SYNCHRONIZATION OF OESTRUS AND OVULATION IN BEEF HEIFERS

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Summary

Forty Shorthorn heifers were removed from pasture, trucked 100 miles, and placed in yards. They were fed a ration containing oat grain and lucerne hay. After 12 days preliminary observations the heifers were randomized into four groups which received the following treatments, commencing on the day of randomization:

a. 20 mg of progesterone in oil intramuscularly each day for 13 days.

b. As for (a) except in addition, 1000 i.u. of PMS on the thirteenth day.

c. 30 mg of progesterone every two days.

d. No treatment.

A high proportion of heifers experienced ovulation unaccompanied by oestrus during the preliminary period of observations. The majority showed oestrus 72–96 hours after the final hormone injection. Four-week non-return rates did not differ between treatments, averaging 25 per cent. The succeeding oestrous cycles were most uniform in the group receiving 20 mg of progesterone daily.

I. INTRODUCTION

A major problem in large-scale artificial insemination in Australian beef herds is detection of oestrus. Methods based on constant observation with or without teaser bulls are of limited value in large herds, particularly under extensive farming conditions, partly because sexual behaviour in beef cattle during oestrus is not always obvious and partly because of problems of management. Satisfactory methods of synchronization of oestrus cycles would eliminate many of the problems associated with detection of oestrus, particularly labour costs and the need for constant handling. In addition, sexual behaviour may be ignored if a group of cows ovulate within a predetermined time period.

Hormonal methods of synchronization that have proved successful in ewes (Robinson 1959; Braden, Lamond, and Radford 1960; Lamond and Bindon 1961) are based on the use of progesterone for suppression of ovarian cycles, with or without subsequent use of gonadotrophins.

'Progesterone suppression of oestrus and ovulation has been attempted in cattle, but, while fertility has been satisfactory at times, at other times it was poor (Christian and Casida 1948; Willett 1950; Ulberg, Christian, and Casida 195 1; Trimberger and Hansel 1955; Nellor and Cole 1956; Donker et al. 1958; Dziuk et al. 1958; Ulberg and Lindley 1960; Ray, Emmerson, and Melampy 1961) .

In a recent series of experiments Lamond and O'Brien (1960) and Lamond (1961, and unpublished) obtained satisfactory fertility after progesterone alone, and followed by gonadotrophins. In other unpublished experiments fertility was poor. The aim in this work has been to obtain successful synchronization and

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fertility, but at the same time to design the experiments to provide quantitative information on pituitary-ovarian relationships. This has been possible by employing factorial designs. One difficulty was the need to carry out the experiments on properties where numerous uncontrolled variables operated. This paper describes the first of a series of experiments in which groups of beef cattle have been housed in partly covered yards throughout the course of the experiments.

II. MATERIALS AND METHODS

(a) Animals and Management

Forty 2½-year-old virgin Shorthorn' heifers were taken off pasture, trucked (by motor transport) 100 miles, and placed in yards on March 3, 1961. Groups of 10 occupied each of four yards, 24 ft by 30 ft; approximately one-third of each yard, including the feed trough, was covered by roofing, and the floors were of concrete construction. The heifers were extremely excitable for the first few days, and slipping on the concrete floors was common. A deep litter system, using oaten straw, was developed on the covered portion of each yard. After 1 to 2 weeks slipping was negligible.

The heifers were fed twice daily. After an initial period on lucerne hay alone, each group of heifers received a total of 30 lb oat grain and 30 lb green, leafy lucerne hay each morning, and 80 lb medium quality lucerne hay each afternoon. The average daily intake per heifer was therefore 3 lb oats and 11 lb of lucerne hay. Water was available at all times. The open portions of the yards were cleaned daily.

(b) Detection of Oestrus

The cattle were observed twice daily, at 9 a.m. and 5 p.m., throughout the experiment. During the first two weeks oestrus was determined by sexual behaviour in the groups. Thus heifers allowing others to mount were judged in heat. Later three Hereford steers, each implanted with 400 mg testosterone, were added to the groups and shifted from pen to pen to facilitate detection of oestrus.

(c) Ovarian Examination

All heifers were submitted to rectal palpation of the genital tract on March 8, March 14, and March 22. Further examinations were carried out as described below. The number of follicles greater than ¾ cm diameter (approximately) and of corpora lutea were recorded at each examination. In all heifers rectal examinations were carried out during and after oestrus to record the approximate times of ovulation.

(d) Experimental Design and Method

On March 14, the heifers were allotted to four treatment groups, each of 10 heifers, at random. Each group was housed in one yard to facilitate handling. Group 1 received no hormone treatment and served as controls. Group 2 received daily injections of 20 mg of progesterone in peanut oil, intramuscularly, until March 26, when each heifer received 1,000 i.u. pregnant mare serum gonadotrophin (PMS) (purified preparation) subcutaneously, at the same time as the final injection of progesterone. Group 3 received 20 mg of progesterone daily until March 26 but did not get PMS. Group 4 was given 30 mg of progesterone every second day, receiving the final injection on March 26. Injections were given between 9 a.m. and 10 a.m.

Semen was collected from one bull and was diluted and frozen six months prior to the experiment. The diluted semen contained approximately 50 million spermatozoa per ml. The cows were inseminated intra-cervically with 1 ml of the diluted semen 12 to 24 hours after oestrus was first detected. Most heifers received a second insemination 12 to 24 hours after the first.

Oestrus was recorded in all groups until April 25, when the cattle were transferred from the yards to pasture.

III. RESULTS

(a) Preliminary Period of Observation

From the time the heifers came into the yards on March 3 until March 14, when injections of progesterone commenced in 30 heifers, only three were seen in heat: one on March 11, and the other two on March 12. When the results of the ovarian examinations on March 8 and March 14 were analysed it was apparent that a high proportion of heifers ovulated without oestrus during this period. The possibility of short oestrus is unlikely, because when heifers are in oestrus the act of mounting generally results in saliva marks along the back, and rubbing of hair at the base of the tail and rump region. These signs were not observed. Data for oestrous cycles and ovarian activity for the control group are presented in Table 1. These data are typical for the remaining heifers up to March 14, and indicate that the majority of ovulations unaccompanied by oestrus occurred 8 to 10 days after arrival in the yards.

TABLE 1

OVARIAN ACTIVITY IN GROUP 1—CONTROLS

Heifer	Date of Ovarian Examination			Date of First Oestrus	First Ovulation Not Accompanied by Oestrus
	March 8	March 14	March 22		
1	F	—	CL	March 29	March 9–13
8	F	F	CL	April 4	March 14–15
9	CL	—	CL	April 2	March 14–15
15	F	F	CL	March 30	March 14–15
17	F	RO	CL	March 12	
19	CL	F	CL	March 17	
24	F	F	F	March 31	Anovular cycle
25	CL	CL	—	March 26	March 5–6
29	F	—	CL	March 26	March 10–12
32	—	CL	CL	—	March 9–13 (possible formation of a cystic corpus luteum)

RO — recent ovulation; F — follicle only; CL — corpus luteum; Silent oestrus refers to an apparent ovulation unaccompanied by oestrus.

Occurrence of oestrus and returns to oestrus after insemination for the control heifers are shown in Fig. 1. Six of nine heifers inseminated at oestrus returned 15 to 22 days later. The remaining three **had** not returned 24 to 3 1 days after

insemination, at the time the cattle were removed from the yards. One heifer in Group 1 was not observed in heat at any time.

(b) Onset of Oestrus in Hormone Treated Groups

In Fig. 2 is shown the time when each heifer was first observed in oestrus after the final hormone injection. Although the times of onset of oestrus are only approximate, the results suggest there were no differences between the three treatments. Evidently the majority of heifers came into oestrus 72 to 96 hours after the final injection. The three heifers that came into oestrus at 144 to 168 hours had well-formed corpora lutea on March 26, which was the day of the final hormone injection. Three of the four that were in oestrus during the period 72 to 96 hours and again two days later also had well-formed corpora lutea at the time of the last injection.

On March 26 three of the ten heifers in each of Groups 2 and 3 had follicles ¾ cm diameter or greater, whereas in Group 4 (30 mg of progesterone every 2 days) follicular development was advanced in most heifers.

The numbers returning to oestrus during the 3½ weeks following insemination and the mean interval between the two oestrous periods are shown in Table 2.

TABLE 2

RETURNS TO OESTRUS IN HORMONE-TREATED HEIFERS

Group	Treatment	Number Returning to Oestrus	Length of Period Between Cycles (days)	
			Mean	S.E.
2	20 mg progesterone per day plus 1,000 i.u. of PMS	8	18·0	1·10
3	20 mg progesterone per day	6	18·7	0·33
4	30 mg progesterone every two days	9	19·7	0·50

Injection of PMS increased variability in the length of the dioestrous interval. Returns to oestrus after progesterone alone were extremely uniform. On the basis of non-returns 25 to 27 days after insemination two heifers conceived in Group 2, four in Group 3, and one in Group 4, compared to three heifers in the controls. These differences between treatments could have arisen by chance

$$(\chi^2\ (3) = 2{\cdot}67;\ 0{\cdot}3 < P < 0{\cdot}5)$$

(c) Ovulation

Ovulation had occurred by the time of the rectal examinations 12 to 36 hours after cessation of heat in all heifers. The majority had evidently taken place within 12 hours of end of oestrus. There were no apparent differences between the four groups of heifers.

IV. DISCUSSION

If it be assumed that oestrous cycles were occurring at random at the time of transfer from pasture to yards, then it seems likely that a higher than expected proportion of heifers ovulated approximately one week after yarding. In addition, the majority of such ovulations were not accompanied by oestrus.

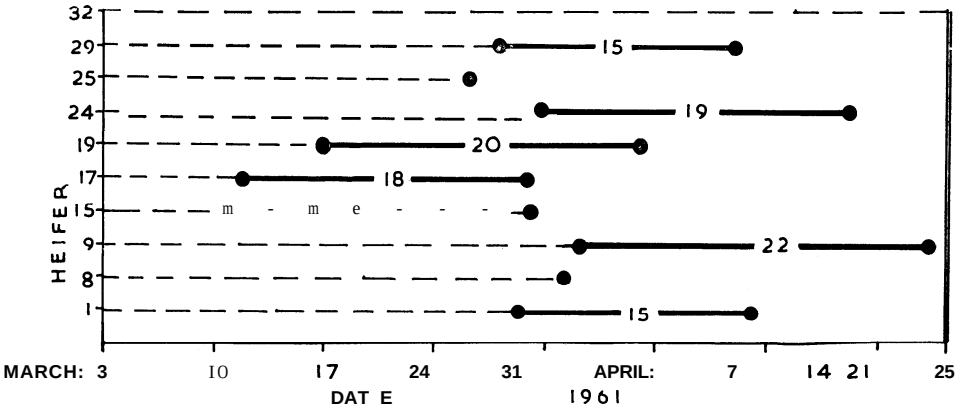

Fig. 1.—Occurrence of oestrus in the control heifers. The cattle were not observed after 25th April. • denotes oestrus.

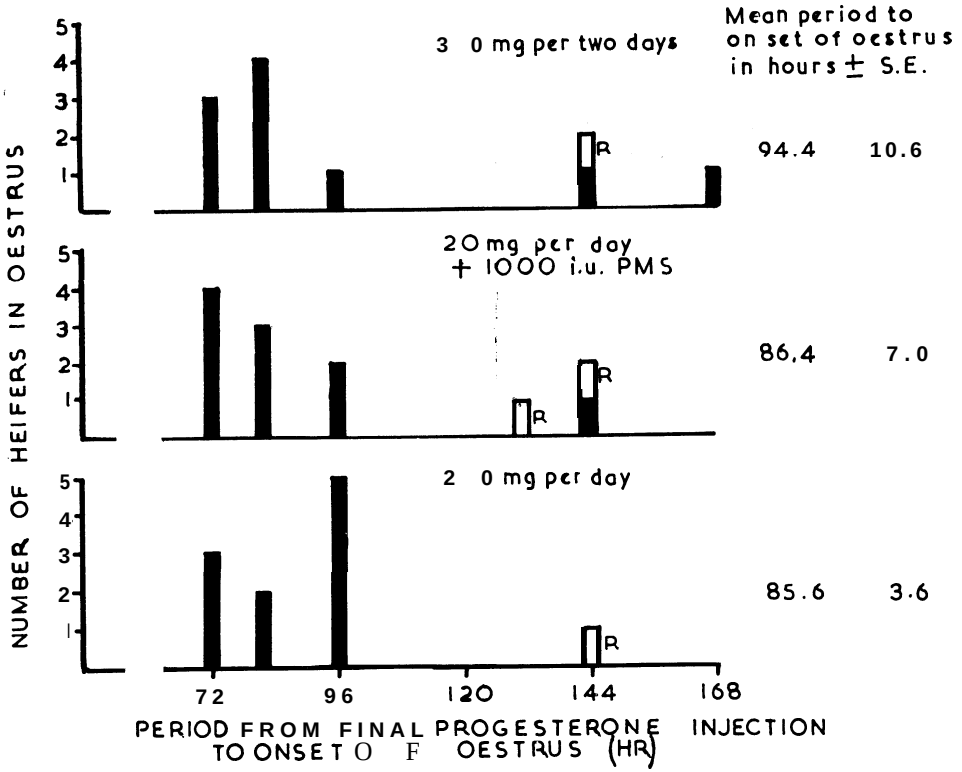

Fig. 2.—Onset of oestrus in hormone-treated groups. R — returned to oestrus.

Braden and Moule (unpublished) observed that anoestrous ewes transported long distances had a peak occurrence of silent heats about one week after experiencing "transport stress." It is not certain, however, that such alterations in reproductive activity are directly related to adrenal gland function, or whether in fact the effects are due to independent action of external factors on the hypothalamic-pituitary-ovarian system.

In this group of heifers the following external factors may have been partly or wholly responsible for the observed aberrations in reproductive activity:

(i) climate-transfer from Tamworth to Armidale;
(ii) nutrition-pasture to grain and hay, also reduced feed intake on the day of travel and perhaps for a few days afterwards;
(iii) physical effects of travelling; and
(iv) psychological and social effects of strange surroundings and close attention by people.

The principle that aspects of reproduction in beef heifers run under extensive farming conditions may be modified by any sudden alteration in management, nutrition, or environment needs careful scientific study because of its obvious wide application in beef cattle husbandry.

On the basis of the results in the control group the fertility of the frozen semen used in this study was below average. Consequently, little significance can be attached to the numbers of returns to services in the various groups, except that there were no marked differences between treatments.

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