OBSERVATIONS ON THE EFFECT OF LIVE WEIGHT, LIVEWEIGHT CHANGE AND EXOGENOUS HORMONES ON THE FERTILITY OF YOUNG HEIFERS

L.J. CUMMINS*, J.H.L. MORGAN*, J.F. GRAHAM* and P.C. GUTHRIE*

SUMMARY

Results of two experiments where grazing Hereford and Friesian heifers were mated by A.I. are reported. In both experiments heifers weighing <275 kg tended to have reduced pregnancy rates. Hereford heifers weighing >275 kg and gaining weight slowly during mating had higher (P<0.05, 84%) pregnancy rates than those weighing <275 kg and losing weight slowly (55%).

In one experiment, the lightest 24% of heifers were fed hay and grain in a feedlot and some were injected with progesterone and oestrogen in an attempt to advance puberty. Neither strategy resulted in high pregnancy rates.

INTRODUCTION

In many situations a yearling mating strategy for beef heifers may be only moderately successful because genetic and nutritional factors prevent a proportion of them from reaching puberty before the end of mating. For example, Morgan (1981) reported that 40% of Hereford heifers grazing pasture at Hamilton failed to reach puberty by 17 months of age. Age and weight at puberty can be modified by both pre- and post-weaning nutrition (Menge *et al.* 1966; Wiltbank *et al.* 1966; Arije and Wiltbank 1974). The desirability of such manipulation of the growth of heifers must be considered both in terms of the extra costs and also the biological implications of rapid early growth (Johnsson and Obst 1980; Robinson 1981).

This report gives information on live weight and fertility in two groups of Hereford and one group of Friesian heifers purchased as weaners and mated as yearlings. In the second group attempts were also made to stimulate the onset of puberty in some of the lightest heifers.

MATERIALS AND METHODS

In these experiments, mating was by artificial insemination (AI) using semen from a number of bulls. In experiments 1 and 2a, the heifers were grazing pasture during the joining period and oestrus detection relied on the use of teaser bulls with chinball harnesses. In both experiments unfasted live weight was measured at various times and live weight immediately before the start of the mating period is considered in the analyses presented here. Pregnancy rates were determined by rectal palpation.

Experiment 1

In August 1970, 166 Hereford and 146 Friesian heifers were mated over a 9 week period. For both breeds the estimated range in age at the start of mating was 10-17 months and the range in live weights was 170-340 kg.

Heifers were ranked in order of pre-mating live weight within breeds and then divided into groups of 20 or 21 heifers. The information on pregnancy rates in these groups was then subject to regression analysis.

Experiment 2a

On April 23, 1976, the 162 heaviest heifers from a herd of 214 Herefords aged 11-13 months and weighing >245 kg were designated experiment 2a. The remaining 52 heifers weighing <245 kg were designated as experiment 2b.

* Pastoral Research Institute, P.O. Box 180, Hamilton, Vic. 3300.

The heifers in experiment 2a continued to graze pasture and were inseminated between June 21 and September 1. During mating, pasture hay was provided as a supplement. Weight gains between April 23 and September 1 only averaged 10 kg.

By July 16, 31 heifers had not been detected in oestrus and were not inseminated, Twenty-one of these (group PE) received steroid hormone therapy by intramuscular injection (25 mg of progesterone {P} on July 16 and 2.5 mg of oestradiol benzoate {E} on July 18) and ten were untreated (group C) . These 31 heifers remained with the herd and normal AI procedures continued.

Chi-squared tests were used to examine the effects of live weight and liveweight change on fertility. Heifers were divided into four groups based on live weight at the start of mating and liveweight change during mating (see Table 1). The 21 heifers receiving steroid hormones were excluded from this analysis.

Experiment 2b

Heifers in experiment 2b were allocated at random to two groups, placed in feedlot pens and offered a daily ration of 7 kg of 50/50 hay/oaten grain. This ration resulted in a liveweight gain of 0.4 kg/day over the period April 23-July 19.

These heifers received their first inseminations following a two dose prostaglandin regime. In addition, steroid hormone therapy was administered to one group (PEF) in an attempt to ensure that all heifers in that group had an active corpus luteum at the time of the second injection. Thus on June 30, group PEF received 25 mg P at 1100 h. They then received 0.5 mg of cloprostenol at 1100 h on July 1, followed by 2.5 mg E at 1400 h on July 2. A second dose of cloprostenol was given at 1400 h on 12 July and all heifers were inseminated on the afternoon of July 15 and again on July 16. The other group of heifers (F) in 2b only received cloprostenol at the nominated times and were inseminated as above. During this synchronization procedure, no attempt at oestrus detection was made. On July 19 these heifers were removed from the feedlots and returned to the main herd (experiment 2a) and all heifers then received similar treatment.

RESULTS

Experiment 1

Pregnancy rates increased as live weight at mating time increased, at least until live weight exceeded 275 kg. The regression equation was:

$$PR = -348 + 3.01\ (\pm 1.17)\ LW - 0.0055\ (20.0023)\ LW^2 + 1.97\ (\pm 0.28)\ B$$

(100 R^2 = 79%; RSD = 8.1; BLW and BLW^2 terms non-significant) where PR = pregnancy rate, LW = live weight and B = breed (-7 for Hereford and +8 for Friesian). The conception rate to first insemination was 40% and was similar in both breeds. A major reason for the low pregnancy rates in Hereford heifers was the failure to inseminate 42% of those weighing <250 kg and 18% of those weighing >250 kg. For Friesian heifers the proportions not inseminated in similar weight classes was 10 and 3%, respectively.

Experiment 2a

Live weight and fertility data for the 141 heifers which were exposed for mating without further treatment is shown in Table 1. There was an interaction between pre-mating live weight and liveweight change during mating. The heavier heifers which gained weight had a higher pregnancy rate than the lighter heifers which lost weight ($P<0.05$). The heavier heifers which lost weight also tended to have a higher pregnancy rate than the lighter heifers which lost weight ($P<0.1$). There was also a tendency for a lower proportion of the light weight heifers to be inseminated during the mating period (91 vs 99%, $P<0.1$).

TABLE 1 Effect of pre-mating live weight and liveweight change during mating on the fertility of yearling Hereford heifers (experiment 2a)

Pre-mating lwt	Lwt change (range kg/day)	No.	1st service preg. rate (%)	Final preg. rate (%)	Proportion not inseminated (%)
342-275	0 to +0.4	57	46	84[a]	2
	-0.1 to -0.4	29	52	79[ab]	0
274-240	0 to +0.4	33	48	73[ab]	6
	-0.01 to -0.4	22	53	55[b]	14

Groups with different superscripts differ ($P<0.05$)

The steroid hormone therapy given to those heifers not inseminated during the first 25 days (PE) of the joining season did not improve their fertility compared with similar untreated non inseminated heifers (C) (Table 2); however it did induce oestrus in 81% within 3 days. Only 16% of these 31 heifers finally became pregnant.

Experiment 2b

The fertility obtained after the synchronization attempt in these feedlot heifers was very poor (15%) and it is clear that the steroid hormone therapy did not improve fertility (Table 2). The final pregnancy rate in these two groups of heifers was only 42% and did not differ significantly.

TABLE 2 Effect of steroid hormone treatment on fertility of peripubertal Hereford heifers

	Expt. 2a		Expt. 2b	
	PE	C	PEF	F
No. of heifers	21	10	25	27
Mean live weight at synchronization attempt	262	263	260	265
No. pregnant after synchronization	2	-	2	6
No. returning to service	6	5	14	10
No. conceiving at returns to service	1	2	7	7

Groups PEF and PE received steroid hormones, PEF and F also received cloprostenol.

DISCUSSION

Yearling Friesian heifers were more fertile than yearling Hereford heifers in Experiment 1. This is likely to be due mainly to earlier puberty in Friesian heifers (Morgan 1981). In both breeds pregnancy rate increased as pre-mating liveweight increased until the maximum rates were achieved at about 275 kg. However, even at this weight the fertility of the Herefords was poor (50%) and this was associated with failure to detect oestrus. Low conception rates and perhaps other problems associated with the first year's experience of a large AI program may have also contributed to this poor result.

In experiment 2a, satisfactory pregnancy rates (84%) were achieved in heifers weighing >275 kg and gaining weight, while poor results (55%) were seen in heifers weighing <275 kg and losing weight. It is perhaps worth noting that the heifers purchased for experiment 2 were selected from the larger and better grown cattle yarded at the local weaner sales. Nevertheless it seemed likely that many would not have reached puberty during the proposed mating period, so one third of them were separated for special treatment (i.e. improved nutrition and/or hormone treatment) and hence excluded from the above considerations of live weight and fertility. Had they remained in the main mob the fertility of light weight heifers would probably have been even worse.

Feeding each heifer almost one third of a tonne of grain and a similar amount of hay in experiment 2b only resulted in a final pregnancy rate of 42%. This ration almost certainly increased growth rate and may have allowed some increase in pregnancy rates above that which would have been achieved had they remained at pasture. Some indication of this effect can be obtained by comparing the results of experiments 2a and 2b as shown in Table 2. The identification of the lightest heifers and their removal to a feedlot must be considered an expensive and relatively unsuccessful strategy in this instance, but has been successful on other occasions (Varner *et al.* 1977; Menné et al. 1978). In our situation it is likely that many of the lightest heifers were amongst the youngest and hence may have needed to reach a heavier live weight during the mating period to become pregnant (Axelsen and Morley 1976). One of the reasons that the oestrus synchronization attempt in experiment 2b failed may have been because many of the heifers had not reached puberty at the time of treatment. It is also apparent that the sequential progesterone and oestrogen therapy applied in experiment 2 failed to stimulate the formation of normal corpora lutea in heifers approaching puberty. In contrast to this, Gonzales-Padilla *et al.* (1975a) showed that single injections of progesterone followed by oestrogen were able to induce normal corpora lutea in 14-15 month old pre-pubertal Angus heifers. However in further evaluation of this procedure, Gonzalez-Padilla *et al.* 1975b) used oestradiol followed by a 9 day progestogen implant with considerable success, but they indicated that the response was at least partly dependent on the body weights of the heifers.

These results confirm that live weight and liveweight change during the mating of yearling heifers can influence pregnancy rate and are in general agreement with other recommendations (e.g. Young 1974).

ACKNOWLEDGMENTS

This work was supported from A.M.R.C. funds.

REFERENCES

ARIJE, G.F. and WILTBANK, J.N. (1974). J. Anim. Sci. 38:803.

AXELSEN, A. and MORLEY, F.H.W. (1976). Proc. Aust. Soc. Anim. Prod. 11:241.

GONZALEZ-PADILLA, E., NISWENDER, G.D. and WILTBANK, J.N. (1975a). J. Anim. Sci. 40:1105.

GONZALEZ-PADILLA, E., RUIZ, R., LE FEVER, D., DENHAM, A. and WILTBANK, J.N. (1975b). J. Anim. Sci. 40:1110.

JOHNSSON, I.D. and OBST, J.M. (1980). Proc. Aust. Soc. Anim. Prod. 13:460.

MENGE, A.C., MARES, S.E., TYLER, W.J. and CASIDA, L.E. (1960). J. Dairy Sci. 43:1099.

MENNE, P.F., HARWIN, G.C. and LISHMAN, A.W. (1978). S.Afr. J. Anim. Sci. 8:115-117.

MORGAN, J.H.L. (1981). Aust. J. Agric. Res. 32:839.

ROBISON, O.W. (1981). Livestock Prod. Sci. 8:121.

VARNER, L.W., BELLOWS, R.A. and CHRISTENSEN, D.S. (1977). J. Anim. Sci. 44:165.

WILTBANK, J.N., GREGORY, K.E., SWIGEY, L.A., INGALLS, J.E., ROTHLISHERGER, J. and KOCH, R.M. (1966). J. Anim. Sci. 25:744.

YOUNG, J.S. (1974). Proc. Aust. Soc. Anim. Prod. 10:45.