Morphological and agronomic attributes of *Cassia rotundifolia* Pers., *C. pilosa* L., and *C. trichopoda* Benth., potential forage legumes for northern Australia

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Summary. This paper reports variation in phenology, morphology, feeding value and environmental adaptation of 18 accessions of *Cassia rotundifolia* and one each of *C. pilosa* and *C. trichopoda.* There were three major maturity groups within *C. rotundifolia* and a very large variation in seed size.

Dry matter and seed yields were measured at four sites in south-eastern Queensland (Beerwah, Gatton, Gympie and Narayen) and at Grafton in New South Wales. There was significant variation in these attributes between accessions, sites and harvest times. All accessions were adapted to light-textured surface soils but did not tolerate waterlogging, particularly on the clay soil at Gatton. One early-flowering accession (34721) of *C. rotundifolia* has been released for commercial use because of its general performance over the range of seasons and sites that were sampled in this investigation, and prior experience of its persistence and spread under intermittent grazing at a number of sites in Queensland and the Northern Territory.

C. rotundifolia and *C. pilosa* were acceptable animal feeds, but *C. trichopoda* had deleterious effects on laboratory rats.

Introduction

The genus *Cassia* contains a number of species known to be grazed in their native habitat yet they have not been utilized in sown pastures. The one possible exception is the Australian *C. sturtii* which has shown promise in grazing experiments in Israel's arid region.

Cassia rotundifolia, C. pilosa and *C. trichopoda* are herbaceous to sub-woody, prostrate to semi-erect perennial herbs native to Central and South America, although *C. rotundifolia* has become naturalized in parts of West Africa. Three accessions of *C. rotundifolia* acquired before 1970 demonstrated the forage potential of this species by their ability to persist and spread under intermittent grazing at a number of sites in southern and central Queensland (R. W. Strickland, unpublished data), in northern New South Wales (G. P. Wilson, unpublished data) and in the Northern Territory (A. Cameron, unpublished data). Those accessions were very similar in morphology and phenology and nothing was known of their feeding value for stock. Subsequent collections of *C. rotundifolia* provided material differing in size and flowering time.

This paper reports results from a series of experiments conducted in southern Queensland and northern New South Wales to investigate differences in environmental adaptation, feeding value, phenology and morphology between 18 accessions of *C. rotundifolia. Cassia pilosa* and *C. trichopoda* were included because of their agronomic similarity to *C. rotundifolia* under field nursery conditions, although only one accession of each was available.

Materials and methods

The accessions that we examined are listed in Table 1 together with origin, seed size, peak flowering and seeding time in southern Queensland and the experiments in which they were grown. Full botanical descriptions of the species have been given by Persoon (1805–1807), Bentham (1870–1876, 1871), Standley and Steyermark (1946), Woodson *et al.* (1951) and Leon and Alain (1974). The most obvious difference between the species is that *C. rotundifolia* is bifoliolate with only one pair of leaflets which are asymmetrically subrotund to broadly obovate, whereas *C. pilosa* and *C. trichopoda* have several pairs, oblong or oblong-obovate. *Cassia pilosa* usually has five pairs and *C. trichopoda* a variable number (8 to 25) — commonly 11 pairs. In addition, *C. trichopoda* has stipitate glands on the petioles.

Sites

The accessions were grown at four sites in south-eastern Queensland and one in New South Wales to assess their dry matter and seed production in the different environments. As all accessions were not available when the study started, all were not grown at each site. However, two accessions were common to all experiments.

Beerwah (26°51'S., 152°58'E.) is 70 km north of Brisbane. The soil at the site is a sandy gleyed podzolic (pH 5·0–5·5) with low exchange capacity, and is severely deficient in N, P, S, Cu, Zn and Mo, and

Table 1. The accessions, their origins, peak flowering and seeding times at Beerwah, seed size and where they were grown

CPI[A]	Origin	Experiment[B]	Peak flowering	Peak seeding	Seed weight (seeds/g)
		C. rotundifolia			
16358	Ghana	1, 3	Jan.	Feb.	470
34719	Brazil	1, 3	Jan.	Feb.	316
34721	Brazil	1,2,3,4,5	Jan.	Feb.	253
49713	Brazil	1, 3	Jan.	Feb.	422
52092	Ghana	1, 3	Jan.	Feb.	401
78355	Argentina	2,3	Jan.	Feb.	271
78916	Nigeria	1, 3,4,5	Jan.	Feb.	428
85836	Mexico	2,3	Apr.–May	June	221
86172	Mexico	2,3	Apr.–May	June	220
86178	Mexico	2,3	Apr.–May	May–June	200
90809	Mexico	2,3	Feb.	Mar.–Apr.	262
92931	Brazil	2	Feb.	Mar.	346
92968	Brazil	2	Mar.	Apr.–May	281
93018	Brazil	2	Feb.	Mar.	388
93093	Brazil	2,3	Mar.	Apr.	366
CQ1467	Nigeria(?)	1, 3,4,5	Jan.	Feb.	454
Q9862	Brazil	1,2,3,4,5	Apr.–May	June–July	272
Q10057	Brazil	1, 4,5	Apr.–May	June–July	436
		C. pilosa			
57503	Venezuela	1, 4,5	Jan.	Feb.	389
		C. trichopoda			
Q9844	Brazil	1, 4,5	Apr.–May	June–July	713

[A]CPI, Commonwealth Plant Introduction number; CQ, CSIRO Queensland number applied to introduced material for which original CPI unknown; Q, Department of Primary Industries Queensland accession number.
[B]Experiments: 1, Beerwah and Narayen 1981–82; 2, Beerwah 1982–83; 3, Gatton 1982; 4, Grafton 1982–83; 5, Gympie 1982.

very low in exchangeable Ca and K. Mean annual rainfall is 1625 mm.

Narayen (25°41'S., 150°52'E.) is approximately 480 km north-west of Brisbane. The soil is a podzolic with gritty coarse loamy sand to sandy loam surface overlying clay subsoil at 30–50 cm depth with pH 6·0–7·0. It is relatively low in organic matter and deficient in N, P, S, and Mo but has satisfactory level of K. Mean annual rainfall is 722 mm.

Grafton (29°43'S., 152°56'E.) is approximately 340 km south of Brisbane. The soils is a sandy yellow podzolic (pH 5·2–5·6) with low exchange capacity. It is severely deficient in P and low in Ca and K. Mean annual rainfall is 880 mm.

Gympie (26°11'S., 152°40'E.) is 200 km north of Brisbane. The soil is a red podzolic with brown clay loam (pH 5·3) overlying a deep well-structured red clay at 15–20 cm depth. It is deficient in P and Mo. Mean annual rainfall is 1100 mm.

Gatton (27°33'S., 152°20'E.) is 100 km west of Brisbane. The soil is a fertile, dark, moderately self-mulching medium-cracking clay. The pH is 7·8 at the surface and increases with depth. Mean annual rainfall is 720 mm.

Fertilizer

Each site was fertilized at a level considered appropriate for the area.

Beerwah. Standard basal application of lime (500 kg/ha), copper sulfate (8 kg/ha), zinc sulfate (8 kg/ha), molybdenized superphosphate (200 kg/ha) and potassium chloride (100 kg/ha) incorporated into the soil pre-planting; topdressed with molybdenized superphosphate (200 kg/ha) and potassium chloride (100 kg/ha) in the second year of each experiment.

Narayen. Molybdenized superphosphate (200 kg/ha) and potassium chloride (100 kg/ha) incorporated into soil pre-sowing; the same rate of each fertilizer topdressed after 12 months.

Grafton and Gympie. Molybdenized superphosphate (500 kg/ha) incorporated into soil at sowing.

Gatton. No fertilizer applied.

Experimental details

A randomized block design was used at each site with three replicates at Beerwah, Gatton and Narayen, and two at Grafton and Gympie. Grafton, Gympie and Narayen plots were sown by hand broadcasting seed but Beerwah and Gatton plots were planted with 3-week-old seedlings.

Experiment 1. (Beerwah and Narayen). Eleven accessions were used in this experiment. Both sites were cultivated to kill weeds in October 1980 and fertilizer was incorporated into the soil in November 1980. At Beerwah, plots comprised 12 plants spaced 30 cm apart in three rows of four, planted on 20 November 1980. At Narayen, scarified seeds were broadcast (2·5 kg/ha) in plots 4 m^2 on 27 November 1980 and lightly covered by hand-raking.

Experiment 2. (Beerwah). The 11 accessions in this experiment were planted in the field in mid-November 1981 in the same manner as in experiment 1 for this site and following similar cultural treatments.

Experiment 3. (Gatton). Fourteen accessions were planted in the field after cultivation in November 1981. As some of the accessions common to experiments 2 and 3 were in very short supply, plots comprised either two or three rows of four plants spaced 30 cm apart, the number of rows varying with the number of plants available after planting experiment 2.

Experiments 4 and 5. (Grafton and Gympie). Both sites were cultivated and treated with trifluralin (2 litres/ha) for weed control prior to sowing. Seed of the seven accessions common to each site was broadcast (4·2 kg/ha) on 3 by 2 m plots and raked into the soil on 14 January 1982 at Gympie, and on 5 February 1982 at Grafton. At Grafton, the inoculated seed was also pelleted with rock phosphate dust before sowing.

Inoculum

Seed for each experiment was inoculated with commercial cowpea inoculum.

Morphological variation

Stipules, petioles, leaves, pedicels and pods were measured on herbarium specimens collected from field plots at Beerwah and Samford, south-eastern Queensland, and peak height and spread in the field were measured at Beerwah before winter defoliation.

Seed size was determined by weighing six replicates of 100 seeds taken at random from bulk samples that had been dried and stored at 30% relative humidity.

Phenological variation

Date of flowering and pod maturity (first and peak) for each accession were recorded in the field at all sites. Once flowering is initiated, the species continue to flower until stopped by drought or frost.

Field measurements and observations

Establishment counts were taken approximately 60 days after sowing and phenological data were recorded throughout the experiments. Dry matter yields were taken by cutting the plants back to a 10 cm stubble in March and June 1981 and 1982 in experiment 1; March and June 1982 and 1983 in experiment 2; April 1983 in experiment 3; January, March and May 1983 in experiment 4; and May–June 1982 in experiment 5. Standing seed was harvested by hand and surface seed by sweeping or vacuum cleaner. Soil-borne seed to a depth of 3 cm was separated by sieving and flotation in perchlorethylene (specific gravity = 1·62) and subjected to laboratory germination tests with and without scarification. Rainfall levels (mm) for the sites are given in Table 2.

Feeding value

Vegetative material was harvested at flowering time from Beerwah and Gatton, dried, ground, and incorporated as 20% of a standard casein diet fed to two groups, each of four weanling rats, for 21 days as part of a forage legume toxicity screening program (J. L. Lambourne and R. W. Strickland, unpublished data). The response of the rat to ingested phytotoxins is a reliable guide to their toxicity to poultry and other monogastic animals and, in most cases, to ruminant animals also. The digestible dry matter intake and liveweight gain of rats on the test feeds were compared with those of controls fed lucerne. A shortage of laboratory resources resulted in only eight of the accessions being tested.

Results

Morphological variation

The range, mean and standard error for the attributes measured are given in Table 3. Mean seed size of the accessions is included in Table 1.

Within *C. rotundifolia*, the accessions varied significantly in height ($P<0·01$), spread ($P<0·01$), stipule length ($P<0·05$), petiole length ($P<0·05$), pedicel length ($P<0·01$), leaf size ($P<0·05$), pod size ($P<0·05$), and seed size ($P<0·001$). The most obvious variation occurred in height, spread and seed size. Early flowering accessions tended to have smaller whole plant dimensions (mean 16 cm × 146 cm) and seed weight (mean 377 seeds/g) than late-flowering accessions (mean plant size 60 cm × 188 cm; mean seed weight 270 seeds/g) with the other maturity groups intermediate (mean plant size 30 cm × 144 cm; mean seed weight 328 seeds/g). Notable exceptions were the seed size of accessions 34721, 78355 and Q10057.

Cassia pilosa had longer stipules (11 mm) and shorter pedicels (29 mm) than *C. rotundifolia* (7·6 mm; 33·6 mm) and *C. trichopoda* (8 mm; 32 mm). *C. trichopoda* had smaller leaflets (12·5 mm × 3·5 mm) than did *C. pilosa* (18·5 mm × 5·5 mm) and both were smaller than *C. rotundifolia* (23 mm × 15 mm). *C. trichopoda* also had longer pods (40 mm) than *C. rotundifolia* and *C. pilosa* (33 and 32 mm, respectively).

Phenological variation

All species were indeterminate in growth habit, continuing stem elongation and initiation of new flower buds towards stem spices as older, more basal pods ripened. It is obvious from Table 1 that *C. rotundi-*

Table 2. Rainfall (mm) for each site over the duration of each experiment

Period	Beerwah(1)	Beerwah(2)	Narayen	Gatton	Grafton	Gympie
Planting to:						
1st cut	697b[A]	1291a	405	751a	944b	638a
1st to 2nd cut						
2nd to 3rd cut	460a	250b	181a		193b	
3rd to 4th cut	1408a	633b	629		405a	
	250b	545a	31b			

[A]a or b, above or below average respectively for the period.

folia contained four maturity groups while *C. pilosa* was early flowering and *C. trichopoda* late-flowering. All accessions started flowering and seeding before the peak times given. Late-flowering accessions flowered at similar times at all sites but early flowering accessions were 6–9 weeks later (depending on accession) at Gympie and Grafton than at Beerwah, Gatton and Narayen.

Establishment counts

Plant densities ranged from 9 to 26 plants/m^2 (mean 15·3; s.e. 0·92) at Narayen; 9 to 26 plants/m^2 (mean 16·2; s.e. 1·6) at Grafton, and 14 to 45 plants/m^2 (mean 24·8; s.e. 2·75) at Gympie, representing mean establishment percentages at 24, 15 and 24 for Narayen, Grafton and Gympie, respectively. The vegetatively established plots at Beerwah and Gatton retained 12 plants/m^2.

Dry matter yields

There were marked differences ($P<0\cdot01$) in dry matter yield of the accessions within and between cuts and sites. Because the experiments involved different sites, accessions, cutting times and frequencies, the site × accession interactions were investigated by regressing the mean yield of an accession at each cut against the mean yield for all accessions at that cut (Finlay and Wilkinson 1963). The fitted linear regressions represent the average reaction of an accession to the changing environmental conditions as measured by the average accession yield. Accessions with regression coefficients of 1·0 had average stability over all environments, and those with coefficients greater or less than 1·0 had below or above average stability, respectively. These relations are shown in Fig. 1 for square root transformed data.

When the data from experiment 1 were plotted, it was obvious that the first cut from Beerwah was having a marked effect on the slope of the regression lines of six of the accessions. The observed values bore a linear relationship for the first seven values then curvilinear to the eighth value (Beerwah first cut). This value has been omitted from all regressions given.

Narayen–Beerwah comparison (Fig. 1a). Accessions Q9844 and 49713 had below average stability ($P<0\cdot01$; $P<0\cdot05$), growing well in good environments and poorly in harsher environments. Accessions 34721 and 34719 had above average stability ($P<0\cdot01$; $P<0\cdot05$) and grew well in the worst environments but did not respond as well as others to the better environments; 34721 had the better mean yield of the two. All other accessions had average stability and only the late-flowering Q9862 and Q10057 performed better than 34721 in all environments.

Beerwah–Gatton comparison (Fig. 1b). Accession Q9862 had below average and 78355 above average stability ($P<0\cdot01$). The others had average stability. Although 86172 had the highest mean response of this group, it was significantly different only from 85836 and 90809 ($P<0\cdot05$, $P<0\cdot01$). Three accessions omitted from this analysis (92931, 92968, 93018) were not in sufficient supply to plant at Gatton. At Beerwah they had above average stability and yielded as well as 34721 in poor growth periods but only half as well in good periods.

Table 3. The range, mean and standard error for number of leaflet pairs, plant height and spread, stipule, petiole and pedicel length, and dimensions of leaflets and pods of *C. rotundifolia*, *C. pilosa* and *C. trichopods*

Attribute	*C. rotundifolia*			*C. pilosa*			*C. trichopoda*		
	Range	Mean	s.e.	Range	Mean	s.e.	Range	Mean	s.e.
Leaflet pairs	—	1	—	4–6	5	0·2	7–12	11	0·3
Height (cm)	5–90	32	3·2	35–65	50	7·6	65–80	72	4·4
Spread (cm)	90–220	157	4·1	190–210	200	5·8	140–210	177	20·3
Stipule (mm)	4–11	7·6	0·23	10–12	11	0·27	7–9	8	0·31
Petiole (mm)	3–8	5·5	0·16	5–6	5·5	0·22	4–5	4·5	0·19
Pedicel (mm)	14–78	33·6	1·77	26–32	29·0	0·68	25–39	32·0	1·90
Leaflet length (mm)	12–38	23·0	1·00	15–22	18·5	0·77	9–16	12·5	0·93
Leaflet width (mm)	5–25	15·0	0·72	5–6	5·5	0·19	3–4	3·5	0·22
Pod length (mm)	20–45	33·3	0·87	31–33	32·0	0·27	34–46	40·0	1·47
Pod width (mm)	2·5–5·0	3·6	0·11	3–4	3·5	0·21	3–4	3·5	0·19

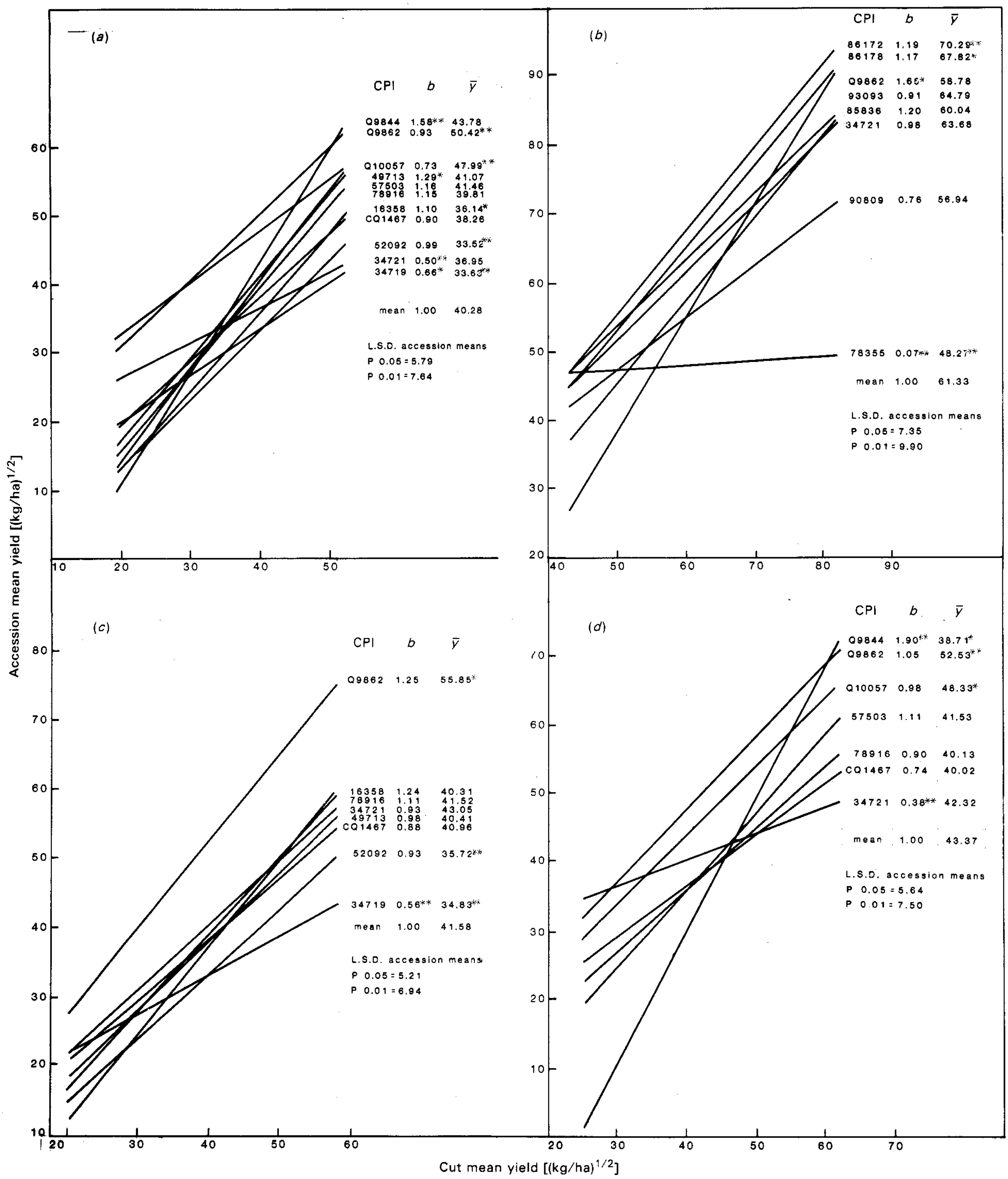

Fig. 1. Linear regressions of accession mean dry matter yield on cut mean dry matter yield: regression coefficient (b) and mean yield ($\bar{y}$) for each accession over all cuts using square root transformed data. (*a*) Beerwah-Narayen (7 cuts); (*b*) Beerwah-Gatton (5 cuts); (*c*) Beerwah-Narayen-Gatton (8 cuts); (*d*) Beerwah-Narayen-Gatton-Gympie (11 cuts). *, **, different from the mean at $P<0.05, 0.01$.

Beerwah–Narayen–Gatton comparison (Fig. 1c). This analysis compared the performance of seven early and one late-flowering accession. All except 34719 had average stability and the late-flowering Q9862 outyielded all others ($P<0 \cdot 01$) over all environments. Accessions 34719 and 52092 had lower ($P<0 \cdot 05$) mean responses than the other early flowering accessions.

Beerwah–Narayen–Grafton–Gympie comparison (Fig. 1d). The late-flowering *C. pilosa* (Q9844) had below average stability ($P<0 \cdot 01$), yielding well in good environments but poorly in others. Only *C. rotundifolia* 34721 had above average stability ($P<0 \cdot 01$) and its mean yield was exceeded only by the late-flowering Q9862 and Q10057, which had average stability.

Seed yields

All accessions yielded satisfactorily in one or more sites (Table 4). Accessions 34721 and 78916 yielded more than 900 kg/ha in individual plots and 57503 produced 730 and 1280 kg/ha in the two replicates at Gympie. Seed yields of the latest-flowering accessions were seriously affected by frost, particularly at Gatton, Beerwah and Grafton.

The mean standing seed harvests (averaged over Beerwah 1982, Gympie 1982 and Grafton 1983) were 43, 67 and 92% of total yield for early, mid-season and late-flowering accessions, respectively, reflecting the harvest time used at the various sites. At individual sites, standing seed accounted for up to 80% of total yield for early flowering accessions harvested at the appropriate time.

Table 4. Mean seed yields (kg/ha) of each accession for each site and year

Accession	1981			1982		1983	Standing seed^{B}
	Beerwah^{A}	Narayen^{A}	Gatton^{A}	Beerwah^{B}	Gympie^{B}	Grafton^{B}	(%)
16358	376	143	446**				
34719	267	108	186				
34721	247	165	721**	642**	583	454	40
49713	438	272**	115**				
52092	438	211*	299				
78355			153*	775**			39
78916	559*	134	255		253	795**	44
85836			10**	19^{C}			
86172			63**	240**			85
86178			46**	345			95
90809			284	392			79
92931				287**			77
92968				466*			43
93018				458*			70
93093			266	301*			68
CQ1467	111*	146	289		330	885**	45
Q9862	316	13**		13^{C}	243	131**	
Q10057	392	133			428	52**	95
57503	463	223**			1008	114**	48
Q9844	287	23**			273	1**	91
Mean	354	143	239	434	445	347	
l.s.d. accession means							
$P=0 \cdot 05$	225	88	111	157	n.s.	198	
$P=0 \cdot 01$	308	118	151	217	n.s.	299	

^{A}Standing seed only.
^{B}Standing plus fallen seed.
^{C}Soil-borne seed only, not included in analysis of variance.
^{D}Mean standing seed as percentage of total seed harvested Beerwah and Gympie 1982, Grafton 1983.
*,**Significantly different from mean at $P<0 \cdot 05$, $P<0 \cdot 01$, respectively.

Germinability of soil-borne seed
Soil-borne seed harvested from the Beerwah plots of experiments 1 and 2 in June 1983 was germinated with and without mechanical scarification. The variation in germination between accessions was not significant within treatment (with or without scarification) or source (experiment 1 or 2) but there was a marked difference between source for the unscarified seed. In experiment 1, seed germination averaged 14·7±2·05% compared with 2·6±0·49% in experiment 2. The two accessions common to both experiments (34721 and Q9862) averaged 13·0 and 3·0% germination from experiments 1 and 2, respectively, showing a small but significant ($P<0·05$) breakdown in hardseededness with time. Scarified seed averaged 98·9±0·41% and 97·9±0·64% germination for experiments 1 and 2, respectively.

Feeding value
Digestible dry matter intake (Table 5) indicated only small differences in acceptability between most feeds other than for 78916, which was markedly poorer than the lucerne control. This accession and Q9844 (*C. trichopoda*) also produced lower liveweight gains than the control. Although the rats ate less of 34721, they gained more weight than the controls over the trial period, the rate of gain per gram of feed eaten reflecting the higher feed quality of this accession. In contrast, Q9844 was eaten as well as the control but the rats gained less weight. The rate of gain per gram eaten indicates the poor quality of this accession, which may even contain deleterious compounds. In general, the later-flowering accessions were poorer feeds than the early flowering accessions, which probably reflected the tougher stems of this material when harvested.

Discussion
There is some confusion in the taxonomic literature describing *C. pilosa*. Leon and Alain (1974) and Standley and Steyermark (1946) describe the species as having small stipitate glands on the petiole, sometimes absent, whereas Bentham (1871) agrees with Linnaeus' description of no petiolar glands. We did not find any glands on our material. The material we have determined as *C. trichopoda* agrees with Bentham's (1870–1876) description of that species in every respect except that our material has larger leaflets. This determination was confirmed by the Queensland Herbarium (BRI). It is probably part of Bentham's var. *luxurians* which has larger leaflets than the ype variety.

The morphological variation observed in *C. rotundifolia* material fell within the range attributed to that species in the various taxonomic descriptions, but the extremely prostrate habit of accession 92931 was unusual. The wide range of variation

Table 5. Feeding value of *C. rotundifolia*, *C. pilosa* and *C. trichopoda* fed to rats

Species	Accession	DDMI[A] (g/day)	LWG[B] (g/day)	LWG/DDMI
Lucerne	Hunter River	7·27	2·81	0·39
C. rotundifolia	34721	6·14*	3·20*	0·51**
C. rotundifolia	49713	6·08*	2·73	0·45
C. rotundifolia	52092	6·67	2·59	0·39
C. rotundifolia	78916	5·06**	2·22**	0·44
C. rotundifolia	Q9862	8·27	2·86	0·34
C. rotundifolia	Q10057	6·56	2·39*	0·37
C. pilosa	57503	6·03*	2·78	0·46
C. trichopoda	Q9844	7·85	2·08**	0·27**
l.s.d. at $P=0·05$		1·08	0·38	0·08
l.s.d. at $P=0·01$		1·58	0·55	0·12

[A]Digestible dry matter intake.
[B]Liveweight gain.
*,**Significantly different from lucerne at $P<0·05$, $P<0·01$, respectively.

encountered in this species suggests there may be varieties within *C. rotundifolia*, although the authors are not aware of any published varieties.

The environmental adaptation of accession 34721 was better than that of all other early flowering accessions of *C. rotundifolia* over a range of seasons and sites. Although late-flowering accessions of this species performed better than 34721, their seed set is so late in the season that frost could militate against their persistence and spread in grazed pastures. This theory is supported by evidence from the cutting trials. At Grafton, plots of 34721 contained 530 seedlings/m^2 in May 1983 compared with 20 to 30 seedlings/m^2 in plots of Q9862 and Q10057. *Cassia pilosa* plots had 40 seedlings/m^2 and there were no seedlings in *C. trichopoda* plots. Similar values were noted at Beerwah and Narayen but the Beerwah data could have been influenced by the need to pick seed of these late-flowering accessions. The success of these species in the early studies mentioned in the introduction is due mainly to a large seedling recruitment rather than perenniality *per se*.

Both *C. pilosa* and *C. trichopoda* performed badly in harsh growing conditions (represented by low site × cut mean yields), the latter being more susceptible than the former.

Cassia rotundifolia and *C. pilosa* were both acceptable animal feeds. Although 78916 was obviously less palatable than other accessions of *C. rotundifolia*, the quality of the feed eaten was comparable to that of the lucerne control. In contrast, *C. trichopoda* was quite palatable but obviously deleterious to rats.

All accessions are capable of high seed yields, the harvested yield depending on time of harvest and environmental conditions, particularly the incidence of frost in relation to flowering time. Hardseededness, present in all accessions, would ensure their regeneration with time, depending on competition and pasture management, as the soil-borne seed was quite viable.

All accessions had apparently effective nodules and were well adapted to light-textured surface soils but did not tolerate waterlogging on the Gatton clay. This is in keeping with their natural distribution, which is restricted to sandier soils rather than clays. The only known incidence of pests or disease is that reported from Gympie, where minimal leaf spotting due to *Pleospora* sp. was found on older leaves of *C. rotundifolia* 34721 in June 1982. The examining pathologist considered that the infection was secondary and unlikely to be of importance in grazed pastures.

The persistence and spread of *C. rotundifolia* under intermittent grazing at several sites in Queensland and the Northern Territory, and under heavy grazing at Samford and Gympie, has led to the release of accession 34721 for commercial use. This is the first release of a cultivar of *Cassia* or indeed of any member of the *Caesalpinoideae* as a plant for sown pastures. The overall performance of late-flowering accessions indicates that they too would be useful pasture legumes in areas that are not prone to frost.

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