THE EVALUATION OF TROPICAL LEGUMES FOR USE IN LEY PASTURES IN CENTRAL AND SOUTHERN QUEENSLAND

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Abstract

Soil fertility decline in the northern grain belt has resulted in corresponding declines in grain yield and quality. One option to overcome this decline is through the incorporation of ley or phase pastures into the cropping system. A range of tropical species are currently being evaluated as either self-regenerating annuals or perennial ley pasture legumes for central (CQ) and southern (SQ) Queensland. Several new accessions have regenerated from seedlings and may provide self -regenerating annuals for use as ley legumes. *C. pascuorum* has consistently been a high yielding accession in both CQ and SQ and has the ability to regenerate strongly from seed. Other accessions which are promising as regenerating annuals include *V. oblongifolia* CPI 121699. The most outstanding perennial species was *M. bracteatum* and within that species, CPI 55769 was the most promising. Other strongly persisting species were *D. virgatus, C. ternatea* and *M. atropurpureum*. Further studies are now being undertaken to develop management options for the most promising of these legumes.

Key words: Soil N, ley legumes, tropical forages.

Long-term cropping has reduced soil fertility over large regions of the northern grain belt of eastern Australia (2). This decline, which has resulted in a corresponding decline in grain yield and grain protein, is seen as a major factor determining the economic and environmental sustainability of the grain industries in the region. Options to overcome this decline include the inclusion of pulses such as chickpea and mungbean in crop rotation, the use of inorganic N fertiliser and the use of forage or ley legumes in the farming system.

The economic benefits of using Mediterranean legumes in farming systems in southern Queensland have been demonstrated through long-term research (5). However, southern and central Queensland receives most rainfall in summer and farmers may require well-adapted summer growing legumes, which can be easily established, especially in central Queensland.

The most commonly used tropical ley legume is lablab (*Lablab purpureus*), a well adapted fast growing annual. However, lablab does not regenerate from self-sown seed which is a major drawback in circumstances where a pasture phase is required for more than one year as it would where soil fertility is low and the climate variable (5). A regional evaluation program aimed to identify well-adapted perennial, or self-regenerating annual legumes, commenced in 1995, and followed on from previous studies which identified a suite of legumes adapted to clay soils (3). This paper reports results from this latest phase of research aimed at producing ley legume cultivars.

Materials and methods

Thirty-five legumes representing 22 species were sown into three replicated trials in central Queensland (CQ) in January 1996. Two of these sites near Emerald (Juanita (23^{o}50'S 148^{o}02'E) and Valencia (23^{o}03'S 148^{o}00'E) were on shallow self-mulching black earths (Ug 5.1) (4) which previously supported open downs or grasslands. The third site was sown at Namgoori near Banana (24^{o}36'S 150^{o}02'E) on a grey clay (Ug 5.2) which previously supported brigalow open forest. Soil depth at all sites was approximately 0.7 m which is relatively shallow, but typical for the region. All three sites have a mean annual rainfall of ca. 650 mm with about 70 % falling between November and April.

A further 56 accessions were sown into two trials in southern Queensland (SQ) in December, 1996, and into three replicated trials at the above sites in central Queensland in January 1997. In southern Queensland, one trial was sown on a black earth (Ug5.1) near Brigalow township (26^{o}51'S, Long. 150^{o}40'E) and the second on a brown clay soil (Ug. 5.3) at Cadarga (Lat 26^{o}08'S, Long. 150^{o}52'E) which previously had supported brigalow-belah open forest. Both these sites have a mean annual rainfall of ca. 680 mm with about 65 % falling between November and April.

Seed, which had been inoculated with the appropriate strain of rhizobia, was drilled into prepared seedbeds. The experiment at Brigalow was grazed in April, 1997 for 6 days. Other sites were not grazed.

Measurements or ratings were taken throughout the experimental period to record establishment, dry matter yield, flowering, seed yield, persistence, seedling regeneration in the second year and, at Brigalow, animal acceptance.

Results

1996 sowing - central Queensland.

Above average rainfall was recorded at all three central Queensland sites in the six months prior to sowing in January, 1996. However, no effective rainfall was recorded at any CQ site between sowing and April 1996. While some larger seeded species established on existing soil moisture, most accessions did not establish until April. At Namgoori, which had the best establishment, the highest yielding accessions in the first year were lablab, *Centrosema schottii*, *C. pascuorum*, *Macroptilium atropurpureum* and *Macrotyloma uniflorum* (Table 1). First year yields at both Juanita and Valencia on the downs soils were very poor (data not presented).

Plant persistence and seedling regeneration counts taken at Namgoori in the second year indicate that only *Clitoria ternatea*, *M. atropurpureum* cv. Aztec and CQ 1382 and *Desmanths virgatus* were able to persist (Table 1). However, many accessions were able to regenerate from seedlings. As might be expected after the poor growth in year 1 and subsequent poor seed set, seedling regeneration on the downs sites was very poor (data not presented). On both downs soils sites, *C. ternatea* cv. Milgarra and *Desmanthus virgatus* cv. Jaribu and CPI 40071 were amongst the highest yielding accessions. *Alysicarpus rugosus* CPI 51655 and *M. bracteatum* CPI 55769 were also high yielding in the second year at Juanita but not at the driest site, Valencia. In the second year (1996/97) on the brigalow soil (Namgoori), *M. atropurpureum*, *M. bracteatum* and *C. ternatea* cv. Milgarra were the highest yielding accessions (Table 1).

1997 sowings - central and southern Queensland

Average or above average rainfall was recorded at most sites in SQ and CQ in 1997. At the Juanita site in CQ, yields of up to 4000 kg/ha were recorded with lablab cv. Highworth, cowpea cv. Red Caloona, *C. pascuorum* and *M. bracteatum* being the highest yielding (Table 2). At Valencia, the only site where rainfall was well below average, the same accessions were the highest yielding but total yield was only ca. 5% of that recorded at Juanita.

The highest yield accessions at the Brigalow site in SQ were the lablab accessions and *Alysicarpus rugosus* CPI 51655 followed by C. schottii and the *M. bracteatum* accessions (Table 2). The highest yielding *M. bracteatum* accession was CPI 55769. Similarly at Cadarga, the highest yielding accessions were the lablab cultivars, *C. schottii* CPI 76010, *C. pascuorum* Q10050, M. bracteatum CPI 55769 and CPI 27404 and *V. unguiculata* CPI 121688, a wild form of the species.

There were large differences among species in animal acceptance at the one site that was grazed. As a genus, *Vigna* was uniformly well grazed (rating of 9-10) while most other species were rated between 5 and 8. Accessions of *C. schottii* were poorly grazed, rating <4.0 and as low as 1.0.

Spring rainfall in 1997-98 at Cadarga and Brigalow resulted in considerable regrowth and seedling regeneration in some accessions. *M. bracteatum* CPI 27404, *V. oblongifolia* CQ3461, CPI 60433 and Q25362, *Desmanthus virgatus* cv. Jaribu and *M. atropurpureum* cv. Aztec had the greatest regrowth. Highest seedling numbers were recorded for *C. pascuorum* CPI 94292 (56 /m^2), *V. oblongifolia* CPI 121699 (60/m^2) and *M. lathyroides* cv. Murray (48/m^2). Most *M. bracteatum* and *D. virgatus* lines had between 4 and 20 seedlings/m^2.

Discussion

The regional evaluation has confirmed the potential of species identified in previous studies (3) and highlighted a new set of species that appear to have potential as ley legumes. As expected, none of the species or accessions has outperformed lablab in the first year. However, several accessions have regenerated from seedlings, unlike lablab, and may provide regenerating annuals for use as ley legumes. *C. pascuorum* has consistently been a high yielding accession in both CQ and SQ and data from Brigalow suggests that at least one accession of this species, CPI 92492 has the ability to regenerate strongly from seed. Other accessions which are promising as regenerating annuals include *V. oblongifolia* CPI 121699.

Anumber of accessions also have potential as perennial ley legumes. One of the most outstanding species was *M. bracteatum* and within that species, CPI 55769 was the most promising. This particular accession was outstanding at both Namgoori and Juanita in CQ in the 1996 sowing with very high yields in the second year. This performance was all the more notable considering that the majority of perennial species failed to persist into 1997 after the very dry 1996. This accession also produced a large number of seedlings at Namgoori in 1997. The performance of CPI 55769 in the 1997 sowing at Namgoori, Brigalow and Cadarga was also outstanding.

Other strongly persisting species were *D. virgatus*, *C. ternatea* and *M. atropurpureum*. The performance of all three species in the second year in CQ highlighted the drought tolerance of these species. However the relatively small seed of desmanthus makes sowing depth and water availability especially critical (1). This may make desmanthus a risky proposition as a ley legumes as good first year establishment is a necessity if soil N build-up is to be achieved in 1- 3 years.

C. ternatea cv. Milgarra persisted and was a high yielding accession at most sites. This cultivar is gaining popularity in CQ as a ley legume but it has the reputation of not being well adapted to more sub-tropical regions. If that is the case, the performance of cv. Milgarra in these trials suggests that efforts should be made to produce a subtropical cultivar of this species.

Table 1 Yield, yield ratings, persistence, and seedling regeneration of 22 of the 35 accessions sown at 3 sites in central Queensland in January 1996.

Site		Namgoori	Namgoori	Valencia	Juanita	Namgoori	Namgoori
Species	Accession	Yield (kg/ha)	yield (kg/ha)	yield (kg/ha)	Yield (rate 0-5)	Perennation plants/m²	Seedlings plants /m²
	Date	5/96	3/97	3/97	1/97	3/97	3/97
Alysicarpus rugosus	51655*	0	13	425	1	0	16
Centrosema pascuorum	Cavalcade	3000	200	50	0.5	0	138
Centrosema pascuorum	94292*	3059	63	25	0	0	277
Centrosema schottii	65967*	2759	200	125	2.5	4	32
Clitoria ternatea	Milgarra	2199	1000	700	6	13	20
Desmanthus virgatus	Jaribu	*	400	450	1.5	10	2
Desmanthus virgatus	40071*	*	375	425	1	3	4
Lablab purpureus	Highworth	3255	225	0	6.5	0	11
Lablab purpureus	Rongai	3872	100	0	10	1	1
Macrop. atropurpureum	Aztec	2169	1550	212	6	17	14
Macrop. atropurpureum	CQ1382**	2453	1200	138	4.5	19	23
Macroptilium bracteatum	27404*	0	63	100	3.5	1	6
Macroptilium bracteatum	55769*	*	900	125	9	5	54
Macrotyloma daltonii	60303*	1373	175	0	1	0	21
Macrotyloma uniflorum	Leichhardt	2715	30	0	0	1	14
Macrotyloma uniflorum	52593*	2111	175	0	1	0	179
Vigna decipiens	52839*	1211	88	150	2	p	63
Vigna unguiculata	R. Caloona	884	25	0	0	0	1
Vigna vexillata	CQ3044**	376	25	0	1	1	0
Vigna luteola	Dalrymple	2379	25	0	1.5	0	1

- * Commonwealth Plant Introduction (CPI) accession number
- ** CSIRO Tropical Agriculture accession number.

Table 2. Summary of performance of 26 of the 56 accession sown at 5 sites in southern and central Queensland in 1996-97.

		Juanita	Valencia	Namgoori	Brigalow	Cadarga	Brigalow	Brigalow
Species	Accession *	Yield (kg/ha)	Yield (kg/ha)	Yield (kg/ha)	Yield (kg/ha)	Yield (kg/ha)	Regrowth (rate 0-5)	Seedling (plant/m2)
	Date	5/97	3/97	3/97	3/97	3/97	10/97	10/97
Alysicarpus rugosus	51655*	6186	375	75	10100	6767	0	2
Centrosema pascuorum	Cavalcade	6842	300	50	3427	3660	0	4
Centrosema pascuorum	65950*	6444	400	15	4317	4700	0	4
Centrosema pascuorum	94292*	6066	200	42	3340	3100	0	56
Centrosema pascuorum	Q10050**	7154	375	50	4437	5500	0	6
Centrosema schottii	82271*	5320	325	100	5003	4700	3	8
Clitoria ternatea	Milgarra	5984	350	150	4830	2773	2	4
Desmanthus virgatus	Jaribu	3526	100	10	4180	2447	5	10
Desmanthus virgatus	40071*	4808	40	10	3760	2188	1.3	10
Lablab purpureus	Highworth	7728	450	3000	8693	7633	2.3	0
Lablab purpureus	Rongai	6684	450	3000	10100	10173	2.6	2
Macrop. atropurpureum	Aztec	4844	275	525	4060	2773	5	4
Macroptilium bracteatum	27404*	5266	200	400	3940	5020	4.6	6
Macroptilium bracteatum	37608*	3634	125	225	2657	1072	3.6	16
Macroptilium bracteatum	55769*	6504	375	2650	5353	5980	3	8
Macroptilium bracteatum	68892*	5294	175	400	3933	2447	3	8
Macrotyloma uniflorum	Leichhardt	7320	200	275	3340	4220	3	0
Stylosanthes seabrana	Primar	1170	10	375	1198	1474	2	16
Stylosanthes seabrana	Unica	508	10	225	675	389	1.6	18
Vigna luteola	Dalrymple	4356	300	750	4260	3893	4	4
Vigna oblongifolia	52828A*	2248	175	350	3940	4220	0.3	12
Vigna oblongifolia	60433*	4082	25	375	4180	3100	4	12
Vigna oblongifolia	Q25362**	1503	175	575	4180	3900	2.3	14
Vigna oblongifolia	121699*	1694	150	250	3680	2120	1	60
Vigna unguiculata	R.Caloona	4130	375	85	4100	4220	0	0
Vigna unguiculata	121688*	3434	100	225	3330	5260	1	2

Conclusions

The study has confirmed that tropical legumes can produce considerable dry matter on the major cropping soils of the northern grain belt and persist for at least two years under the range of rainfall environments encountered. The priorities now are to investigate more closely the variation within collections of the most promising species, select out a core set of accessions and evaluate these under grazing on a range of cropping soils. Grazing management options for these legumes will also need to be established.

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