TOXICITY OF *LEUCAENA LEUCOCEPHALA* I. EQUAL TOXIC EFFECTS OF TWO *LEUCAENA* STRAINS ON TWO BREEDS OF TROPICAL CATTLE

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ABSTRACT

The toxic effects of Hawaii and Peru varieties of Leucaena leucocephala *on Brahman crossbred and Javanese Zebu cattle were compared under grazing, using Buffel grass* (Cenchrus ciliaris) *as a non-thyrotoxic control. Incidence of hair loss, erosions of the mucosa of the tongue and goitre was the same for both varieties of* Leucaena *and both breeds of cattle. These effects were not found with Buffel grass. Toxicity was also observed with the indigenous Papua New Guinea variety of* Leucaena. *Animal production per hectare on* Leucaena *was similar to that on Buffel grass.*

INTRODUCTION

Toxic effects of *Leucaena leucocephala* (Cv. Peru) on ruminants include depilation (Hegarty, Schinkel and Court 1964), goitre (Bindon and Lamond 1966) and infertility (Holmes 1976). These effects have been related to the content of mimosine or to that of its fermentation product 3, 4, di-hydroxy pyridine (DHP) (Hegarty, Court, Christie and Lee 1976). However, the Hawaii variety of *Leucaena* is used extensively as forage for ruminants in Hawaii and a similar variety is used in S.E. Asia, with few reported ill-effects, despite the mimosine content which is higher than that of the Peru variety (Hutton and Gray 1959).

The toxic effects of *Leucaena*, cited above, have been demonstrated with *Leucaena* making up most or all of the diet. While *Leucaena* is sometimes grazed in mixed pastures in Hawaii and S.E. Asia, it is often hand fed in limited quantities as hot-air dried (in Hawaii) or wilted or sun-dried material (e.g. in the Philippines). The small quantities fed or the drying treatments may ensure that the quantity of mimosine ingested is below a toxic limit and Hawaii *Leucaena* may be as toxic as Peru *Leucaena* if grazed as a pure stand.

Alternatively, Hawaii *Leucaena* may be less toxic than Peru *Leucaena*, or indigenous S.E. Asian cattle (Javanese Zebu) may have metabolic or digestive differences from *Bos taurus* and *Bos taurus x Bos indicus* hybrids rendering them less susceptible to the toxic factors. This trial was designed to compare the toxicity of Peru and Hawaii *Leucaena* for *Bos indicus* (Brahman) × *Bos taurus* and *Bos indicus* (Javanese Zebu).

MATERIALS AND METHODS

The Beef Cattle Research Centre, Erap, is situated at 100 m elevation in the Markham Valley, latitude 7° 30′ S. Rainfall is 1250 mm per annum, in two distinct wet seasons. Temperatures range from 18° to 35°C with little variation throughout the year.

The experiment was a 3 × 2 factorial, with three pastures, two breeds of cattle and three steers per group. The

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pastures available were 4.1 ha of Nunbank Buffel grass, 2.35 ha of Hawaii *Leucaena* and 3.7 ha of Peru *Leucaena*. Both *Leucaena* pastures were planted in rows 2-3 m apart, with only inedible weeds between the rows. The Hawaii *Leucaena* grew on slightly better soil, a sandy loam, while the other pastures were on more gravelly soil.

The Brahams crossbred steers, about ⅝ to ¾ Brahman, were 14-17 months old and weighed 215 + 8 kg. The "Javanese Zebu" (Holmes 1977), a smaller breed from South East Asia, were 12-18 months old, and weighed 177 ± 10 kg. Three steers of each breed were allocated to each pasture on the basis of liveweight, in November, 1976. They were set stocked and weighed every 4 weeks after an overnight fast. In October, 1977, the steers were slaughtered. Hair loss from the tail switch and erosions in the mouth were assessed on an arbitrary scale from 0 to 3. Carcass weight, back fat thickness and weight of thyroid were measured.

Statistical analysis was by the method of Snedecor and Cochran (1967).

RESULTS

HAIR LOSS

Nine of the 12 animals on *Leucaena* pastures lost hair from the tail switch, but only one lost all the hair. There was no difference in score between breeds of cattle or between varieties of *Leucaena (Table 1)* however results from both varieties of *Leucaena* differed significantly from those from Buffel grass ($P < .05$) where hair loss did not occur.

EROSIONS

Erosions on the side of the tongue, just anterior to the torus, occured in 5 of 12 steers grazing *Leucaena* but were smaller than previously seen, and no drooling of saliva was noted in any of these animals. There was no difference between breeds of cattle or varieties of *Leucaena (Table 1)*. No tongue erosions were found in cattle grazed on Buffel grass.

THYROID GLAND WEIGHT

Steers grazing *Leucaena* had significantly ($P < .05$) larger thyroids than steers on Buffel grass *(Table 1)*. There was no difference between *Leucaena* varieties or breeds of cattle. The heaviest thyroid from a steer fed Buffel grass weighed 25 g while thyroids from animals fed *Leucaena* ranged from 67 g to 245 g.

LIVEWEIGHT GAINS

Animals grazing Buffel grass and Peru *Leucaena* grew at similar rates *(Table 2)*. Animals grazing Hawaii *Leucaena* at a heavier stocking rate grew more slowly ($P < 0.01$) but on a per hectare basis, Hawaii *Leucaena* was as productive as the other pastures. "Javanese Zebu" steers grew 0.3 kg/day, significantly ($P < 0.05$) more slowly than Brahman cross steers (0.4 kg/day).

CARCASS WEIGHTS AND BACK FAT

The carcasses of steers grazed on Hawaii *Leucaena* were smaller ($P < .01$) than those of steers fed Buffel grass or Peru *Leucaena (Table 3)*. Steers grazing Peru *Leucaena* had slightly smaller carcasses than steers fed Buffel grass. The dressing percentage for steers grazing *Leucaena* was significantly ($P < 0.01$) greater than for steers grazing Buffel grass. The "Javanese Zebu" produced smaller ($P < .01$), fatter ($P < .01$) carcasses with a similar dressing percentage ($P < .10$).

DISCUSSION

Specific toxic effects, i.e. hair loss, erosions on the tongue and goitre did not differ significantly between *Leucaena* varieties or cattle breeds in incidence or severity. In a larger trial, or one using more sensitive techniques of assessing toxicity, such as measurements of circulating thyroid hormone concentrations, some difference

Table 3. — Carcass data for Brahman cross and "Javanese Zebu" steers grazed on Buffel grass or varieties of *Leucaena leucocephala* (dressing percentage and back fat corrected for carcass weight, within breeds)

	Carcass weight	Dressing	Backfat thickness
	kg	%	mm
Buffel grass	208 a	57.2 a	4.6
Hawaiian *Leucaena*	172 b	61.5 b	not recorded
Peruvian *Leucaena*	194 a	60.5 b	5.4
Brahman cross	212 a	59.2	3.8 a
Javanese Zebu	170 b	60.3	6.4 b

a, b: Means with different letters are significantly different ($P < 0.05$) by Newman Keul's test.

between varieties or cattle breeds may be detectable. However, the lack of reports of toxic effects of *Leucaena* in Hawaii and S.E. Asia does not seem to be due to a lower toxicity of Hawaii *Leucaena* or to a greater tolerance in S.E. Asian cattle. It is probably due to the feeding of small amounts of *Leucaena* which have often been subjected to drying processes which reduce the amount of mimosine (Matsumoto, Smith and Sherman 1951), or to restriction of feeding of *Leucaena* to the dry season when less active growth results in lower concentrations of mimosine (Hegarty and Court 1972).

No areas of the indigenous variety of *Leucaena* are available at Erap. On an area of 100 ha on an adjacent plantation, the indigenous variety of *Leucaena* was planted in rows and the intended underplanting with coffee did not take place. Cattle were grazed on this *Leucaena* and adjacent grassland at a stocking rate which compelled consumption of a large amount of *Leucaena*. Birth of dead hairless calves occurred, and some calves were born very weak and died soon after birth. Ten out of 20 live calves up to one month old showed visible goitre. This experience suggests that the indigenous P.N.G. variety of *Leucaena* is also strongly goitrogenic.

The higher dressing percentage of steers grazed on *Leucaena* was associated with a more extensive fat cover on the carcasses, although fat thickness did not show as significantly greater, partly due to unskilled skinning. Thyroid deficient animals normally show somewhat slower growth rates and more subcutaneous fat.

Accurate comparisons of animal production on the different pastures cannot be made, due to lack of replication. However, *Leucaena* did not exhibit the great advantage in cattle

Table 1. — Scores for hair loss and erosions of the epithelium of the tongue, and weight of thyroid glands from Brahman and "Javanese Zebu" steers grazing Buffel grass or *Leucaena leucocephala*

	Hair loss score	Erosions score	Thyroid weight (g)
Buffel grass	0 a	0	22 a
Hawaiian *Leucaena*	2.0 b	1.0	135 b
Peruvian *Leucaena*	1.8 b	1.0	133 b
Brahman cross	1.1	0.4	94
Javanese Zebu	1.4	0.9	100

a, b: Means with different letters are significantly different ($P < 0.05$) by Newman-Keul's test.

Table 2. — Growth rates of Brahman cross and "Javanese Zebu" steers grazing Buffel grass or varieties of *Leucaena leucocehala* in almost pure stands

	Growth rate kg/day	Stocking rate steers/ha	Growth rate kg/ha/day
Buffel grass	0.44 a	1.46	0.62
Hawaiian *Leucaena*	0.24 b	2.55	0.61
Peruvian *Leucaena*	0.38 a	1.63	0.62
Brahman cross	0.40 a		
Javanese Zebu	0.30 b		

a, b: Means with different letters are significantly different ($P < 0.05$) by Newman Keul's test.

growth rate it would need to compensate for the difficulty of management of browse pasture.

Blunt (1976) found that growth of steers on *Leucaena* planted in rows 2-3 m apart, interplanted with *Digitaria decumbens* was poor and toxic signs were seen. When grazed free-choice in blocks of up to 20% of the pasture area (Partridge and Ranacou 1974) *Leucaena* was an effective supplement to *Dichanthium caricosum* in the drier zones of Fiji, but the best growth rates achieved were only about 0.5 kg/day. In the present experiment, growth rates of animals grazing pure stands of *Leucaena* were even lower, 0.38 lbs/day. Thus animal performance on *Leucaena* in several trials has been below what would be expected from such a high protein, high energy forage, and presumably the limiting factors are mimosine and its metabolites. This suggests that the maximum amount of *Leucaena* in the diet of grazing cattle ought to be kept quite low to avoid toxicity. Under rapid growth conditions in the humid tropics or under irrigation during the dry season the method of utilizing *Leucaena* by grazing must be re-examined.

Current work in CSIRO's Division of Tropical Crops and Pastures (Hutton 1976) is directed to the production of a "Low-Mimosine" variety of *Leucaena*. This could be a big advantage for cattle-raisers who are contemplating planting *Leucaena*. Such new varieties however, will not solve the problems of areas where the older, toxic varieties already grow. *Leucaena* is widespread throughout Papua New Guinea up to 1500 m elevation. It grows in dense thickets along streams, where water-dispersal of seeds aids further spread, and it is in common use as a shade tree in plantations. Eradication and replacement by less toxic varieties does not appear feasible. Further studies are under way to find methods of using this legume in Papua New Guinea.

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