THE APPLICATION OF OESTRUS SYNCHRONIZATION IN NEW ZEALAND DAIRY HERDS

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SUMMARY

Three field trials involving over 1400 lactating dairy cows and 105 maiden Friesian heifers provided data for the evaluation of a synthetic prostaglandin (ICI 80996) in dairy herd management. The factors which must be considered when planning a breeding programme involving oestrus synchronization include the incidence of anoestrum, the occurrence of silent heats and variable responses with cows treated within 60 days post-partum. Using a single injection regime in conjunction with efficient oestrus detection, the proportion of cows conceiving during the first two weeks of a seasonal breeding programme was increased from 36% in the control group to 60% in the treated group. The use of oestrus synchronization among maiden heifers will be uneconomical in most dairy herds.

INTRODUCTION

NEW ZEALAND dairy farming is relatively unique in that over 90% of the 2.18 million lactating cows are in comparatively large herds which have a single calving period lasting from 9 to 14 weeks. Most herds graze improved pastures *in situ* and the only forms of supplement are grass hay or silage. In 1974 the average number of animals in herds whose owners used the artificial insemination service provided by the New Zealand Dairy Board was 119 lactating cows with an average of 1.3 labour units per herd. Previous studies have shown that around 85% of the lactating cows in a herd will be mated or inseminated during the 4 weeks from the date selected by the herd owner for the commencement of his herd's breeding programme (Macmillan and Watson, 1973; Macmillan *et al.*, 1975). This high submission rate is associated with a high incidence of errors in oestrus diagnosis (Macmillan, 1970), with the frequency of short return intervals increasing with herd size (Macmillan and Watson, 1971). These errors in diagnosis may partly reflect a liberal interpretation of oestrus symptoms by herd owners (Macmillan and Watson, 1976; Macmillan *et al.*, 1976) when striving to maintain a seasonally concentrated calving pattern.

Therefore, the advantages associated with oestrus synchronization in New Zealand dairy herds may be threefold. First, the incidence of error in oestrus detection may be reduced; secondly, the calving pattern may be altered to allow for increased production arising through improved herd management; and, finally, the genetical benefits of artificial breeding can be conveniently extended to include maiden heifers.

EXPERIMENTAL

In three field trials, the experimental regimes involved the use of intramuscular injections of 0.5 mg of ICI 80996 — a synthetic analogue of prostaglandin $F_2\alpha$. There was an 11-day interval between injections in the double injection regimes. Cows were inseminated twice with 0.5 ml of Caprogen containing 2.5 million total sperm at 72 h and 96 h after the first or second prostaglandin injection. Deep-frozen semen in 0.25 ml straws containing 25 million total sperm was used for the double inseminations with the maiden heifers. Results have been based either on conceptions confirmed by pregnancy diagnosis or on actual calving dates following pregnancy diagnosis.

TRIAL 1 (October 1974)

Selected cows in each of 17 herds were divided into three groups. Each cow had calved at least 40 days prior to the commencement of the treatment regime which was planned to start 2 weeks prior to the date selected by the herd owner for the onset of his breeding programme. Within each herd, cows of similar age, breed and calving date were divided equally between each of the three experimental groups. There was a maximum of 15 cows per group per herd.

The three groups were:

Group A (double injection-double insemination) in which each cow was injected with ICI 80996 on Day 0 and again on Day 11. These cows were inseminated 72 h and 96 h after the second injection (Day 14 and 15).

Group B (double injection-single insemination) in which the injection regime was similar to Group A, but the cows were submitted for insemination only when observed in oestrus by the herd owner following the second injection.

Group C (control) which were not injected and were submitted for insemination when detected in oestrus by the herd owner from Day 14 onwards.

TRIAL 2 (May 1975)

Maiden Friesian heifers in 4 town-supply herds were subjected to a treatment regime similar to that used for cows in Group A of Trial 1.

TRIAL 3 (October 1975)

Lactating cows in each of 9 herds were divided into two groups with cows being paired according to age, breed and calving date. Cows in the control half were submitted for insemination when observed in oestrus. Cows in the experimental half were injected with ICI 80996 on the seventh day of the breeding programme if they had not been inseminated prior to this time. Some of the injected cows came in oestrus on the eighth or ninth day of the breeding programme and were inseminated at that time. The remaining injected cows were inseminated 72 h and 96 h after the single injection.

In every case, herd owners recorded when they considered each cow was in oestrus, irrespective of whether a cow was inseminated at 72 h and 96 h after an injection of ICI 80996. Animals not observed in oestrus following an injection were examined per rectum around 10 days later to determine if a palpable corpus luteum was present.

To facilitate comparison in terms of changes in herd calving patterns, calving dates for every cow in 43 herds included in a previously reported study (Macmillan, 1974) were analysed. The most suitable parameter was to calculate the proportion of cows calving within each weekly period from the predicted date for the first calving based on the date on which the breeding programme commenced in the previous season. Cows which calved prior to this date because of shorter gestation periods were included in the results for the first week.

RESULTS AND DISCUSSION

The major techniques used to produce oestrus synchronization in cattle involve either artificially extending the length of the interval between periods of oestrus through use of progestational implants, or shortening this interval by reducing the normal functional lifespan of the corpus luteum. The degree of precision in

the synchronized expression of oestrus or subsequent ovulation varies, first, because of differences in the rate of the decline of the natural or synthetic progesterone following implant removal or corpus luteum destruction; and, secondly, because of some variation in the rate of subsequent follicular development and the hormonal interactions involving oestrus. Ideally, synchronization of ovulation should be sufficiently precise to produce satisfactory pregnancy rates to a single insemination at a specific time after the commencement of the selected form of synchronizational treatment. Naturally this will mean that an increased number of cows will conceive at the same time and therefore alter a herd's calving pattern.

While it is widely recognized that most New Zealand dairy herds have a seasonally concentrated calving period, data which describe district or herd calving patterns are very limited. The 27th Farm Production Report of the New Zealand Dairy Board (1951) recorded that 85% of cows calved within six weeks of the "district median calving date". Among 43 seasonal dairy herds using the production testing service provided by the Wellington-Hawkes Bay Livestock Improvement Association in 1972, only 60% of the cows starting their second or subsequent lactation calved within the 4 weeks following the date for these herds' planned commencements of calving (Table 1). The calving pattern was more concentrated among 2-year-old heifers commencing their first lactation. There were marked differences in calving patterns between these 43 herds which averaged 146 cows per herd. The proportion of cows calving in this 4-week period in each herd varied from 44 to 78% (standard deviation ± 8%) and none of these herds had calving patterns as concentrated as that which was recorded by a research herd at Ruakura (Table 1). With these quite large differences in the concentration

TABLE 1: PERCENTAGE OF COWS CALVING DURING SELECTED PERIODS FROM PREDICTED DATE FOR CALVING TO COMMENCE

	Period (weeks)					
Group	*1-4*	*5-7*	*8-10*	*11-13*	*⩾ 14*	*n*
All cows[1]	60	20	13	5	2	4939
All heifers[1]	72	17	6	4	1	1343
Herd average[1]	63	19	12	4	2	6282
Best herd	78	13	9	—	—	80
Worst herd	44	26	6	16	8	120
Ruakura No. 5	82	17	1	—	—	148

[1] Averages for data derived from 43 herds.

TABLE 2: CALVING PATTERNS FOLLOWING OESTRUS SYNCHRONIZATION USING A DOUBLE INJECTION REGIME OF ICI 80996 PRIOR TO THE COMMENCEMENT OF THE HERDS BREEDING PROGRAMMES
(Trial 1)

		% of Cows Calving each Period (weeks)						
Group	*Treatment*	*1*	*2*	*3*	*4*	*5-7*	*≥ 8*	*n*
A	2 inject. 2 insem.	41	10	7	9	11	22	160
B	2 inject. 1 insem.	32	15	10	7	18	18	163
C	controls	19	20	16	4	21	20	165

of calving, this parameter may be as important in herd management as selected date for the start of calving, mean calving date or stocking rate.

The results from Trial 1 showed that the use of a potent synthetic prostaglandin used in a double-injection regime could alter calving patterns in a seasonal dairy herd (Table 2). Whereas 41% of the cows remaining to calve in Group A calved during or immediately prior to the week in which the calving programme was planned to commence, the comparable figure for the control group (Group C) was only 19%. A greater response was expected as all the cows in Group A were inseminated at the same time after the second prostaglandin injection. The reason for the lower response is that only 50% of the treated cows ovulated at or close to the times selected for the set-time inseminations (Table 3). Synchronization was not sufficiently precise in half the cows partly because some were anoestrous. This problem, which can reduce the effectiveness of any synchronization programme (Smith, 1974), may be greater in New Zealand dairy cattle in which the interval to first post-partum ovulation is 36

TABLE 3: CLASSIFICATION OF DAIRY COWS INJECTED WITH ICI 80996
(Trial 1, Groups A and B; $n = 359$)

Group	%
Overt oestrus from 48 to 96 h after second injection of ICI 80996	37
Unobserved (silent) oestrus from 48 h to 96 h after second injection of ICI 80996	13
Anoestrus — no previous heat dates and no palpable ovarian activity	16
Overt oestrus more than 96 h after second injection of ICI 80996	34

TABLE 4: CONCEPTION PATTERNS FOLLOWING OESTRUS SYNCHRONIZATION USING A SINGLE INJECTION REGIME OF ICI 80996
(Trial 3)

Group	*% of Cows Conceiving each Period (weeks)* 1	2	3	4	5-7	⩾ 8	*n*
Experimental[1]	16	44	4	4	14	18	441
Control[2]	18	18	19	8	15	22	442

[1] Based on pregnancy test results.
[2] Based on non-return rates.

days in mature cows and 52 days in 2- or 3-year-old heifers (Moller, 1970). In addition, a high proportion of cows do not ovulate following the first post-partum oestrus (Moller, 1970) and also experience genuine short oestrous cycles (Macmillan and Watson, 1971).

The programme was therefore modified to a single injection regime which effectively delayed treatment by 3 weeks relative to each cow's previous calving date (Trial 3). Again the conception pattern was radically altered by use of oestrus synchronization with 44% of the cows in the experimental group conceiving during the second week of the mating programme (Table 4).

With a double injection-double insemination regime, each cow must be injected twice and inseminated at least twice (Trial 1). By contrast, in the alternative single injection regime, only 68% of the experimental group were injected (32% were inseminated during the week prior to the injection date) and only 58% of the group were inseminated on consecutive days (three and four days after the injection). A practical and economical limitation of both regimes is that anoestrous cows are injected and then inseminated. The drug and the semen are wasted on these animals; but because many of these cows will fail to show oestrus until normal ovarian activity recommences, the herd owner is deceived by believing they are pregnant. An advisable modification to the single injection regime is only to treat cows for which the herd owner has a recorded pre-mating heat date. However, the single injection regimes can only be used in conjunction with adequate heat detection programmes which must ensure that all cows are observed and correctly diagnosed when in oestrus.

For oestrus synchronization to be sufficiently precise to allow for timed inseminations, only normal cycling animals should be used. This requirement is demonstrated with data from maiden

TABLE 5: RESULTS FROM USING A DOUBLE INJECTION-DOUBLE INSEMINATION REGIME IN MAIDEN FRIESIAN HEIFERS IN FOUR HERDS
(Trial 2)

	Herd				
	A	*B*	*C*	*D*	*Total*
No. of heifers	29	39	17	20	105
No. of heifers synchronized[1]	26	38	10	2	76
No. conceiving to synchronized mating	15	18	7	1	41
No. anoestrous	1	0	7	18	26

[1] In oestrus from 48 h to 96 h after second injection of ICI 80996.

Friesian heifers subjected to the double injection-double insemination regime (Trial 2). In two herds with a negligible level of anoestrum, 26 of 29, and 38 out of 39 heifers were successfully synchronized (Table 5), but in another herd with poorly fed heifers of the same age only 2 of 20 heifers responded. Ovarian examination indicated no apparent normal ovarian activity in the remaining 18. Similar variation in the degree of synchronization was observed between herds of dairy cows. The incidence of post-partum anoestrum was the critical factor, further emphasizing the limiting nature of this syndrome in reproductive efficiency (Fielden and Macmillan, 1973; Smith, 1974).

First calving heifers normally have a more concentrated calving pattern than other cows in the herd (Table 1), although this could be further concentrated with synchronization among groups of cycling maiden heifers (Table 5). In almost all New Zealand dairy herds a young sire is run with the heifer replacements from about the time that the herd breeding programme commences. Oestrus synchronization could facilitate the use of artificial insemination with these heifers. Even in well managed groups of heifers (such as A and B in Table 5) the pregnancy rate to the synchronized mating was only 49% (33 of 68), and therefore four maiden heifers would need to be treated for each heifer calf that would be produced. Since a double injection regime would be essential if the heifers were not regularly observed for oestrus, eight injections and eight inseminations per heifer calf produced could prove uneconomic. In addition, many herd owners are reluctant to rear many replacement calves from 2-year-old heifers of unknown productive ability and often prefer to use a breed of sire whose progeny are least likely to cause calving difficulties.

CONCLUSIONS

Oestrus synchronization achieved through the use of potent prostaglandin analogues can further concentrate calving patterns in seasonal dairy herds. However, the relevance of calving patterns to herd management has not been adequately investigated. Even without synchronization, the variations in calving patterns which have been reported here indicate that a major feature of New Zealand dairy farming (a seasonally concentrated calving pattern) has largely been overlooked.

It is probable that single injection regimes with selected lactating cows being injected around the end of the first week of a herd's breeding programme will be more economic and at least as effective as double injection regimes commenced prior to the breeding programme. A major factor influencing the effectiveness of synchronization programmes will be the relatively high incidence of post-partum anoestrum present in many New Zealand dairy herds at the time when the seasonal breeding programme is to commence. This factor will also largely preclude the use of synchronization as an alternative to efficient detection of oestrus. Nonetheless, many herd owners will consider the use of oestrus synchronization because of their desire to get as many cows in calf as quickly as possible. While this may also be applicable to maiden heifers, the use of a double injection-double insemination regime among a group of animals from which few heifer calves are reared as future herd replacements and which subsequently have a relatively concentrated calving pattern is unlikely to be economical.

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