THE EFFECTS OF CLIMATE AND NUTRIENT SUPPLEMENTATION ON THE FERTILITY OF HEIFERS IN NORTH QUEENSLAND

B.D. SIEBERT*, M.J. PLAYNE† and L.A. EDYE†

Summary

For five years separate groups of pregnant two- and three-year old heifers were held on native pasture and supplemented with combinations of urea, minerals, maize and protein concentrates. In three years out of five, sufficient rain fell during the dry season for regrowth of pasture to occur and for animals to gain weight. The pregnancy rates in the years following these rains were high (>73%). In one other year when no rain fell, supplements of phosphorus or nitrogen, sulphur and sodium had no significant effect on liveweight change or pregnancy rate. In a fifth year, heifers receiving cottonseed meal or maize were heavier prior to mating in the following January than control animals or those receiving nitrogen, sulphur and sodium. Those receiving cottonseed meal recorded pregnancy rates of 84%, significantly greater than those on other treatments (< 46%). Calves of heifers receiving maize were significantly heavier at weaning.

I. INTRODUCTION

The low fertility of cattle on unimproved pastures of north Queensland is associated either with wide variations in ages at which heifers first become pregnant or with long and variable intervals between the first and second pregnancies. The variations in turn are associated with poor growth prior to puberty or during the first lactation resulting from undernutrition during the long dry seasons (Edye *et al*. 1971; Siebert and Field 1975). This paper describes the indirect effects of climate, and the direct effects of non-protein or natural protein nutrients on the liveweight change and pregnancy rate of breeding heifers.

II. METHODS

(a) Period and location

The trial was conducted over five years between July 1970 and May 1975 at the CSIRO Pasture Research Station 50km south of Townsville.

(b) Pastures and stocking

Four paddocks containing mainly native pasture (*Heteropogon contortus*) and about 20 per cent legume (*Stylosanthes humilis*) were used. Trees were not cleared. The area had previously been aerially fertilized with 100 kg/ha of superphosphate in both 1968 and 1969. Each July the paddocks were stocked with new animals at a rate not greater than 0.4 beasts/ha with pregnant two- or three-year old Droughtmaster heifers mated the previous Jan./Feb. The number used ranged from 14 to 24 beasts per paddock. Plentiful stands of poor quality forage was available each year.

*CSIRO Division of Animal Physiology, Davies Laboratory, Townsville Q.4810

†CSIRO Division of Tropical Agronomy, Davies Laboratory, Townsville Q.4810

(c) Treatments and procedures

Each year three forms of supplement were provided during the dry season (Jul-Oct) in an attempt to offset liveweight loss. In the first three years phosphorus (P) as phosphoric acid (11g P/cow/day) or nitrogen (N) as urea, sulphur (S) as sulphate and sodium (Na) as sodium sulphate (22gN, 5gS, 6gNa/cow/day) were included in the treatments.

Because of the detrimental effects of phosphoric acid (Playne 1974) P was provided in the following year in 300g meat-meal/cow/day. Potassium (K) as potassium chloride (10g K/cow/day) was included in another treatment because of low values in the pasture.

In the final year, nitrogen was provided from three sources (urea, cottonseed meal or crushed maize). Each source was chosen to supply the same quantity of N (12g/cow/day) but varying quantities of energy (0, 200g, 1200g organic matter/cow/day respectively). The treatments were thus:-

1970, 1971, 1972 (i) Control, (ii) P, (iii) N,S,Na, (iv) N,S,Na,P.
1973 (i) Control, (ii) meat-meal, (iii) N,S,Na, (iv) N,S,Na,K.
1974 (i) Control, (ii) N,S,Na, (iii) cottonseed meal (iv) maize.

Urea and inorganic supplements were all dissolved and provided through the drinking water to individually metered troughs in each paddock. In addition, all treatments received adequate copper and zinc salts by the same method. Feed supplements (meat-meal, cottonseed meal or maize) were fed out in large troughs three times a week. In all years the animals were transferred from paddock to paddock monthly in a randomized sequence. Multi-sire mating was carried out in Jan./Feb. over a six-week period.

(d) Measurements

Live weight of animals was recorded monthly and pregnancy testing was carried out each year in April/May.

III. RESULTS

(a) Climate

In three of the five years (1970, 1971, 1973), there was sufficient rain (> 40mm) between July and October to cause regrowth of pasture and gains in the live weight of cattle receiving no supplement (Table 1). The pregnancy rate in the years following the rains was greater than 70%. Since the rates for the unsupplemented groups were not significantly higher than the control groups only the latter are presented here. In the other two years (1972, 1974) less than 20 mm of rain fell at any one time during the dry season. Live weight of control animals declined over this period and the subsequent pregnancy rate was low (< 25%).

TABLE 1

Dry season rainfall, liveweight change and pregnancy rate in the following year of control groups of heifers receiving no supplement

Year	Number of heifers	Dry season rainfall (mm) Jul.to Oct.(kg)	Liveweight change Jul. to Oct. (kg)	Percentage pregnant (following year)
1970	13	40	+ 28	83
1971	18	48	+ 43	79
1972	24	4	- 41	15
1973	15	59*	+ 58	73
1974	14	38*	- 10	25

* separate falls of 20 and 18mm

TABLE 2

Liveweight change during the dry season, live weight at mating and the proportion of heifers which became pregnant following nutrient supplementation

	Supplement	Liveweight change Jul. to Oct. (kg)	Live weight at mating Jan./Feb. (kg) (following year)	Percentage pregnant in May (following year)
1972	Nil	-41	288	15
	P	-31	238	7
	N,S,Na	-35	288	18
	N,S,Na,P	-25	285	11
1974	Nil	-10	333	25
	N,S,Na	- 3	340	46
	Cottonseed meal	-14	359	84
	Maize	- 8	355	38

The seasonal conditions of 1974 were less severe than 1972 but there was no clear effect of supplements on liveweight change during the dry season in either year (Table 2). The pregnancy rates were low in all groups except that receiving cottonseed meal. Pregnancy was significantly ($P<0.05$) greater in this group than others during 1974. Significance was calculated by carrying out an exact-test of independence for the two-way tables. Heifers that became pregnant were 54 kg heavier at mating.

There was'no significant difference in calf weight at weaning following the 1972 supplementation, but the corresponding mean weights of calves born in 1974 of the four groups were 179, 180, 182 and 198 kg respectively. Those whose dams had previously received maize were significantly heavier at weaning ($P<0.05$) than the controls.

IV. DISCUSSION

The cyclical pattern of climate and growth of pasture found in mediterranean and tropical areas can be tolerated by livestock to some degree. In the tropics the situation tends to be extreme and can affect production and reproduction severely (Siebert 1973). Older cows are not affected as greatly as younger animals. In 80% of two- and three-year old heifers pregnancy occurs in only alternate years with only a small percentage becoming pregnant in consecutive years (Donaldson 1968). It seems however that only small changes in climate or diet are needed to cause quite significant changes in reproductive performance. As can be seen from the results presented, only relatively light falls of rain between July and October were sufficient for more than 70% of heifers to become pregnant in the following year, whereas in low rainfall years, the value was 25% or less. Similarly large changes in oestrus activity can be achieved by feeding small quantities of legume with poor quality roughage (Siebert and Field 1975). This suggests that the protein available from new growth after rain is sufficient to enhance reproductive activity. In drier years this is less likely to occur.

Options open to livestock producers are either to tolerate the low rainfall years or to provide nutritional supplements. In the present experiment supplements were not needed in 3 years out of 5, though long term rainfall records indicate that such climatic conditions would occur in only about 50% of years. The supplements available to producers include minerals, non-protein nitrogen and protein and energy concentrates. In the present experiments only the protein concentrate, cottonseed meal, significantly improved pregnancy rate. Urea was ineffective as is at times found commercially. The reasons for this are probably related to the digestibility of forage and frequency of urea ingestion (Playne, Siebert and Edye 1975; Romero, Siebert and Murray 1976). Maize as a supplement did not improve the pregnancy rate, although calves from heifers fed maize during the dry season weaned at a higher live weight, presumably because maize provided more energy for a better lactation.

The implications of the results are that the short term use of only relatively small quantities of protein supplement may be more effective than other supplements in maintaining regular pregnancy. Urea/molasses is possibly effective in the same way if it can be supplied frequently and the forage available is reasonably digestible. The manner in which small quantities of protein act on reproductive function is not clear. Whether non-protein nitrogen can be just as effective if used correctly is also to be determined.

V. ACKNOWLEDGMENTS

We wish to thank Messrs. R. Dixon, L. Whiteman, M. Breen and G. Tait for assistance with animals and Mr. P.N. Jones for statistical advice.

VI. REFERENCES

DONALDSON, L.E. (1968). Australian Veterinary Journal, 44: 493.

EDYE, L.A., RITSON, J.B., HAYDOCK, K.P. and GRIFFITHS-DAVIES, J. (1971). Australian Journal of agricultural Research 22: 963.

PLAYNE, M.J. (1974). Proceedings of Australian Society of Animal Production 10: 111.

PLAYNE, M.J., SIEBERT, B.D. and EDYE, L.A. (1975). Proceedings III World Animal Conference Melbourne 1973, Ed. R.L. Reid. Sydney Univ. Press.

ROMERO, A., SIEBERT, B.D. and MURRAY, R.M. (1976). Australian Journal of experimental Agriculture and Animal Husbandry 16: (in press)

SIEBERT, B.D. (1973). International Journal of Biometeorology 17: 123.

SIEBERT, B.D. and FIELD, J.B.F. (1975). Australian Journal of experimental Agriculture and Animal Husbandry 15: 12.