TOXICITY OF *LEUCAENA LEUCOCEPHALA* II. REDUCED FERTILITY OF HEIFERS GRAZING *LEUCAENA LEUCOCEPHALA*

J.H.G. Holmes*

ABSTRACT

Twenty four heifers grazing Leucaena leucocephala *cv. Peru were mated when they reached 300 kg live weight. Eight heifers conceived in less than four months, ten conceived in 9-18 months and six did not conceive in 12-27 months. Eleven similar heifers on grass pastures all conceived in less than two months. Growth rates of heifers with different reproductive performances were similar. Fourteen heifers were slaughtered, including six which had not conceived, five which were not detectably pregnant by rectal palpation but had embryos one to six weeks old and three which had calved but not conceived again. All had some degree of goitre. All non-pregnant heifers had ovaries and uteri of normal appearance. All calves born had goitre. Five heifers tested pregnant failed to produce a calf. Three bulls used had normal semen and libido. A defect is suspected in establishment or maintenance of pregnancy after mating.*

INTRODUCTION

Leucaena leucocephala is a leguminous browse tree or shrub with great potential for production of high protein forage. It occurs in many areas of the tropics and sub-tropics, where it is used as forage or as a shade for plantation crops such as cocoa or coffee. Its agronomic, genetic, nutritional and toxic characteristics were reviewed by Gray (1968). Toxicity was manifest in depilation, growth reduction, infertility in rats and embryonic death in mice. In ruminants the most obvious toxic features are hair or fleece loss (Hegarty *et al.* 1964), oesophageal ulcers and enlarged thyroids in sheep (Bindon and Lamond 1966) and cattle (Hamilton *et al.*1971), when it is fed as the sole diet in pens. Goitre has been found in cattle grazing *Leucaena* as mixed pasture or pure stands (Jones *et al.* 1976). Although Hylin and Lichton (1965) and Joshi (1968) have shown effects of mimosine and *Leucaena* on reproduction of rats, the effects upon reproduction in ruminants is not clear. Beaumont (1948) fed *Leucaena* as the sole roughage to dairy cows for two years and recorded no abnormalities. However Hutton and Gray (1959) and Gohl (1975) state that *Leucaena* is suspected of causing sterility in cows. Bindon and Lamond (1966) fed *Leucaena* to ten pregnant ewes in pens and recorded one abortion and the birth of small weak lambs with 50% mortality in one month. Hamilton *et al.* (1971) fed *Leucaena* to five heifers in pens, and recorded no alterations in oestrus cycle length, conception rate or gestation length, but recorded one still birth and four undersized (19 kg) calves with enlarged thyroids. The present paper reports on a two and half year trial with 24 heifers grazing pure stands of *Leucaena*, in which reproduction was severely affected. A preliminary report has been published (Holmes 1976).

* Formerly Senior Veterinary Officer (Cattle) Department of Primary Industry, Beef Cattle Research Centre, Erap, Papua New Guinea. Present address: School of Agriculture and Forestry, University of Melbourne, Parkville, 3052, Victoria, Australia.

MATERIALS AND METHODS

Leucaena leucocephala (cv. Peru) was established at Erap, Morobe Province in 1967 on light sandy soil, in rows two to three metres apart. Guinea grass and

Buffel grass failed to persist between the rows despite repeated sowings. The pasture during the experiment contained *Leucaena* and inedible weeds (*Sida* spp., *Solanum torvum*, *Digitaria insularis*). For the first five months, four paddocks totalling 5.35 ha were available for grazing and subsequently 7.15 ha were used.

The experiment was designed to measure heifer and calf growth rate on a diet of *Leucaena*. The trial was set up in August, 1974, using 24 crossbred (½ to ¾ Brahman) heifers 12-18 months old grazed rotationally on *Leucaena*. Twelve heifers received two grams of potassium iodide orally per month for the first year and subsequently the same amount of iodine in iodized oil by injection. When they reached 300 kg, they were placed with a bull in a separate paddock of *Leucaena*.

Eleven similar heifers, grazing grass, *Imperata cylindrica, Themeda australis* and *Cenchrus ciliaris,* were also mated at 300 kg. All animals were weighed every 28 days and calving dates were recorded.

When a pregnancy examination revealed that many mated heifers grazing *Leucaena* were not pregnant, a second bull was used after eight months and a third bull 12 months later. The bulls were proven sires and throughout the trial semen evaluation was normal. The experiment was terminated after 27 months. Eleven nonparous, apparently non-pregnant heifers and three which had calved but not become pregnant again were slaughtered, and thyroids and genitalia examined. Ten heifers which were detectably pregnant or had small calves at this time were not slaughtered.

Apparent conception interval (ACI), the period from placing the heifers with the bull until conception occurred, was calculated using calving date or foetal size at slaughter.

RESULTS

Weight gains for both *Leucaena*-fed and grass-fed heifers have been reported previously (Holmes 1976). All eleven grass-fed heifers conceived within two months (*Table 1*). *Leucaena*-fed heifers fell into three groups, eight with short ACI, ten with long ACI and six which did not conceive. There was no difference associated with iodine supplementation.

ACI was not related to season, since heifers mated at the same time had different reproductive performances; for

Table 1. — **Breeding and growth performances of Brahman Cross heifers grazed on mixed grasses or on *Leucaena leucocephala* (means ± S.E.M.)**

	Native pasture	*Leucaena*		
Conception interval group	Short	Short	Long	No Conception
No. of heifers	11/11	8/24	10/24	6/24
Mating interval, to conception or slaughter (days)	30 ± 7	65 ± 11	388 ± 43	564 ± 90
Live weight at conception or slaughter (kg)	308 ± 5	320 ± 9	423 ± 17	468 ± 90
Live weight gain in 56 days after placing with bull (kg)	18.6 ± 2	13.0 ± 3	19.0 ± 3.0	15.1 ± 7
Live weight gain in 56 days before conception (kg)	19.6 ± 2	17.8 ± 3.8	16.2 ± 6.9	
Period of grazing *Leucaena* prior to mating (days)	0	228 ± 52	277 ± 47	224 ± 73
Weight of thyroid of slaughtered heifers (g)	—	69 ± 9 (3 heifers)	116 ± 11 (5 heifers)	224 ± 73 (6 heifers)

example, of those mated at eight weeks from the start of the experiment, two were classed short ACI, two were classed long ACI and one did not conceive. Five heifers showing positive pregnancy tests at three to five months failed to produce a calf at the expected time. Live weight at the conception which produced a calf or a foetus at slaughter and rates of growth at the time of first mating and at the time of conception are presented in *Table 1*. Animals which conceived after greater than normal ACI were significantly heavier, but their rates of growth at the time of first mating and at the time of conception did not differ from those of grass-fed or *Leucaena*-fed heifers which bred normally. The average period of grazing *Leucaena* prior to mating, with a minimum of 56 days, did not differ between ACI groups.

Of the fourteen heifers slaughtered, six had not calved and were not pregnant at slaughter. All had apparently normal, active ovaries and visually normal uteri. All six had goitre (*Table 1*). Five heifers from the long ACI group were slaughtered: one had an apparently dead embryo while the others carried embryos which appeared normal. Goitre was less pronounced. The three short ACI heifers, which had not conceived rapidly a second time, exhibited normal genitalia and mild goitre. Thyroid size was not related to iodine treatment.

Birth weight of calves was 22 $\pm$ 2 kg, only slightly underweight for Brahman calves. However, the lightest calf weighed only 11 kg and died on the day of birth. No autopsy was performed. One apparently normal 20 kg calf suffered an accidental death at birth. This animal was goitrous, with the thyroid weighing 83 g, compared to the normal weight of about six grams. Other calves had goitre detected by palpation, but growth rates for the first three months of life, 0.73 $\pm$ 0.06 kg per day, were normal for Erap conditions.

DISCUSSION

Although reproductive problems in ruminants grazing *Leucaena* have been suspected previously, and undersized offspring have been produced in pen feeding trials, Everist (1974) states that no definite experimental evidence is available for lowered fertility of ruminants grazing this plant.

The results of this trial clearly show a marked deficiency in breeding performance of heifers fed on *Leucaena* for even a short period before and during mating.

The cause of reproductive failure has not been identified but a number of factors can be eliminated. Failure was not related to iodine treatment or duration of feeding *Leucaena*, over a minimum of 56 days. Failure was not related to season or to growth rates of heifers. Since the bulls used were proven sires and semen evaluations were all normal the problem was presumably not one of male sterility. No systematic mating records were kept, since the infertility was not suspected until the trials had run six months, but animals which failed to conceive were observed mating, so oestrus and libido appeared to be normal. Ovaries of infertile heifers had normal-appearing follicles and *corpora lutea*.

The remaining possible areas for failure are the processes of sperm and egg transport, implantation or placental defects and maintenance of pregnancy. In rats, Joshi (1968) found *Leucaena* caused foetal death and resorbtion. Bindon and Lamond (1966) working with sheep, and Hamilton *et al.* (1971) working with cattle reported undersized offspring, abortions and still births. One of the heifers slaughtered in this trial had a three months foetus which appeared dead; five other heifers, shown to be pregnant by rectal palpation by two operators, failed to produce a calf and one undersized calf died at birth. This suggests that in several cases conception, implantation and early development did occur, but that some type of failure occurred in mid pregnancy resulting in abortions or production of undersized weak offspring.

The results confirm the suspicions aroused in some previous work with *Leucaena* as a forage for ruminants. Under the conditions in this trial 16 of 24 animals

experienced reproductive failure, which may have been due to failure of maintenance of pregnancy after successful conception.

REFERENCES

BEAUMONT, J.H. (1948). Koa haole roughage as a substitute for oil cake meals. *Report of the University of Hawaii Experiment Station for the Biennium ending June 30, 1948.* pp. 38-39.

BINDON, B.M. and LAMOND, D.R. (1966). Examination of tropical legumes for deleterious effect on animal reproduction. *Proceedings of the Australian Society of Animal Production,* 6: 109-116.

EVERIST, SELWYN L. (1974). *Poisonous Plants of Australia.* Angus and Robertson. 1325 pp.

GOHL, B. (1975). Tropical Feeds. Feeds information summaries and nutritive values. *FAO Agricultural Studies* No. 96. pp. 196-197.

GRAY, S.G. (1968). A review of research on *Leucaena leucocephala. Tropical Grasslands,* 2 (1): 19-30.

HAMILTON, R.I., DONALDSON, L.E. and LAMBOURNE, L.J. (1971). *Leucaena leucocephala* as a feed for dairy cows: Direct effect on reproduction and residual effect on the calf and lactation. *Australian Journal of Agricultural Research,* 22: 681-692.

HEGARTY, M.P., SCHINKEL, P.G. and COURT, R.D. (1964). Reaction of sheep to the consumption of *Leucaena glauca* Benth, and to its toxic principle mimosine. *Australian Journal of Agricultural Research,* 15: 153-167.

HOLMES, J.H.G. (1976). Growth of Brahman cross heifers grazing *Leucaena. Proceedings of the Australian Society of Animal Production,* 11: 453-456.

HUTTON, N.M. and GRAY, S.G. (1959). Problems in adapting *Leucaena leucocephala* as a forage for the Australian Tropics. *Empire Journal of Experimental Agriculture,* 27 (107): 187-196.

HYLIN, J.W. and LICHTON, I.J. (1965). Production of reversible infertility in rats by feeding mimosine. *Biochemical Pharmacology,* 14: 1167-1169.

JONES, R.J., BLUNT, C.G. and HOLMES, J.H.G. (1976). Enlarged thyroid glands in cattle grazing *Leucaena* pastures. *Tropical Grasslands,* 10 (2): 113-116.

JOSHI, H.S. (1968). The effect of feeding of *Leucaena leucocephala* (Lam) de Wit., on reproduction in rats. *Australian Journal of Agricultural Research,* 19: 341-352.

(Accepted for publication, December 1980)