PRODUCTIVITY OF THREE TREE LEGUMES GRAZED BY CATTLE

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ABSTRACT
Three tree legumes *Albizia chinensis*, *Leucaena leucocephala* K 636 and *Tipuana tipu* were grown in conjunction with the grass *Brachiaria decumbens* and grazed by weaner cattle at a stocking rate of 2.5 animals per hectare for a total of 447 days. Albizia was best adapted to this acidic, poorly drained site in south east Queensland giving the highest yields of edible dry matter, high survival rate and moderate liveweight gains of 0.45 kg/head/day. The productivity of *L. leucocephala* K 636 was always poor but it gave the highest liveweight gains of all treatments in the first 280 days of grazing, reflecting the high quality of its forage. *Tipuana tipu* was the least acceptable of the three tree legumes and as a consequence it gave the lowest liveweight gains. Seedling survival of Tipuana was also poor.

KEYWORDS
Albizia chinensis*, *Leucaena leucocephala K636, *Tipuana tipu*, animal performance, direct grazing.

INTRODUCTION
Over the past 10 years, increasing interest has been shown by the grazing industry in the use of tree and shrub species as sources of fodder for livestock. *Leucaena leucocephala* has been the most widely used fodder tree legume with over 40,000 hectares planted in northern Australia in the last 15 years. However, the folly of relying heavily on one or two species has been illustrated by the devastating effect of the psyllid insect (*Heteropsylla cubana*) on *L. leucocephala* in some areas (Bray and Sands 1987). Thus there is a need to identify and develop new species and varieties of tree legumes to expand the suite of material available to farmers and extend the use of these species into areas not suited to *L. leucocephala*.

Albizia chinensis and *Tipuana tipu* are tree legumes which have shown agronomic promise in a series of screening trials (Gutteridge 1990, Staples 1990). They are reported to grow over a wide range of edaphic and climatic conditions and have been shown to be palatable to livestock in preliminary feeding trials. A new variety of *L. leucocephala*, K 636 identified by The University of Hawaii has demonstrated superior seedling vigour, vegetative growth, psyllid tolerance and is more cold and frost tolerant than the commonly used varieties of *L. leucocephala*.

These three species were evaluated in a grazing trial conducted at The University of Queensland Research Farm Mt Cotton south east Queensland.

MATERIALS AND METHODS
Site: An experimental site of 6.4 ha was selected at The University of Queensland research farm Mt Cotton, south eastern Queensland (27^0 53'S and 153^0E) on a poorly drained, infertile gleyed podzolic soil (ultisol) with undulating topography. The soil has a pH of 5.1 (1:5 soil: water), a total nitrogen concentration of 0.10%, an organic carbon content of 1.3% and an available phosphorus content of 7µg/g (sodium bicarbonate extract). Deficiencies of sulphur, calcium, potassium and copper are also common.

Climate: Mt Cotton has a sub-tropical humid climate with a mean annual rainfall of 1400 mm 70% of which falls between October and March. Mean maximum summer temperature is 27^0 and mean minimum winter temperature is 9^0C. An average of 6 light frosts occur on the lower slopes between May and September each year. Rainfall for the experimental period was 1210, 855, 1050 and 889 mm for 1992, 1993, 1994 and 1995 respectively all below the mean annual rainfall.

Experimental Procedure: The experimental site was divided into eight 0.8 ha paddocks to which one of the following treatments was allocated at random with two replications.

1. *Albizia chinensis* plus signal grass (*Brachiaria decumbens*)
2. *Leucaena leucocephala* (K 636) plus signal grass
3. *Tipuana tipu* plus signal grass
4. Signal grass alone plus nitrogen fertilizer at 200 kg N/ha/year (control)

Signal grass was selected as the standard grass to be used in all comparisons as it is compatible with tree legumes, it grows well at Mt Cotton, responds well to nitrogen fertilizer and is widely used throughout Queensland for beef production.

The tree legumes were established in a glasshouse in soil filled planter bags. After 6-8 weeks growth they were transplanted into the field in November/December 1992 into cultivated rows 4 m apart. Plant spacing within the row was 1 m so that approximately 2,500 tree seedlings were planted per hectare. After 10 weeks growth the interrow areas were cultivated and sown to signal grass at 4 kg seed/ha. The dry matter yield of the tree legume and grass components was monitored by visual (dry weight rank) and destructive sampling techniques at 6 monthly intervals. Changes in plant morphology, regeneration and survival were also monitored at these times.

Grazing commenced in May 1994 after 17 months growth. Each paddock was continuously grazed by two Brahman cross weaner steers each weighing approximately 150 kg liveweight. The steers were weighed every 28 days after fasting for 24 hours and their liveweights recorded. When the combined (grass plus tree legume) dry matter on offer in any on paddock fell below 800 kg/ha, the cattle were removed to a holding paddock of signal grass alone until regrowth in the treatment paddock exceeded 1000 kg/ha.

RESULTS AND DISCUSSION
Climate: The low annual rainfalls especially in the establishment year restricted the growth of tree legume seedlings and delayed commencement of grazing by 6 months. Over eight frosts occurred in the trial area between June and September 1994. These caused the signal grass to hay off and a severe frost on August 1 1994 with a screen temperature of -1^0C caused substantial scorching and leaf death in Albizia and the low lying sections of Tipuana and Leucaena paddocks. By late September 1994 the frosted Leucaena plants had commenced regrowth but in both Albizia and Tipuana green buds were present but regrowth had not commenced. Other years were milder with few if any frosts.

Tree and Grass Growth: *Albizia chinensis* showed the fastest early growth of the three tree species. By May 1993 mean height of Albizia seedlings was 107cm. *Tipuana tipu* displayed variability in growth with a mean height of 75 cm by May 1993. Growth in one replication of *L. leucocephala* K 636 was always poor. One half of this paddock was continuously grazed by hares and marsupials from planting and the seedlings never recovered. This replication was abandoned after

2 years and was never grazed by cattle. In the other replication Leucaena growth was uniform and by May 1993 average height was 58 cm.

The superiority of Albizia was maintained into the second year with an average yield of 885 kg/ha edible yield just prior to the commencement of grazing. This exceeded the yields of both Leucaena (610 kg/ha) and Tipuana (295 kg/ha) (Table 1). Yields of all species declined from 1994 to 1995 but this was to be expected as all paddocks had been grazed for 10 months by this stage. Albizia again gave the highest yield while Leucaena was the lowest (Table 1). There was an increase in edible yields in all species from 1995 to 1996 but the order of yield remained the same (Table 1). Grass yields remained relatively constant over the years with fluctuations associated with grazing rather than treatments. In May of each year there was always more than 2000 kg grass dry matter/ha in all treatments (Table 1).

Tree Survival: Tipuana had the lowest survival rate of the three species at 63% after three years. More than one quarter of Tipuana seedlings died in the first six months from planting. Albizia (71%) was intermediate while survival in Leucaena (94%) was always high. Yearly mortality rates for the three species generally decreased with time. Survival rates did not reflect dry matter yield. Individual tree size was greatest in Albizia followed by Tipuana then Leucaena.

Live Weight Gain: Live weight gain of the steers grazing the experiment has been divided into 3 periods. Period 1 (May to November 1994), Period 2 (January to May 1995) and Period 3 (May to November 1995). Period 1 ran from the commencement of grazing of the first draft of animals until November 1994 when all animals were removed from the trial because the total dry matter on offer in 5 of the 7 treatment paddocks fell below 800 kg/ha. All animals were grazed on a 4 ha spare area of *B. decumbens* until early January 1995 when they were returned to their treatments after feed on offer had regrown to exceed 1500 kg/ha in all paddocks. The first draft of test animals was replaced in May 1995 (Period 2) with a second draft which grazed on the trial until November 1995 (Period 3).

In periods 1 and 2 liveweight gain was highest from the Leucaena paddock followed by the Albizia treatment although there was no significant difference between treatments except for Tipuana which was significantly lower in Period 2 (Table 2).

Liveweight gains from all treatments declined in Period 3 with the largest decline occurring in the Leucaena paddock. This was associated with the dry cool conditions occurring during this period and the low yield of Leucaena at the start of this period. Liveweight gains were highly variable throughout the trial. Animals within the same paddock often had markedly different liveweight gains and this was reflected in the lack of significant difference between treatments.

Leucaena was poorly adapted to this acidic, poorly drained site. It never reached its potential productivity even in the grazed paddock. Although its yield was always low liveweight gain was highest in Periods 1 and 2 reflecting the high quality of Leucaena forage. By Period 3 however, Leucaena yields were virtually negligible and the animals struggled to maintain weight. Albizia was the best adapted tree legume at this site. Individual tree size was greatest and it always had the highest yield of edible forage. Liveweight gains from the Albizia treatments were always relatively high. Early seedling growth and survival of Tipuana was poor although the yield of surviving plants increased with time. Acceptability of Tipuana foliage by the grazing animals was lowest of the three tree legumes. It was only eaten when grass yields declined and the animals were forced to look for alternative sources of feed. Leucaena on the other hand was always preferentially grazed.

ACKNOWLEDGMENTS

The author is indebted to Mr. J. Hales and his staff of the University Research Farm Mt. Cotton for invaluable technical assistance.

The financial support of the Meat Research Corporation of Australia and the Rural Industries Research and Development Corporation of Australia is gratefully acknowledged.

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Table 1
Edible yield (kg/ha) of three tree legumes and signal grass in a grazing trial in southeast Queensland.

Species	Dry matter yield kg//ha					
	MAY 1994		MAY 1995		FEB. 1996	
	Tree	Grass	Tree	Grass	Tree	Grass
Albizia *chinensis*	885	4300	802	3200	1220	4275
Tipuana *tipu*	295	2200	121	3020	529	4025
Leucaena* leucocephala *K636*	610	2000	63	2280	370	3450
Control (grass alone)	-	3425	-	3030	-	4355
LSD 5%	586	2606	690	1487	687	1574

* Leucaena was not included in the analysis (data from one paddock only).

Table 2
Liveweight gain (kg/head/day) of steers grazing tree legume/signal grass associations in southeast Queensland.

Species	Liveweight gain (kg/head/day)		
	May-Nov 1994 (160 days)	Jan-May 1995 (120 days)	May-Nov 1993 (167 days)
Albizia *chinensis*	0.51	0.54	0.30
Tipuana *tipu*	0.42	0.35	0.19
Leucaena* *leucocephala*	0.53	0.60	0.17
Control (grass alone)	0.44	0.54	0.30
LSD 5%	NS	0.19	NS

*Leucaena was not included in the analysis (data from one paddock only).