STEER LIVEWEIGHT GAINS IN RELATION TO THE PROPORTION OF TIME ON *LEUCAENA LEUCOCEPHALA* PASTURES

C. G. BLUNT* and RAYMOND J. JONES†

ABSTRACT

Kimberley shorthorn weaner steers stocked at 5.6 ha^{-1} initially made good gains (0.9 kg day^{-1}) on irrigated leucaena-pangola pastures but subsequently gained poorly. Over 308 days they gained a mean of only 0.29 kg day^{-1}. A pasture rotation of one week grazing and three weeks rest, designed to produce feed lower in mimosine, did not alleviate the situation compared with a rotation of one week graze and one week rest.

When steers were moved from leucaena pasture to a pangola pasture they gained poorly compared with those grazing only pangola grass. On returning to leucaena pastures they grew much faster than those grazing leucaena pasture only. Overall gains were, however, very similar. Toxicity ratings were related to the time spent on leucaena.

In a subsequent trial steers grazed leucaena or pangola for 224 days and gained respectively 0.29 and 0.46 kg day^{-1}. When common grazed on leucaena they gained 0.24 and 0.62 kg day^{-1} respectively.

It is concluded that animals grazing leucaena develop a chronic toxicity which depresses liveweight gain. It is further postulated that the toxicity may be overcome by removing animals to pasture free of leucaena.

Genetic potential of the Kimberley shorthorn cattle in this hot tropical environment could not be implicated since these animals gained 0.9 kg head^{-1} day^{-1} on a feedlot ration.

INTRODUCTION

Poor weight gains have been a feature of young steers grazing fertilized irrigated *Leucaena leucocephala* cv. Peru (leucaena)–*Digitaria decumbens* (pangola pastures) in the Ord Valley (Blunt 1976) and this low weight gain has been associated with enlargement of the thyroid glands (Jones *et al.* 1976). These effects are thought to be due to a chronic toxicity resulting from prolonged intake of leucaena and its toxic amino acid, mimosine. Breaking the continuity of leucaena feeding by alternating the grazing of leucaena pastures with a grass pasture was considered as a possible method of overcoming the problem. A reduction in the mimosine concentration of material on offer to the animals could also be achieved by lengthening the rotational cycle. This would produce older shoots with a smaller proportion of growing tips and young leaves known to contain high levels of mimosine (R. J. Jones and M. P. Hegarty, unpublished data).

These possibilities were examined in the experiment reported here and in addition the potential growth rate of Kimberley shorthorn steers (KSH), used in this and previous experiments, was measured under feed lot conditions. This latter aspect was considered important to ensure that the feed, and not the genetic potential of these animals, was the major limiting factor to better growth in this hot tropical environment.

MATERIALS AND METHODS

An area of 6.1 ha of leucaena-pangola pasture (hereafter referred to as leucaena pasture) and an adjacent area of 1.6 ha of nitrogen fertilized pangola pasture on the CSIRO Kimberley Research Station (15°39′S, 128°43′E) was used for the grazing experiment.

---

* CSIRO Division of Tropical Crops and Pastures, Kimberley Research Station, Kununurra, W.A. 6743 (present address: 63 Mackenzie Street, Hackett, A.C.T.).

† CSIRO Division of Tropical Crops and Pastures, Davies Laboratory, Townsville, Qld. 4810.

All pastures were flood irrigated fortnightly except when there was less than 50 mm net evaporation since the previous irrigation. They received 214 kg ha^{-1} of single superphosphate on September 12, 1973 and the pangola grass pastures received in addition a total of 454 kg N ha^{-1} as urea in five separate applications.

The area of leucaena was divided into twenty paddocks and used in conjunction with the one pangola paddock to obtain different sequences of stocking and different rotational treatments as set out in Table 1.

The overall stocking rates were maintained at 5.6 steers ha^{-1} on the leucaena pastures and at 10.6 steers ha^{-1} on the pangola pastures by a reciprocal movement of animals between pastures. Those animals spending two-thirds of their time on leucaena spent two months on leucaena, common grazing with animals spending all their time on leucaena, and one month on the single 1.6 ha pangola paddock. The animals spending one-third of their time on leucaena exchanged places with the two-thirds leucaena animals on the pangola pasture. The stocking rates on the leucaena/pangola pastures were lower than the stocking rates required to achieve maximum gains ha^{-1} measured previously (Blunt 1976) and ensured that there was adequate leucaena available to the steers.

The pasture treatments were incorporated into a randomized block design with unequal replication. The core of the experiment was a factorial combination of rotation treatment by time spent on leucaena, viz.:—

2 paddocks (1 week graze, 1 week rest) } × { Full time on leucaena; $\frac{2}{3}$ time on leucaena; $\frac{1}{3}$ time on leucaena }
4 paddocks (1 week graze, 3 week rest)

The remaining treatments were the full time pangola treatment and the feed lot treatment giving a total of 8 treatments. The treatments, numbers of replicates and number of steers per replicate are given in Table 1. The uneven allocation of animals was necessary because of the areas available and the paddock layout.

TABLE 1

Management treatments on leucaena/pangola and pangola pastures

Management Treatments	Time on Leucaena/ Pangola pasture	Number of Replications	Total number of steers per replicate			Stocking Rate Steers ha^{-1}
	%		*Rep* 1	*Rep* 2	*Rep* 3	
1. Leucaena-pangola pasture 2-paddock system	100	3	4	3	3	5·6
	67	2	3	3		
	33	2	3	3		
4-paddock system	100	3	4	4	4	
	67	3	2	2	2	
	33	3	2	2	2	
2. Pangola pasture 1-paddock system	0	1	5			10·6
3. Feed lot	—	1	6			—

Weaner KSH steers in light to emaciated condition and averaging 130 kg live-weight were used. They were grazed on irrigated nitrogen fertilized pangola grass pastures for one month prior to the commencement of the experiment on November 8, 1973. The experiment finished on September 13, 1974. Worms were controlled by a single initial injection of "Nilverm" and ticks were controlled by spraying.

A mineral supplement containing 13.5% P, 23.0% Ca, 50 ppm Co, 250 ppm Cu and 750 ppm F was supplied as a lick to all grazing animals throughout the experiment. During the period November to April iodised salt blocks (400 ppm I_2) were also offered.

The feed lot animals were fed *ad lib*. They received sorghum hay for the first five days, 50% hay/50% grain ration for the next five days, 25% hay/75% grain ration for the third five days and thereafter the full grain ration of 87.7% sorghum grain, 9.8% sorghum hay, 0.5% meatmeal, 1.0% urea, 1.0% limestone and a vitamin mix at a rate of 17 g/100 kg of ration.

Steers were weighed each month after a 14 hour fast from feed and water. At each weighing they were rated on a scale of zero to eight for toxicity symptoms, one point being given for each of the following: hair loss from tail, coronet, body, pizzle and face and lesions on coronet, body and pizzle.

Mean live weight gains per animal were calculated for each cell and an analysis of variance for eight groups with unequal replication was used to determine the statistical significance of differences between treatments.

In December 1973, February/March and May/June 1974, the leucaena leaf yield in each paddock just prior to grazing was estimated using the method described by Campbell and Arnold (1973).

In a second trial steers grazed either leucaena pastures (18 head) or pangola grass (six head) for 224 days at 7.4 steers ha^{-1}. They were then common grazed on leucaena pasture for a further 56 days and their weight gains recorded to assess the effect of previous pasture history on liveweight gain.

RESULTS

Over the period of the experiment mean gain of lot fed steers was 0.90 kg day^{-1} which was significantly greater ($P < 0.01$) than the mean gains of steers on the pasture treatments (Figure 1) of 0.29 kg day^{-1}.

There was no significant difference between the two and four paddock rotations, so the results from these have been pooled in the data presented.

Overall the gains from all the pasture treatments were not significantly different, but the patterns of gain differed greatly. Compared with the steers grazing pangola full time and which gained weight in a linear manner throughout, those on leucaena pasture full time gained weight rapidly initially (0.9 kg day^{-1}) and then declined until finally animals only maintained weight (Figure 1). For the first two months gain was identical to the gains of steers in the feed lot.

Steers which alternated between leucaena pastures and pangola pastures invariably gained better when moved to leucaena pastures and gained significantly ($P < 0.01$) more weight at these times than those maintained continuously on leucaena (Figure 2). Furthermore, the weight gains in the second month on leucaena pastures were better than in the first month after returning to leucaena (Figure 2). Conversely, steers moved to pangola after leucaena gained less than those on pangola full time. In every case, steers which grazed leucaena for two months consistently lost weight when moved to pangola (Figure 2).

Toxicity ratings increased as the experiment progressed and were related to the proportion of time spent on leucaena. The longer rotation system, however, did not alleviate the toxic effects of leucaena (Table 2).

The yield of leaf available to the steers was similar for the two and four paddock rotation systems with a mean of 770, 1370 and 1150 kg leaf dry matter ha^{-1} in December, February/March and May/June respectively. Although there were paddock differences in leucaena leaf yield between replicates there was no relation between leaf yield and toxicity rating indicating that there was adequate leucaena in all paddocks to satisfy the animal requirements.

In the second experiment, steer liveweight gains over 224 days were 0.28 and 0.46 kg day^{-1} for the leucaena and pangola pastures respectively. For the 56 day period of common grazing on leucaena pastures daily gains were 0.24 kg for those previously on leucaena pasture and 0.62 kg for those previously on pangola grass.

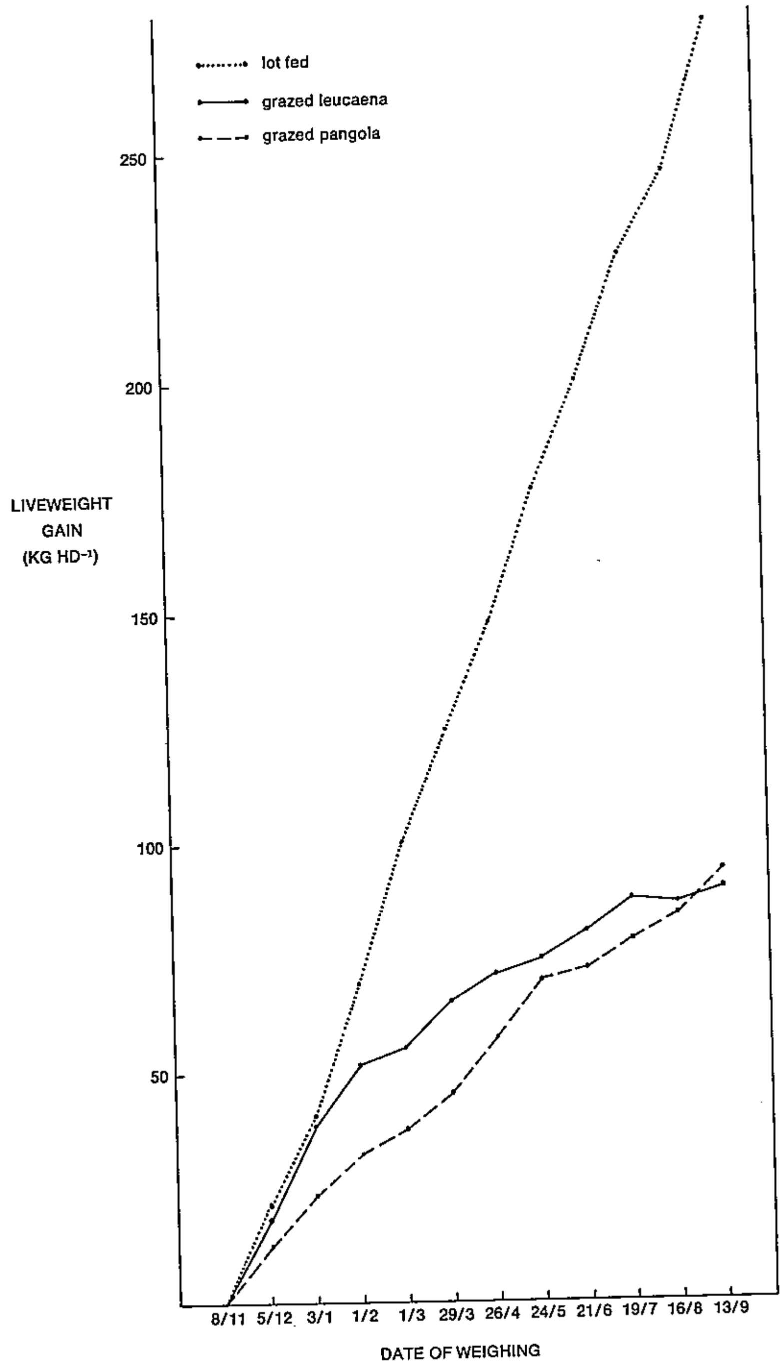

FIGURE 1

Liveweight gain of steers fed in a feed lot, grazing irrigated leucaena-pangola pastures and grazing irrigated nitrogen fertilized pastures.

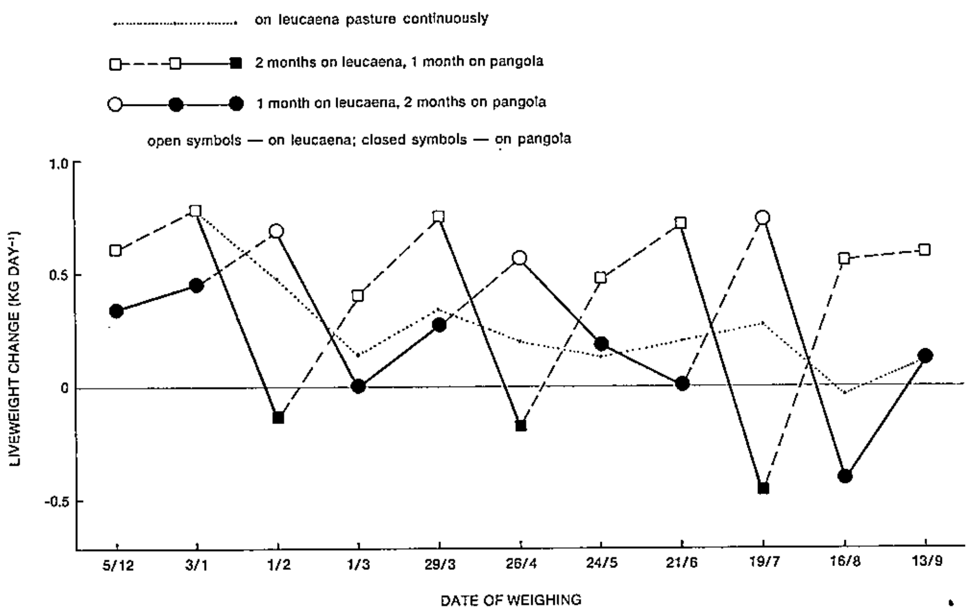

FIGURE 2

Liveweight change of steers grazing irrigated nitrogen fertilized pangola grass and different sequences of irrigated pangola and leucaena pastures.

TABLE 2

Toxicity ratings of cattle exposed to leucaena

Leucaena Management	Exposure to leucaena			
	Full	⅔	⅓	Mean
2-paddock	3·6	1·2	0·5	1·8
4-paddock	3·2	1·2	0·5	1·6
Mean	3·4	1·2	0·5	—

Standard errors of differences between:—
Full and ⅔ or ⅓ = ±0·52
⅔ and ⅓ = ±0·55
2 and 4 paddock = ±0·44

DISCUSSION

It is clear from the lot feeding experiment that KSH steers have the potential for weight gain in the environment of the Ord Valley and that the poor gains experienced on pasture are not due to low genetic potential.

The pattern of gain of the steers on leucaena pastures is suggestive of a cumulative effect of leucaena (possibly mimosine) intake on animal performance. Toxicity scores also decreased as the amount of leucaena feeding decreased.

The improved weight gain of animals on leucaena following a break on pangola is of considerable interest. Fill differences or compensatory effects may be postulated. However, the better gain in the second month compared with the first after returning to leucaena pastures negates the proposition that gut fill was involved. The results of the second experiment clearly show that simple compensatory gain is not involved. Compensatory gain of steers that had previously grazed pangola would certainly not be expected when they changed to leucaena because the previous weight gains over 224 days were so superior to those on the leucaena pastures.

The toxic effect of leucaena feeding may persist for a time after leucaena feeding ceases but a further period of time off leucaena results in recovery. This hypothesis is supported by the lower weight gains of the steers grazing pangola after leucaena compared with those permanently on pangola—a carry-over effect of the toxicity, and by the superior gains when grazing leucaena pastures after pangola compared with the gains of steers permanently on leucaena—a dissipation of the toxicity when on pangola.

The lack of overall difference between pasture treatments was probably due to the low feed availability on the pangola pasture resulting from the high stocking rate used. In the second experiment the gains on pangola at the lower stocking rate of 7.4 steers ha^{-1} were far superior.

It is therefore concluded that a chronic toxicity problem severely reduces the gain of animals grazing leucaena pastures. The hypothesis that the toxicity is cumulative but can be reduced or overcome by removing animals to pastures free of leucaena requires further testing.

ACKNOWLEDGEMENTS

We wish to thank Mr. J. H. Hindmarsh and Mr. R. Lethbridge for technical assistance, Mr. R. B. Cunningham for statistical advice and Hooker Corporation for lending the animals.

REFERENCES

BLUNT, C. G. (1976)—Preliminary cattle grazing trials on irrigated *Leucaena leucocephala* and pangola grass in the Ord Valley N.W. Australia. *Proceedings of the Australian Society of Animal Production* **XI**: 10p.

CAMPBELL, N. A., and ARNOLD, G. W. (1973)—The visual assessment of pasture yield. *Australian Journal of Experimental Agriculture and Animal Husbandry* **13**: 263-7.

JONES, R. J., BLUNT, C. G., and HOLMES, J. H. G. (1976)—Enlarged thyroid glands in cattle grazing Leucaena pastures. *Tropical Grasslands* **10**: 113-6.