.7	1.5	1.2	0.9	1.0	1.5	16	274	0	4.9	1.0
Des. pube. (Uman)	0.7	1.3	1.3	1.2	0.7	0.3	9	449	0	2.7	0.7
Des. virg. (Marc)	2.3	1.7	1.7	2.0	2.0	2.0	104	375	0	2.2	1.5
Des. pern. (40071)	3.3	3.7	1.7	1.8	3.3	3.3	23	216	0	4.7	3.7
Des. lept. (55719)	8.0	6.3	5.0	2.7	0.3	0.3	54	2483	73	5.0	1.7
Des. virg. (85178)	2.7	0.7	1.3	0.3	0	1.3	5	113	0	1.7	1.7
Des. lept. (TQ90)	1.3	0.7	1.3	2.3	1.0	4.3	5	832	0	5.7	3.3
Desm. dich. (47186)	6.0	6.3	0	0	0	0	519	0	0	0	0
Gal. spp. (82294)	0	0		0	0	0	0	0	0	0	0
Gly. lati. (CQ3368)	6.7	6.0	3.7	2.0	1.0	0.7	10	44	0	2.0	0.7
Ind. schi. (16055)	2.7	2.0	3.3	3.8	4.7	5.3	7	1066	863	8.0	7.3
Ind. schi. (69495)	6.5	5.7	6.0	4.7	6.7	6.5	20	1326	773	8.0	8.0
Ind. schi. (73608)	19.7	8.7	10.0	4.5	10.0	11.0	29	829	607	6.0	6.7
Lab. purp. (24973)	3.3	1.0	0	0	0	0	44	0	0	0	0
Lab. purp. (28701)	3.7	1.0	0	0	0	0	12	0	0	0	0
Lab. purp. (51564)	8.2	4.3	0	0	0	0	115	0	0	0	0
Lab. purp. (52437)	5.0	0.3	0	0	0	0	5	0	0	0	0
Lab. purp. (H'worth)	5.8	3.5	0	0	0	0	480	0	0	0	0
Mac. atro. (84989)	9.0	7.7	2.7	0.8	0.3	1.7	36	47	0	2.3	1.7
Mac. atro. (90844)	14.0	5.7	0.7	0.2	0.7	0.3	68	5	0	1.3	0.7
Mac. atro (Siratro)	32.2	14.3	0.7	0.2	0.7	0.2	250	9	0	2.9	0.3
Mac. brac. (27404)	10.5	5.8	0.2	0.0	0.2	0	194	6	0	0.2	0
Mac. brac. (55755)	8.3	4.7	0	0	0	0	49	0	0	0	0
Mac. grac. (93084)	14.7	5.0	0	0	0	0	128	0	0	0	0
Mac. lath. (49771)	23.0	14.3	5.3	2.2	0	0	452	291	0	1.0	0
Mac. lath. (Murray)	13.3	15.3	2.0	2.0	0	0	341	70	0	0.3	0.3
Macr. axil. (52469)	0.7	2.0	0	0	0	0	5	0	0	0	0
Macr. dalt. (60303)	9.3	6.3	0.5	0.6	0	0	59	5	0	0	0.2
Macr. unif. (Leich.)	4.0	3.0	0	0	0	0	98	0	0	0	0
Med. sati. (Trifecta)	0	0	0.3	0	0	0	0	5	0	0	0
Pso. spp. (CQ2973)	2.3	0	0.3	0	0	0	0	5	0	0	0
Pso. tena. (CN55)	6.7	4.0	0	0	0	0	13	0	0	0	0
Rhy. mini. (81386)	15.3	10.7	7.7	0.7	0.3	0	270	175	0	0.7	0.7
Rhy. subl. (52727)	8.3	4.0	0.3	0.2	0.3	0	18	5	0	1.3	0.3
Rhy. verd. (52724)	7.7	4.7	5.0	0.7	0.3	0.3	55	365	0	1.3	0.7
Sty. seab. (110361)	0.3	2.0	2.3	1.8	5.3	12.3	5	200	440	5.0	4.3
Sty. seab. (110370C)	0.3	2.3	1.3	2.0	3.3	8.3	5	193	50	4.7	4.3
Sty. seab. (115994)	0	0.3	1.3	1.3	3.3	4.0	5	188	0	3.7	3.0
Sty. scab. (Seca)	0	0	0	0	0	0	0	0	0	0	0.3
Vig. lute. (P1469)	2.0	2.3	0	0	0	0	42	0	0	0	0
Vig. oblo. (60430)	21.2	4.8	0	0	0	0	60	0	0	0	0
Vig. tril. (13671)	12.8	10.8	2.0	0	0	0	301	46	0	0	0
Vig. ungu. (R. Cal.)	21.0	6.0	0	0	0	0	310	0	0	0	0

All accession numbers are CPI (Commonwealth Plant Introduction) numbers unless otherwise stated

Table 10. Plant density and yield of legumes at Emerald Research Station in the 1993/94. Full species names are given in Table 2.

Accession	Plant density						Plot yield				
	4/94	7/94	6/95	2/96	5/97	5/98	7/94	6/95	2/96	5/97	5/98
	(plants/m^2)						(kg/ha)				
Aes. amer. (Lee)	1.7	0.7	0	0	0	0	0	0	0	0	0
Aes. vill. (Reid)	27.0	8.7	0	0	0	0	5	0	0	0	0
Ali. mono. (52343)	12.3	5.0	0	0	0	0	5	0	0	0	0
Cli. tern. (Milgarra)	10.7	6.0	0.7	1.7	1.3	1.3	6	18	370	230	270
Des. illi. (Sabine)	1.7	2.3	0	0	0	0	5	0	0	0	0
Des. lept. (Bayamo)	5.8	2.3	0	0	0	0	5	0	0	0	0
Des. pube. (Uman)	2.7	2.3	1.3	3.3	0.2	0.7	5	73	290	800	330
Des. virg. (Marc)	9.2	5.2	0.5	2.8	0.1	0.6	5	6	370	0	165
Des. pern. (40071)	9.0	1.3	0.3	0.7	0	0	5	5	5	0	0
Des. lept. (55719)	13.7	8.3	0.7	1.0	0	0	6	5	40	0	0
Des. virg. (85178)	9.7	3.7	0.3	1.3	0.1	0.3	5	0	0	0	0
Des. lept. (TQ90)	10.0	5.7	0	0.3	0.1	0	5	0	5	0	20
Desm. dich. (47186)	4.0	2.0	0	0	0	0	6	0	0	0	0
Gal. spp. (82294)	0	0	0	0	0	0	0	0	0	0	0
Gly. lati. (CQ3368)	11.0	17.7	2.3	5.3	0.2	0.1	216	33	370	0	0
Ind. schi. (16055)	5.0	4.0	1.7	3.7	1.4	1.1	5	48	620	400	800
Ind. schi. (69495)	5.0	3.7	0.5	6.3	2.5	2.1	5	18	2900	1430	1765
Ind. schi. (73608)	6.0	4.0	0.3	2.7	0.8	0.4	5	5	350	470	800
Lab. purp. (24973)	3.3	4.0	0	0	0	0	16	0	0	0	0
Lab. purp. (28701)	1.7	0.3	0	0	0	0	7	0	0	0	0
Lab. purp. (51564)	6.3	3.0	0	0	0	0	16	0	0	0	0
Lab. purp. (52437)	1.3	0.3	0	0	0	0	0	0	0	0	0
Lab. purp. (H'worth)	5.5	3.0	0	0	0	0	35	0	0	0	0
Mac. atro. (84989)	5.3	0.7	0.7	2.7	0	0.3	5	62	210	0	200
Mac. atro. (90844)	2.3	0.7	0.3	0.7	0	0	5	6	5	0	0
Mac. atro (Siratro)	14.3	10.0	0.8	2.3	1.0	0	48	72	310	130	100
Mac. brac. (27404)	0.8	0	0	0	0	0	0	0	0	0	0
Mac. brac. (55755)	2.3	2.7	0	0	0	0	5	0	0	0	0
Mac. grac. (93084)	17.8	8.8	0.3	0.2	0	0	20	7	0	0	0
Mac. lath. (49771)	42.7	11.3	0	0	0	0	11	0	0	0	0
Mac. lath. (Murray)	17.0	12.0	0	0	0	0	48	0	0	0	0
Macr. axil. (52469)	0.3	0.0	0	0	0	0	0	0	0	0	0
Macr. dalt. (60303)	1.2	0.3	0	0.2	0	0	5	0	0	0	0
Macr. unif. (Leich.)	3.7	2.0	0	0	0	0	6	0	0	0	0
Med. sati. (Trifecta)	0	0	0	0	0	0	0	0	0	0	0
Pso. spp. (CQ2973)	2.7	0.7	0	0	0	0	0	0	0	0	0
Pso. tena. (CN55)	10.0	5.0	0	0	0	0	5	0	0	0	0
Rhy. mini. (81386)	19.0	11.3	0	0	0	0	71	0	0	0	0
Rhy. subl. (52727)	41.3	15.3	0	0	0	0	46	5	0	0	0
Sty. seab. (110361)	14.7	6.3	0.3	0.7	1.7	1.1	7	6	50	270	130
Sty. seab. (110370C)	11.0	6.3	0.3	1.0	1.1	2.5	5	9	30	230	330
Sty. seab. (115994)	17.7	6.3	0.3	3.0	1.7	2.7	5	0	240	300	300
Sty. scab. (Seca)	2.7	2.7	0	0	0	0	5	0	0	0	0
Sty. symp. (67704)	8.0	3.0	0	0	0	0	5	0		0	0
Vig. lute. (P1469)	9.2	2.8	0	0	0	0	9	0		0	0
Vig. oblo. (60430)	15.3	5.3	0	0	0	0	9	0		0	0
Vig. tril. (13671)	26.8	16.7	0	0	0	0	61	0		0	0
Vig. ungu. (R. Cal.)	17.0	6.7	0	0	0	0	111	0		0	0

All plant accession numbers are CPI (Commonwealth Plant Introduction) numbers unless otherwise stated

Mundubbera 1994/95. The highest yielding accession in the establishment year was *M. bracteatum* CPI 55769. The next highest yields were from *V. trilobata* CPI 13671, *D. leptophyllus* CPI 55719, *S. seabrana* CPI 92939b and *Macroptilium martii* CPI 49780. The yield of Highworth lablab was again adversely affected by low density (Table 11). In the following years, *I. schimperi* was the highest yielding accession until it was killed by herbicide in 1997. In the final year of sampling, the highest yields came from *S. seabrana* followed by *M. atropurpureum* and *D. virgatus*, especially CPI 90750. This accession was still persistent and productive when the site was last inspected in March 2000.

Theodore 1994/95. Establishment was usually poor, with only the two accessions of *M.lathyroides* having above 10 seedlings/m^2 (Table 12). The highest yields in the first year were from accessions of *M. atropurpureum, M. lathyroides* cv. Murray, *V. trilobata* and two accessions of *Rhynchosia*. In the second year the *Macroptilium* accessions were still among the highest yielding, along with accessions of *I. schimperi.* The three accessions of *I. schimperi* were by far the highest yielding in the third and fourth year whereas yields of *Macroptilium* accessions declined. Accessions of *S. seabrana* established poorly and gave very low yields in the first two years, but yield and density increased in the last two years.

Emerald 1994/95. The highest yielding accession in the first year was *Macroptilium lathyroides* cv. Murray, though the yield of Highworth lablab would have again been limited by low density (Table 13). The highest yielding species in years 2-4 was *I. schimperi.* Some accessions of *M. atropurpureum, S, seabrana, Neptunia* spp. and desmanthus, particularly *D. virgatus* CPI 85172 and *D. bicornutus* CPI 90857, also yielded well in the last two years.

Table 11. Plant density and yield of legumes planted near Mundubbera in 1994/95. Full species names are given in Table 2.

Accession	Plant density					Yield			
	2/95	5/95	9/95	10/96	11/97	5/95	2/96	4/97	3/98
	(plants/m^2)					(kg/ha)			
Aly. long. (94490)	46.7	0	0	0	0	0	0	0	0
Aly. rugo. (51655)	8.3	8.0	0	0	0	169	0	0	0
Aly. rugo. (69487)	33.7	11.0	0	0	0	17	0	0	0
Aly. rugo. (84470)	20.7	26.3	0	0	0	51	0	0	0
Ara. spp. (58121)	33.7	19.0	4.3	0	0	72	0	0	0
Aty. scar. (52372)	11.0	5.0	1.0	0	0	11	0	0	0
Caj. caja. (Jay)	2.7	0.7	0	0	0	5	0	0	0
Caj. caja. (Quest)	0.3	0	0	0	0	0	0	0	0
Cen. bras. (55698)	3.7	2.0	0	0	0	0	0	0	0
Cen. scho. (95967)	1.0	0.7	0.3	0	0	17	7	0	0
Cli. tern. (Milgarra)	4.0	1.7	0	0	0	5	5	0	0
Des. lept. (Bayamo)	32.3	32.0	24.0	13.7	8.3	136	274	168	89
Des. pube. (Uman)	25.3	24.3	14.0	2.3	0.3	149	246	6	9
Des. virg. (Marc)	60.0	46.0	53.0	17.7	16.7	128	138	367	430
Des. bico. (90857)	15.0	19.7	6.0	3.7	7.3	259	114	103	96
Des. lept. (55719)	22.7	13.0	13.0	0.3	0.3	346	43	0	0
Des. covi. (84972)	30.7	19.0	23.3	2.0	3.0	190	91	13	5
Des. virg. (85172)	30.0	17.7	10.0	3.3	2.3	203	78	11	57
Des. virg. (85177)	44.7	35.3	29.3	0	4.0	328	32	12	76
Des. virg. (89197)	18.3	15.3	8.0	1.3	2.3	255	93	12	19
Des. virg. (90750)	84.0	47.3	42.3	14.3	13.7	515	245	224	299
Desm. dich. (47186)	20.7	3.3	0	0	0	0	0	0	0
Desm. scor. (89707)	91.3	3.3	0	0	0	0	0	0	0
Desm. seti. (52431)	2.0	0	0	0	0	0	0	0	0

Accession	Plant density					Yield			
	2/95	5/95	9/95	10/96	11/97	5/95	2/96	4/97	3/98
	(plants/m^2)					(kg/ha)			
Gal. spp. (67646)	4.3	2.0	0.7	0	0	0	0	0	0
Gal. stri. (49740)	1.3	0.3	0.3	0	0	0	0	0	0
Gly. lati. (CQ3386)	5.0	0.7	1.3	1.3	1.0	0	15	0	0
Gly. lati. (G1909)	7.0	2.7	2.3	1.0	1.0	0	0	0	0
Hey. late. (31951)	35.0	21.0	13.7	0	0	174	0	0	0
Ind. schi. (52621)	20.0	22.0	20.7	10.7	na	109	919	1205	na
Ind. schi. (73608)	38.0	37.0	34.0	6.3	na	67	354	782	na
Ind. schi. (16055)	21.7	21.7	25.7	15.7	na	129	963	465	na
Lab. purp. (H'worth)	2.0	2.7	0.7	0	0	322	0	0	0
Mac. atro. (84989)	6.3	6.3	7.3	1.7	3.0	165	119	84	21
Mac. atro. (90748)	5.3	2.7	1.3	1.0	2.7	8	125	339	46
Mac. atro. (90776)	2.7	4.3	0.3	0	2.0	0	69	21	65
Mac. atro. (90905)	7.3	1.3	5.7	5.7	4.6	19	274	167	142
Mac. atro. (Aztec)	14.3	11.7	14.3	6.0	5.3	7	545	157	87
Mac. brac. (27404)	15.3	12.3	10.0	1.7	0.7	176	168	0	0
Mac. brac. (55758)	7.7	4.0	1.3	0	0	27	27	0	0
Mac. brac. (55769)	19.3	13.0	14.3	0.7	0	1020	354	0	0
Mac. grac. (93084)	21.3	7.3	1.0	0	0	214	0	0	0
Mac. lath. (49771)	17.0	7.3	10.7	6.0	4.3	120	498	212	34
Mac. lath. (Murray)	42.7	24.7	12.7	2.7	0	288	104	0	0
Mac. mart. (49780)	21.3	19.3	9.3	0	0	341	142	0	0
Med. sati. (Trifecta)	78.0	20.3	25.0	1.3	3.7	13	0	5	10
Nep. dimo. (CQ1839)	4.3	3.0	1.7	0	0	42	6	5	0
Nep. grac. (CQ1849)	9.3	11.0	5.3	2.3	4.7	65	92	77	160
Nep. grac. (CQ3226)	11.0	13.0	7.0	0.0	1.3	283	12	15	49
Nep. grac. (CQ3227)	7.3	5.7	6.0	0.7	3.0	41	51	47	77
Nep. mono. (CQ2082)	4.0	1.0	0.7	0	0.7	8	18	47	3
Nep. plen. (46380)	3.3	2.0	0.3	0	0	25	36	0	0
Nep. spp. (CQ1842)	13.3	6.7	1.7	0	1.0	99	6	0	5
Rhy. mini. (52704)	10.7	8.0	9.7	0.7	3.3	79	35	31	3
Rhy. mini. (60335)	23.0	20.0	9.3	5.3	4.7	249	369	177	7
Rhy. subl. (52727)	0.0	0.3	0.7	0	0	5	0	0	38
Sty. seab. (110361)	87.3	43.7	52.0	17.3	8.3	122	403	225	144
Sty. seab. (115994)	47.7	22.3	31.3	8.7	7.7	125	381	308	139
Sty. seab. (115995)	48.3	26.0	31.3	16.7	9.0	66	429	401	211
Sty. seab. (92838b)	157.0	114.7	95.7	39.0	19.3	346	836	585	346
Vig. deci. (52835b)	6.3	6.3	1.7	0	0	10	54	0	0
Vig. deci. (52839)	12.7	12.7	8.3	0	0	329	312	0	0
Vig. deci. (73602)	6.0	0	0	0	0	0	0	0	0
Vig. oblo. (28763)	6.3	0	0	0	0	0	0	0	0
Vig. oblo. (43799)	2.7	0.3	0	0	0	0	0	0	0
Vig. oblo. (57524)	10.0	0.3	2.0	0	0	0	0	0	0
Vig. oblo. (60433)	16.3	13.3	5.3	0	0	82	73	0	0
Vig. tril. (13671)	38.3	27.0	0	0	0	359	0	0	0
Vig. vexi. (15463)	8.0	0	0	0	0	0	0	0	0
Vig. vexi. (43799)	1.7	0.3	0	0	0	0	0	0	0
Vig. vexi. (69030)	3.7	6.7	0	0	0	30	0	0	0
Vig. vexi. (CQ3044)	10.3	2.7	2.3	0	0	0	0	0	0

All plant introduction numbers are CPI (Commonwealth Plant Introduction) numbers unless otherwise stated

na = not applicable as *I. schimperi* was sprayed in April 1997

Table 12. Plant density and yield of legumes planted at Brigalow Research Station near Theodore in 1994/95. Yields in 1997 and 1998 are on a 1-9 scale where 9 = highest. Full species names are given in Table 2.

Accession	Plant density					Plot yield			
	3/95	6/95	2/96	5/97	4/98	6/95	2/96	5/97	4/98
	(plants/m^2)					(kg/ha)	(kg/ha)	(1-9)	(1-9)
Aly. long. (94490)	2.0	0.7	0	T	0	7	0	0.3	0
Aly. rugo. (51655)	2.3	9.7	0.8	0.7	0	82	0	0.3	0
Aly. rugo. (69487)	1.7	0.7	0.2	0	0	5	0	0	0
Aly. rugo. (84470)	0.7	0.3	0	0	0	11	0	0	0
Aty. scar. (52372)	1.7	4.3	1.2	T	0	919	0	1.0	0
Caj. caja. (Jay)	2.3	1.7	0	0	0	94	0	0	0
Caj. caja. (Quest)	0	0	0	0	0	0	0	0	0
Cen. bras. (55698)	0	3.7	0	0	0	20	0	0	0
Cen. scho. (95967)	0.3	1.7	0.2	0.3	T	260	0	2.7	0.7
Cli. tern. (Milgarra)	0.3	5.7	3.0	2.3	1.3	29	72	3.7	2.7
Des. lept. (Bayamo)	0.0	0.3	0.5	0	T	24	0	0	0.3
Des. pube. (Uman)	0	0	0	0.1	0	0	0	4.7	0
Des. virg. (Marc)	0.3	0.3	0.3	0.1	0.7	17	5	1.3	1.3
Des. bico. (90857)	0.7	0.7	0.2	0	0	64	0	0	0
Des. lept. (55719)	0	0.3	0.3	1.0	1.0	130	0	2.7	1.0
Des. covi. (84972)	0.0	0.3	0.2	0	T	127	0	0	0.3
Des. virg. (85172)	0.7	0.7	0.4	0.3	0.3	410	0	1.0	0.3
Des. virg. (85177)	2.0	2.0	0.7	0.3	2.0	215	0	2.7	1.3
Des. virg. (89197)	0.7	1.0	2.3	0.3	2.7	78	30	3.7	1.3
Des. virg. (90750)	0.7	0.7	0.0	0.3	0.7	96	0	3.7	0.7
Desm. dich. (47186)	0.7	2.3	0	0	0	20	0	0	0
Desm. seti. (52431)	0	0	0	0	0	0	0	0	0
Gal. spp. (67646)	1.3	0.7	1.2	0.7	0	6	8	2.3	0
Gal. stri. (49740)	2.3	2.3	1.2	T	T	34	65	1.0	0.3
Gly. lati. (CQ3386)	4.3	4.3	5.8	5.0	0.7	314	317	4.3	0.7
Ind. schi. (52621)	3.0	2.0	0.8	1.3	4.0	660	987	9.0	6.0
Ind. schi. (73608)	1.7	0.7	1.5	3.0	3.3	184	641	9.0	5.7
Ind. schi. (16055)	0.3	0.7	0.5	1.3	2.0	265	219	8.3	4.3
Lab. purp. (H'worth)	0.7	0.7	0	0	0	358	0	0	0
Mac. atro. (84989)	1.0	6.3	3.0	2.0	1.7	2230	334	3.3	2.0
Mac. atro. (87506)	0.3	7.7	4.0	2.7	3.7	988	306	2.7	3.3
Mac. atro. (90338)	2	4.3	1.7	1.0	1.3	761	78	3.0	2.0
Mac. atro. (90748)	3.3	5.0	2.3	1.3	2.3	219	94	2.3	3.0
Mac. atro. (90776)	1.3	5.0	2.0	1.7	1.7	2327	119	2.7	3.0
Mac. atro. (90905)	5.0	6.0	3.7	3.3	3.3	849	359	3.7	3.7
Mac. atro. (Aztec)	8.7	7.3	3.7	3.0	0.7	1443	589	3.0	1.7
Mac. brac. (27404)	3.3	4.3	3.3	0.3	0.3	43	209	1.0	1.0
Mac. brac. (55758)	1.7	3.3	1.2	0.3	1.3	44	61	2.7	1.3
Mac. brac. (55769)	9.0	5.3	4.7	3.3	4.7	127	962	3.3	3.3
Mac. brac. (81724)	0	0	0	0	0	0	0	0	0
Mac. grac. (84999)	3.3	2.3	2.2	0	0	711	23	0	0
Mac. lath. (49771)	11.3	12.0	7.2	4.3	0.7	785	313	3.0	1.3
Mac. lath. (Murray)	10.3	27.3	8.8	2.0	0	2285	1355	3.0	0
Mac. mart. (49780)	3.0	4.3	0.3	0	0	424	0	0	0
Med. sati. (Trifecta)	0	0	0	T	0	0	0	0.3	0
Nep. dimo. (CQ1839)	1.7	0.7	0.3	0	0	72	0	0	0
Nep. grac. (CQ1849)	1.0	1.0	2.7	T	1.3	135	127	0.7	1.3

Accession	Plant density					Plot yield			
	3/95	6/95	2/96	5/97	4/98	6/95	2/96	5/97	4/98
	(plants/m^2)					(kg/ha)	(kg/ha)	(1-9)	(1-9)
Nep. grac. (CQ3226)	5.0	5.3	2.8	1.3	1.3	849	97	1.3	1.3
Nep. grac. (CQ3227)	4.3	2.3	3.8	0.1	0.3	70	141	1.3	0.3
Nep. mono. (CQ2082)	1.3	1.7	1.7	T	0.3	53	75	0.7	0.3
Nep. plen. (46380)	2.0	1.0	0.3	0	0	438	0	0	0
Nep. spp. (CQ1842)	3.3	3.3	2.8	0.1	0.3	109	0	1.7	1.3
Rhy. mini. (52704)	4.0	7.0	1.0	1.0	0.3	85	14	2.3	0.7
Rhy. mini. (60335)	6.7	7.3	1.7	2.0	0.7	1255	13	1.3	0.3
Rhy. subl. (52727)	0.3	2.3	0.7	0.7	0	28	0	2.0	0
Rhy. verd. (34133)	4.7	9	2.7	2.0	2.7	2684	397	3.7	2.3
Sty. seab. (110361)	0.3	0.3	0.7	0.3	1.3	0	0	2.7	2.0
Sty. seab. (115994)	0.7	0.0	0.2	0.3	1.7	0	0	3.0	1.3
Sty. seab. (115995)	0	0.3	0.2	1.3	5.3	0	0	3.0	2.0
Sty. seab. (92838b)	1.0	0.3	1.0	4.0	6.0	37	0	4.0	2.3
Vig. deci. (52835b)	3.0	3.7	0	0	0	401	0	0	0
Vig. deci. (52839)	7.7	8.0	3.3	0.3	0	602	274	0	0
Vig. deci. (73602)	1.0	1.0	0	0	0	5	0	0	0
Vig. oblo. (28763)	1.0	0	0	0	0	0	0	0	0
Vig. oblo. (43799)	0.3	0.7	0	0	0	5	0	0	0
Vig. oblo. (57524)	0.0	0.3	0	T	0	5	0	1.3	0
Vig. oblo. (60433)	2.3	1.7	1.2	0	0	43	0	0	0
Vig. tril. (13671)	8.0	9.3	0.8	0	0	2682	12	0	0
Vig. vexi. (15463)	3.7	4.3	0	0	0	14	0	0	0
Vig. vexi. (43799)	0.0	2.0	0	0	0	5	0	0	0
Vig. vexi. (69030)	0.7	2.0	0	0	0	15	0	0	0
Vig. vexi. (CQ3044)	0.7	4.7	0.2	T	0	278	0	1.7	0

All accession numbers are CPI (Commonwealth Plant Introduction) numbers unless otherwise stated
T = present in plots but not in quadrats where density was recorded

Table 13. Plant density and yield of legumes planted at Emerald Research Station in 1994/95. Yields in 1998 and 1999 are on a 1-9 scale where 9 is the highest. Full species names are given in Table 2.

Accession	Plant density					Yield			
	3/95	6/95	2/96	5/97	4/98	6/95	2/96	5/97	4/98
	(plants/m^2)					(kg/ha)	(kg/ha)	(1-9)	(1-9)
Aly. rugo. (51655)	20.3	18.0	0	0	0	191	0	0	0
Aly. rugo. (69487)	21.0	8.7	0	0	0	23	0	0	0
Aty. scar. (52372)	4.3	3.7	0.3	0	0	61	0	0	0
Caj. caja. (Jay)	1.0	2.7	0.3	0	0	94	0	0	0
Caj. caja. (Quest)	1.7	1.3	0	0	0	20	0	0	0
Cen. bras. (55698)	3.7	3.7	0	0	0	24	0	0	0
Cen. scho. (65967)	1.3	0.7	0.2	0	0	9	0	0	0
Cli. tern. (Milgarra)	3.0	2.0	3.7	3.3	3.3	6	92	5.7	2.3
Des. bico. (90857)	9.3	4.0	6.7	4.0	4.7	11	541	4.3	4.0
Des. lept. (55719)	2.0	2.0	0.8	1.3	1.0	5	35	8.0	1.7
Des. covi. (84972)	13.0	6.0	4.3	2.3	2.7	43	360	4.0	2.7
Des. virg. (85172)	18.0	5.7	8.0	7.3	7.3	30	340	7.0	4.0
Des. virg. (85177)	35.7	8.7	8.8	4.0	6.7	103	410	3.7	2.7
Des. virg. (89197)	4.7	3.0	3.0	5.0	1.7	17	184	5.0	2.0
Des. virg. (90750)	10.7	6.0	2.3	4.0	3.0	22	79	7.0	3.3
Des. lept. (Bayamo)	1.0	0.3	0.2	0.3	1.3	0	6	4.7	1.7
Des. pube. (Uman)	3.0	2.3	0.5	0.7	0.3	6	6	5.0	0.3
Des. virg. (Marc)	13.3	9.0	5.0	3.0	7.3	49	310	4.3	4.3

Accession	Plant density					Yield			
	3/95	6/95	2.96	5/97	4/98	6/95	2/96	5/97	4/98
	(plants/m^2)					(kg/ha)	(kg/ha)	(1-9)	(1-9)
Desm. dich. (47186)	16.7	13.3	0	0	0	307	0	0	0
Desm. seti. (52431)	0	0	0	0	0	0	0	0	0
Gal. spp. (67646)	4.3	3.0	0	0.3	0	31	0	2.7	0
Gal. stri. (49740)	2.0	1.0	0.2	0.3	0	27	0	1.0	0
Gly. lati. (CQ3386)	4.3	4.0	3.2	2.7	0	28	34	3.0	0
Gly. lati. (Line 6)	2.7	5.7	0.8	1.0	0	25	8	1.0	0
Ind. schi. (52621)	11.7	11.0	10.3	11.0	8.3	16	645	9.0	8.0
Ind. schi. (73608)	19.7	4.7	3.8	5.7	4.7	6	378	9.0	7.0
Ind. schi. (16055)	6.3	1.3	2.3	3.7	4.0	5	120	9.0	7.3
Lab. purp. (H'worth)	1.0	2.3	0.3	0	0	266	0	0	0
Mac. atro. (84989)	10.0	5.7	4.0	1.3	2.0	95	282	5.0	2.7
Mac. atro. (87506)	0.3	0.7	0.7	0	0	10	9	2.0	0
Mac. atro. (90338)	3.3	3	0.8	1.3	0.7	29	15	5.0	0.7
Mac. atro. (90748)	4.3	3.3	1.8	1.3	0	43	153	4.7	0
Mac. atro. (90776)	2.7	1.7	1.2	1.7	2.0	20	52	5.3	3.0
Mac. atro. (90905)	8.0	3.7	2.5	2.3	3.0	37	174	5.7	4.0
Mac. atro. (Aztec)	6.0	7.7	2.2	2.7	1.3	117	126	4.7	1.7
Mac. brac. (27404)	15.3	14.3	4.5	1.0	0	157	198	6.0	0
Mac. brac. (55758)	2.3	3.3	3.2	0	0	35	250	0	0
Mac. brac. (55769)	25.0	17.7	4.2	0.7	0	382	239	2.7	0
Mac. grac. (84999)	6	1.0	0.2	0.3	0	5	0	1.7	0
Mac. lath. (49771)	8.3	4.7	1.7	0	0	89	35	0.7	0
Mac. lath. (Murray)	36.0	23.3	3.8	0	0	679	179	0	0
Mac. mart. (49780)	18.3	16.0	2.2	0	0	338	130	0	0
Med. sati. (Trifecta)	0.0	0.0	0.0	0	0	0	0	0	0
Nep. dimo. (CQ1839)	7.7	4.3	3.5	1.7	1.7	56	101	3.7	0.7
Nep. grac. (CQ1849)	4.7	2.0	4.0	5.3	6.3	19	213	5.3	5.3
Nep. grac. (CQ3226)	10.0	6.7	3.7	7.0	8.6	35	96	3.7	3.0
Nep. grac. (CQ3227)	6.7	2.3	3.0	3.7	4.3	5	78	4.3	3.3
Nep. mono. (CQ2082)	3.7	1.3	0.7	0.7	0.3	5	5	3.0	0.3
Nep. plen. (46380)	2.0	2.3	0.8	2.0	0	8	69	2.7	0
Nep. spp. (CQ1842)	10.7	2.7	4.2	4.0	2.0	5	32	2.7	1.0
Rhy. mini. (60335)	6.0	4.0	0.3	0.7	0.7	38	5	0.7	0.3
Rhy. subl. (52727)	1.7	0.3	0.3	0.3	0	5	0	1.3	0
Sty. seab. (110361)	3.7	2.7	0.7	2.3	1.0	9	15	6.3	1.7
Sty. seab. (115994)	5.7	2.0	1.3	2.0	2.0	5	25	7.0	2.7
Sty. seab. (115995)	5.0	2.3	2.8	3.3	3.7	6	80	7.0	3.3
Sty. seab. (92838b)	7.3	8.0	4.2	4.3	4.3	33	95	8.0	4.7
Vig. deci. (52835b)	3.7	0.7	0	0	0	19	0	0	0
Vig. deci. (52839)	12.3	10.7	0.2	0	0	83	0	0	0
Vig. deci. (73602)	2.0	0	0	0	0	0	0	0	0
Vig. oblo. (28763)	2.0	0	0	0	0	0	0	0	0
Vig. oblo. (43799)	1.3	0.3	0	0	0	5	0	0	0
Vig. oblo. (57524)	5.7	0.7	0	0	0	0	0	0	0
Vig. oblo. (60433)	2.0	0	0	0	0	0	0	0	0
Vig. tril. (13671)	22.3	24.7	0.2	0	0	138	0	0	0
Vig. vexi. (15463)	6.7	0	0	0	0	0	0	0	0
Vig. vexi. (43799)	0.0	0.3	0	0	0	5	0	0	0
Vig. vexi. (69030)	3.3	0	0	0	0	0	0	0	0
Vig. vexi. (CQ3044)	2.0	0	0	0	0	0	0	0	0

All accession numbers are CPI (Commonwealth Plant Introduction) numbers unless otherwise stated

Discussion

The consistently low rainfall during the first three years had a major effect on yield and persistence, and the results obtained must be viewed in this context. It is possible that some potentially useful accessions may have not been recognised. This limitation is more likely to apply to legumes suitable for ley pastures than to legume intended for permanent pastures, as the latter must be able to cope with the inevitable periods of below average rainfall.

Due to either poor establishment of the sown grasses, mainly at Narayen, and/or to invasion by unsown grasses, mainly at Theodore and Emerald, there was little effect of sown grass on legume yield in these trials. However, other studies have shown that, provided there is reasonable establishment, sowing grasses with legumes can markedly depress legume yield in the first and subsequent years after sowing (Jones and Rees 1997, Jones 1998).

Some comments about particular genera/species are given below.

Aeschynomene and *Alysicarpus* spp. No accessions showed any promise, as also was the case during dry conditions at two other clay soil sites in southern Queensland (Jones 1998).

Cajanus cajan Although establishment was usually low (*c.*1-4 seedlings/m^2), first year productivity of these was poor compared with Highworth lablab at approximately the same density.

Clitoria ternatea. Although establishment was low, similar to *C. cajan*, it persisted and yielded better than *C. cajan.* It gave the best results on the downs soils at the Emerald site in Central Queensland although it never showed quite the same promise that it has in other work in Central Queensland where it is now in commercial use (Pengelly and Conway 1998). This could be partly a reflection of the dense grass stands at the Emerald site. This species showed little promise in other trials on brigalow soils in southern Queensland, also carried out under dry conditions (Jones 1998), but is now showing promise on several sites on downs soils in the Burnett region of south-east Queensland (authors unpublished data).

Desmanthus spp. The three components of the commercially available "Jaribu" desmanthus gave variable results in the different sowings, although cultivars Marc and Bayamo tended to have higher ratings than cv. Uman (Table 2). However, usually there was a decline in yield in density in the third or fourth growing season after sowing. This obviously related to the death of original plants (Table 5) not being compensated for by successful seedling recruitment. This is despite the fact that all these cultivars, especially cv. Marc, set seed. High reserves of soil seed of Marc have been measured elsewhere (Jones and Brandon 1988). There are well documented cases of successful recruitments of desmanthus from seed (Clem and Hall 1994, Jones and Brandon 1998), and it is possible that sufficient recruitment of desmanthus could still occur to enable some lines to regain their original density and productivity. This is more likely with Marc which is the heaviest seeding line under dry conditions. None of the other desmanthus accessions evaluated were consistently superior to Marc. Possibly the most promising results from these other accessions were from CPI 90750 in the final sowing at Mundubbera, and from TQ90 and CPI 40071 in the 1993/94 sowing at Mundubbera and Theodore. In the 1993/94 sowing, desmanthus showed more promise on the two brigalow sites (Mundubbera and Theodore) than on the downs site at Emerald.

All desmanthus accessions showed periodic damage on their growing points from psyllids, identified on one occasion as being from the genus *Accizzia*. However, the damage was spasmodic and minor. CPI 85178 tended to be the most affected.

Desmanthus has also been suggested as a possible ley legume (Pengelly and Conway 1998). This would draw on its ability to produce well in the second and third year (Tables 6-13) and yet would mean that difficulties or delays in seedling recruitment would be of no consequence. Accessions for use in leys would preferably be late flowering, thus optimising leaf production during the growing season. This could markedly reduce any potential weed problems associated with high soil seed banks of desmanthus in a cropping system. However, it is also possible that seed banks could enable re-establishment of desmanthus after a cropping phase and that the relatively small and slow growing desmanthus seedlings would not compete with crops during the cropping phase. CPI 55719 was possibly the most promising accession identified for ley pastures.

Desmodium dichotomum. This growth of this annual species was severely restricted by dry conditions and better results could be expected given more favourable rainfall. It has shown some ability to recruit from seed set in the year of sowing, although second year yields were always very low. It was the highest yielding accession in the establishment year in the 1993/94 sowing at Theodore.

Glycine latifolia. Both accessions of this native legume usually persisted, but productivity was very poor under the adverse rainfall conditions, as also reported by Jones (1998). The persistence of individual plants was poorer than that of *Indigofera shimperi* but better than that of *Desmanthus virgatus*, as previously recorded elsewhere under similar conditions (Jones 1998). As this species appears to reach its peak productivity in spring/early summer rather than autumn, its potential may have been further restricted in these experiments as yield was only measured in autumn. The low yields under dry conditions confirm the results given by Jones (1998) although it has the potential to give good yields under better rainfall conditions (Jones and Rees 1997).

Indigofera schimperi. This species had outstanding persistence and productivity in every sowing at every site (Tables 5-13). In general, CPI 73608 did not persist as well as CPI 69495 and CPI 52621, as noted elsewhere (Jones 1998). Compared with other species, plant densities did not change much over time and, as plants survive for several years, this suggests there was little recruitment. Although it was well eaten in rare instances, and more lightly grazed on most occasions, it was concluded that it was generally inadequately grazed and, in some instances, too competitive for the associated grass. Similar conclusions were reached by Clem and Hall (1994), Jones and Rees (1996) and Jones (1998). Consequently, all accessions were eliminated from the experiments described here, in 1997-1998.

The more prostrate CPI 16055 appeared to be the least aggressive and, with CPI 73608, eaten more than CPI 52621 or 69495 (authors' unpublished data). CPI 16055 and 73608 accessions come from Kenya whereas, CPI 52621 and 69495 come from Zimbabwe. This suggests that there may be material in Kenya which could have adequate persistence and productivity yet be more accepted by cattle and more easily grown with a grass than the Zimbabwe material.

Lablab purpureus. Although Highworth lablab often established poorly in these hand-sown plots, it was usually the most productive annual legume. Some 600 t/year of lablab seed is sown every year in Queensland (Smith 1996) and it value is well recognised. Yields of the more perennial types such as CPI 24973 were consistently lower and persistence and production in the second year were poor.

Macroptilium atropurpureum. No accessions were consistently superior to cvv Siratro or Aztec in terms of yield, though data in Tables 11 and 12 suggest that some lines, such as CPI 90905, had less decline in plant density. Most accessions persisted for 3-4 years, although they would not persist in the long term as there was very little seeding or seedling recruitment to compensate for the death of older plants. Nonetheless, *M. atropurpureum* was the highest yielding species, except for *I. schimperi,* in the fourth and final year of the 1994/95 sowing at Theodore, and also persisted well at Emerald.

Despite the ability of siratro to yield well in the second year after sowing, given favourable rainfall (Jones and Rees 1996: Pengelly and Conway 1998), it is very doubtful if siratro will ever be consistent enough to warrant use in monospecific commercial ley pastures. At the best, it could have a role as one component of a legume mixture.

Macroptilium bracteatum. Accession CPI 27404 of this species has previously yielded well in the second year after sowing, given that it was sown without grass under favourable rainfall conditions (Jones and Rees 1972, Jones and Rees 1996, Pengelly and Conway 1998). However, although CPI 27404 was established on eight occasions in the trials reported here, it was outstanding in the second year only once - in the 1992/93 sowing at Mundubbera. Jones (1998) also found that it did poorly under very dry conditions, although it has yielded *ca.* 8000 kg/ha under good growing conditions (Jones and Rees 1997). CPI 55679 showed more promise in the 1994/95 sowings at all three sites, especially at Mundubbera, and also in results from more detailed testing reported by Pengelly and Conway (1998).

Macroptilium lathyroides. Individual plants of the two accessions of this species, Murray and CPI 49771, both persisted well into the second year in most sowings and some plants persisted into the third year. CPI 49771 generally had slightly better persistence. Both accessions were consistently among the higher yielding accessions in the first year. Previous studies have shown that Murray can give high yields in the second year given above average (Jones and Rees 1997) or near average growing conditions (Jones 1998). In this study it gave similar yields to *I. schimperi* and *D. virgatus* in the second year in the 1993/94 sowing at Mundubbera. However, there are concerns about the potential for it to become a weed in cropping systems (Rees *et al.* 1995, B.C. Pengelly, personal communication) as it can set high amounts of seed under some conditions and established quickly. There is evidence that the intensity of seeding of Murray is controlled by light intensity and humidity (Elich 1988) and quite probably by soil moisture levels. Evaluation of a wider range of accessions of this species could be warranted.

Macroptilium gracile CPI 93084 and *M. martii* CPI 49780. Under the rainfall conditions experienced, these accessions did not show enough promise to warrant widespread evaluation, although they were each given a "some promise" rating on one occasion.

Macrotyloma axillare, M. daltonii and *M. uniflorum*. The single accession of each of these species showed little promise under the dry conditions, *M. daltonii* CPI 60303 being the best. Similar results under dry conditions were reported by Jones (1998). *M. daltonii* CPI 60303 is persisting under grazing in a legume-grass pasture at "Brian Pastures" Research Station near Gayndah, although its growth varies widely in different years, primarily depending on rainfall (R.L. Clem, personal communication).

Medicago sativa. Lucerne did not do well in these experiments. This could be partly due to sowing in summer, which often results in poor establishment. The yield results presented would also be biased against lucerne as only one growth period, following late summer and early autumn, was sampled. This poor result from summer sown lucerne has been a feature of two other reports (Jones and Rees 1997, Jones 1998).

Neptunia spp. Seven accessions of *Neptunia* spp. were sown in 1994/95, six being collections of Australian native species. While there was only occasion when an accession was rated in the "some promise" (rating 3) category (*N. gracilis* CQ 1849 at Emerald – Table 2) the three accessions of *N. gracilis* were never in the "no promise" (rating 1) category. With the interest in using Australian native legumes as pasture plants, this species could warrant further investigation.

Psoralea spp. The two accessions of the native *Psoralea* did not give any encouragement for further testing.

Rhynchosia spp. Three accessions of *R. minima* and one of *R. sublobata* did not show enough promise to recommend further testing. Two accessions of *R. verdcourtii* were rated more highly for persistence and productivity, but this legume appears to have a low percentage of leaf and it is not attractive as a pasture legume, as noted by Jones (1998).

Stylosanthes spp. Nine accessions of *S. seabrana* showed promise in several sowings. Generally, if one accession showed promise in a sowing, then all accessions did (Table 2). However no accession was consistently superior to CPI 110361 and CPI 92828b which have been released as cvv. Unica and Primar. On many occasions, all accessions appeared to have only a light green colour and it is possible that their performance could have been restricted by ineffective nodulation. More seedling recruitment was noted for this species than for any other legume. Based on fluctuations in density, there was evidence of successful seedling recruitment at all sites. Generally, *S. seabrana* was more heavily grazed than *D. virgatus* which, in turn, was grazed more than *I. schimperi*. The good performance of *S. seabrana* in these sowings is the only case where there was a major difference between the results reported here and those of Jones (1998) carried out on similar soils under similar low rainfall conditions. In contrast, *S. scabra* cv. Seca and *S. sympodialis* performed very poorly in both the sowings reported here and those of Jones (1998).

Vigna spp. Similar to the results reported by Jones (1998), none of the *Vigna* accessions showed great promise under the dry conditions experienced. The best results were obtained from Red Caloona cowpea (*V. unguiculata*) at Munduberra, *V. trilobata* at Theodore and Emerald and *V. decipiens* CPI 52839 at two sites in the final 1994/95 sowing. Red Caloona is already a widely sown species. After widespread testing, *V. trilobata* CPI 13671 was withdrawn from pre-release since, although it could occasionally be high yielding, it was often very poor under adverse conditions, such as experienced in these trials, and so could not be recommended commercially.

Conclusions

The widespread testing reported here did not reveal any exciting prospects for new cultivars. It added considerably to our knowledge of how different accessions perform and confirmed the general adaptation of *Desmanthus* spp., *Indigofera schimperi, Stylosanthes seabrana* and some *Macroptilium* accessions to clay soils in southern and central subhumid/semi-arid Queensland. No annual legume was superior to the commercially used *Lablab purpureus.* The results gave some encouragement for the wider evaluation of *Macroptilium bracteatum* reported by Pengelly and Conway (1998).

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