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Growth of Cattle Grazing *Leucaena* Genotypes in the Humid Lowland Tropics of Papua New Guinea

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ABSTRACT: The animal production potential of 4 new *Leucaena* genotypes with superior pysllid tolerance and high yield x was investigated in a grazing trial in the Markham Valley of Papua New Guinea (PNG). Nursery raised seedlings of *Leucaena leucocephala* K636 cv. Tarramba, *L. collinsii* OFI 51/88 subspecies *collinsii, L. pallida* CQ 3439 and *L. trichandra* CPI 46568 were each planted into two 1.0 ha paddocks of existing signal grass in rows 5 m apart and 1 m between plants within rows. After 1 year, the *Leucaena* /signal grass pastures, and a control pasture of signal grass only, were rotationally grazed at 6 week intervals by 6 Brahman steers. Pasture DM yield before and after each rotation was estimated. X….X *L. leucocephala* K636 cv. Tarramba and *L. collinsii* OFI 51/88 gave best liveweight gains while *L. pallida* CQ 3439 proved to be less palatable and of lower quality. *L. trichandra* CPI 46568 did not perform well in this lowland tropical environment.

Key Words: Cattle, Leucena. Humid Lowland Tropics, Papua Nerw Guinea

INTRODUCTION

The common LEUCAENA (*Leucaena leucocephala)* is extensively used as a multi-purpose tree x legume in tropical and subtropical agricultural systems (Shelton and Brewbaker 1994). It is highly regarded as a productive tropical legume due to its ability to promote high liveweight gain (Jones 1994). Three major limitations have restricted the more widespread use of *L. leucocephala* as a forage x. These are slow establishment (Lesleighter and Shelton 1986), mimosine toxicity (Jones 1979) and susceptibility to the psyllid insect (*Heteropyslla cubana*) (Mullen *et al*. 1998a). The problem of slow establishment is management related, and the mimosine toxicity problem was been overcome by the discovery of rumen bacteria capable of degrading mimosine and its metabolite, DHP (3-hydroxy-4 (1H)-pyridone) (Jones 1985). However, the arrival of the pysllid insect, *Heteropsylla cubana*, throughout the tropics in mid-1980s has had a devastating effect on the productivity and animal production potential of *L. leucocephala* cultivars (Shelton and Jones 1994).

Agronomic screening in germplasm trials of over 116 genotypes in 17 different environments in south-east Asia, Africa, Papua New Guinea (PNG) and Australia has identified new *Leucaena* genotypes and their hybrids with high pysllid tolerance and superior forage yield (Mullen *et al*. 1998b). The animal production potential of some of these lesser - known genotypes has been recently summarised (Jones *et al*. 1998).

This paper reports the results of a grazing study in PNG to assess the animal production potential of four new *Leucaena* genotypes that offer significant agronomic advantages of psyllid tolerance and high yield x.

MATERIALS AND METHODS

Location

The grazing trial was conducted on a commercial beef cattle stud breeding station at Munum in the exit

Markham valley, PNG, situated at 6^0 33' S longitude and 147^0 48' E latitude, at an altitude of 86 m a.s.l. Munum has a humid tropical climate with an average annual rainfall of 1700 mm, mean maximum and minimum temperatures of 33^0C and 23^0C respectively and a mean relative humidity ranging from 61 % at 0900 hours to 81 % at 1500 hours. The soils are grey black with clay texture, pH 7.2 and highly fertile.

Treatment and experimental design

Ten hectares (ha) of existing signal grass (*Bracharia decumbens* cv. Basilik) was subdivided into 10 individual 1.0 ha paddocks. Four *Leucaena* genotypes (*L. collinsii* sub-species *collinsii* OF1 51/88, *L. leucocephala*, K636 cv. Taramba, *L. trichandra* CPI 46568 and *L. pallida* CQ 3439) were each randomly allocated to two paddocks, giving eight *Leucaena* treatment and two control paddocks. Each pasture treatment was rotationally grazed by 6 steers over 6 grazing periods (2 paddocks x 3 grazings).

Leucaena establishment

Nursery raised seedlings of the 4 *Leucaena* genotypes were transplanted into established signal grass paddocks at row spacings of 5 m and within row spacing of 1 m.

L. pallida CQ 3439, *L. leucocephala* K636 Taramba and *L. trichandra* CPI 46568 were planted between 28th August and 13th September 1996. One and one half paddocks of *L. collinsii* OFI 51/88 were planted on the 10th October 1996. The remaining half of the second paddock of *L. collinsii* OFI 51/88 was planted on 4th January 1997.

All paddocks received 50 kg N/ha as urea before the leucaenas were transplanted in order to increase signal grass growth and thus reduce broadleaf weed competition.

Grazing management

Grazing commenced on 11th August 1997 after the *Leucaena* had been established for 12 months. Thirty (30) Brahman weaner steers weighing 167 ± 2.8 kg liveweight were randomly allocated to one of the treatment paddocks described above and grazed for 6 weeks at X 6 head/ha. The animals were then moved to the second paddock of the same treatment for a further 6 weeks.

During the 1997 drought the trial was suspended for 49 days due to feed shortage; the steers were removed after the completion of first rotation. The trial resumed again on 1st January 1998 and was completed on 18th May 1998. The total grazing period was 243 days.

All animals were inoculated with mimosine degrading rumen bacteria (*Synergestis jonsii*) at the beginning of the trial. Water was reticulated to each paddock and all animals had access to mineralised salt blocks containing sodium and other minor elements but without urea.

Measurements

Liveweight of steers was measured once after four weeks from commencement of grazing and thereafter at 2 weekly intervals. All animals were fasted overnight before weighing. Edible herbage mass (EHM) of the leucaenas and the companion signal grass on offer, were measured at the beginning and at the end of each grazing period, using a calibrated visual ranking method. Fresh samples of new young fully expanded leaves (YEFL) of the leucaenas and plucked samples of signal grass (green leaf and edible stems) were sampled at each measurement period and dried at 70 ^{0}C for 72 hours. The dried samples were ground to pass through 1.0 mm mesh and stored for subsequent determination of nitrogen (N), neutral detergent fibre (NDF) and *in vitro* dry matter digestibility (IVDMD).

RESULTS

Edible herbage mass and herbage allowance on offer

The mean yield of edible herbage mass (EHM) of both *Leucaena* forage and understorey grass of the five pasture types over 6 grazing periods are presented in Table 1. EHM yield of the *L. pallida* CQ3439 pasture treatment was high (>1.0 t/ha). However, its companion understorey of edible signal grass yield was lower (< 1.0 t/ha). X *L. collinsii and* L. leucocephala K636 cv. Tarramba produced similar edible forage yields (~ 0.7 t/ha) while the yield of *L. trichandra* edible forage was the lowest at 0.3 t/ha. In contrast, the yields of companion understorey signal grass in *L. trichandra* and *L. collinsii* pasture treatments were high (> 1.0 t/ha) and equal to that of the control signal grass only treatment.

Understorey grass yield *of L. leucocephala* K636 cv. Tarramba was the lowest at 760 kg/ha. *Leucaena* forage allowance was about 50 % of the total herbage allowance in *L. pallida* CQ3439 and *L. leucocephala* cv. Tarramba pasture treatments, while *L. collinsii* OFI 51/88 contributed 32 % of the total herbage allowance. Due to the low edible *Leucaena* forage yield and high understorey grass yield, the *L. trichandra* pasture treatment had the lowest herbage allowance of edible *Leucaena*. All *Leucaena* pastures had higher total herbage allowance than the grass only pasture treatment.

Chemical composition and *in-vitro* dry matter digestibility

The mean *in vitro* DM digestibility and chemical composition of the 4 *Leucaena* species and signal grass pastures are given in Table 2. Except for *L. collinsii* OFI 51/88, the mean IVDMD of the YFEL of both *Leucaena* and the understorey grass in all pasture treatments were similar (50.4 - 55.8 % digestibility). The mean IVDMD of the YFEL of *L. collinsii* OFI 51/88 was 2 - 3 % higher than the other treatments. The mean N content of all *Leucaena* forages was higher than the edible grass components. The mean N content of *L. collinsii* OFI 51/88 was 0.6 - 0.7 % higher than the other three species. The mean NDF contents of the signal grass components in all treatments were similar and higher than for *Leucaena* forage. Ash contents of both edible grass and *Leucaena* in all treatments were similar.

Liveweight gain

The animal production of the different *Leucaena* pasture types, expressed as liveweight gain (LWG) per day (kg/d), are presented in Table 3. Steers grazed on *L. leucocephala* cv. Tarramba and *L. collinsii* OFI 51/88 pasture treatments gave significantly ($P<0.001$) higher LWG than the other pasture types. *L. pallida* CQ3439 gave the lowest LWG. Despite having lower yields and lower herbage allowance of edible *Leucaena* forage, *L. collinsii* OFI 51/88 gave significantly ($P<0.001$) higher LWG than the *L. pallida* CQ3439 pasture treatment. LWG of steers on *L. trichandra* CPI 3439 and signal grass only control treatments were similar and significantly ($P<0.001$) higher than those on the *L. pallida* CQ3439 pasture treatment.

DISCUSSION

The agronomic superiority of *L. pallida* CQ3439 and *L. leucocephala* K636 cv. Tarramba reported in the germplasm trails by Mullen *et al*. (1998b) was evident in this grazing trial. Both species were quick to establish in the field after transplanting and overcame any pest attack or weed competition. As a result, these species produced the highest edible herbage mass (EHM) when rotationally grazed over 243 days. Even when cut, both species regenerated fast. It was observed that *L. leucocephala* K636 cv. Tarramba produced multiple stems from the base when the cut stems were ring-barked by cattle during the drought in 1997.

Table 1. Mean (± s.e) edible herbage mass (EHM), percentage of edible *Leucaena* forage and herbage allowance on offer in *Leucaena* signal grass pastures grazed by steers at Munum, PNG.

	Pasture treatment				
	L. pallida CQ3439	*L. collinsii* OFI 51/88	*L. leucocephala* cv. Tarramba	*L. trichandra* CPI 46568	Signal grass only
Edible herbage mass (kg/ha)					
Leucaena	1028 ± 234	670 ± 168	745 ± 191	313 ± 53	-
Signal grass	813 ± 295	1178 ± 406	760 ± 256	1220 ± 415	1155 ± 388
Total	1841 ± 404	1848 ± 508	1506 ± 439	1533 ± 451	1155 ± 388
Herbage allowance †					
Leucaena	10 ± 2	6 ± 1	7 ± 2	3 ± 1	-
Signal grass	9 ± 3	13 ± 5	8 ± 3	14 ± 5	12 ± 4
Total	19 ± 4	19 ± 6	15 ± 4	17 ± 6	12 ± 4

† Herbage allowance calculated as kgDM/100 kg liveweight (LWt.) per day.

L. trichandra CPI 46568 was slow to establish in the field and suffered 18 % mortality after transplanting. It did not coppice well when cut at 1 m stem height after the first grazing period. Mullen *et al*. (1998b) found that *L. trichandra* CPI 46568 did not coppice well at all lowland sites in a multi-site germplasm trial. *L. collinsii* OFI 51/88 suffered 23 % seedling mortality after transplanting due to grasshopper attack on the young succulent stems, which were nipped off at the base. However, despite the high mortality at establishment, it produced two times more EHM than *L. trichandra* due mainly to its multi-stem shrubby growth habit.

It was observed that the *L. leucocephala* K636 cv. Tarramba and *L. collinsii* genotypes were very palatable to the steers and readily eaten. This phenomenon was also reported by (Jones *et al*. 1998). *L. pallida* CQ 3439 and *L. trichandra* CPI 46568 were only eaten by steers when the edible signal grass components were low.

The animal production potential of the four *Leucaena* genotypes was highest in *L. leucocephala* K636 cv. Tarramba and *L. collinsii* OFI 51/88. This could be due to the higher quality of EHM on offer. Although, the N contents of the YFEL of all *Leucaena* species was similar and higher than the understorey grass at similar digestibility, *L. pallida* CQ 3439 and *L. trichandra* CPI 46568 were clearly less palatable perhaps due to anti-nutritive factors (Norton *et al*.1994), or due to high concentrations of condensed tannins compared with *L. leucocephala* K636 cv. Tarramba (Dalzell *et al*. 1998). These authors also found that *L. collinsii* OFI 51/88 contained no condensed tannins. Condensed tannins could have affected not only the palatability but also the digestion and utilisation of proteins by the steers grazing *L. pallida* CQ 3439 and *L. trichandra* CPI 46568 (McNeill *et al*. 1998).

Table 2. Mean *in-vitro* dry matter digestibility (IVDMD), nitrogen (N), neutral detergent fibre (NDF) and ash content (%DM) of the YFEL* of the four *Leucaena* species and edible components ‡ of the understorey signal grass (*Bracharia decumbens*) grazed by steers at Munum in PNG.

Pasture Treatment	IVDMD	N	NDF	Ash
L. pallida CQ3439	53.6	3.4	47.7	4.8
signal grass	50.8	1.4	63.6	6.7
L. collinsii OFI 51/88	57.0	4.0	46.3	5.6
signal grass	54.5	1.1	63.8	8.2
L. leucocephala K636	54.8	3.4	47.6	6.5
signal grass	55.8	1.2	63.6	7.6
L. trichandra CPI46568	50.4	3.3	46.6	6.0
signal grass	53.8	1.3	65.3	7.9
Signal grass (control)	54.8	1.0	71.0	8.0

*YFEL = Young fully expanded leave

‡ Green leaf and stem;

Table 3. Least square mean liveweight gain (LWG) of steers grazing *Leucaena* signal grass (*Bracharia decumbens* pastures at Munum, Papua New Guinea.

Pasture treatment	LWG (kg/d)
Signal grass only control	0.48a
L. pallida CQ3439	0.36b
L. collinsii OFI 51/88	0.56c
L. leucocephala cv. Tarramba	0.65c
L. trichandra CPI 46568	0.48a

LSMeans within column with different letters are significantly different (P<0.001)

CONCLUSION

The results show that *L. leucocephala* K636 cv. Tarramba was superior in its ability to promote liveweight gain when grown in combination with a highly productive tropical grass such as signal grass. *L. collinsii* OFI 51/88 is an alternative to Tarramba in areas of high pysllid incidence.

For better utilisation, Tarramba should be cut low (50 - 75 cm) after first grazing to promote more basal branching and may need to be regularly cut to maintain plant height suitable for grazing animals. *L. pallida* CQ 3439 was found to be not suitable for use in grazing systems because of its lower quality and palatability. It may be best utilised as a parent plant for inter-specific hybridisation where it is known to contribute excellent hybrid vigour. *L. trichandra* is not recommended for grazing systems in the lowlands as it was not tolerant of the high grazing pressures imposed.

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