

# The Production of Multiple Births In Beef Cows By Gonadotropic Hormone Injection Timed From a Synchronized Estrus

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## Story in Brief

Four groups of lactating beef cows were given subcutaneous injections of 1080 IU of PMS on day-5 and 1440 IU of PMS on day-17 of the estrual cycle, with the injections timed from either a non-synchronized estrus (treatment I) or an estrus synchronized by the individual feeding of an oral progestogen, CAP, for 18 days (treatments II, III, IV). At the first estrus following the second PMS injection the cows were either bred by natural service (treatments I and II) or by artificial insemination (treatment III) and given an intravenous injection of 2500 IU of HCG. In treatment IV the cows were given the intravenous injection of 2500 IU HCG on the third day following the second PMS and were artificially inseminated at that time and 24 hours later regardless of the occurrence of estrus.

Of the 65 cows treated, 21 (32.3 percent) conceived at the first estrus following the second PMS injection and produced 9 singles and 12 multiple (7 sets of twins, 4 sets of triplets and 1 set of quadruplets). Of the cows not conceiving at the first post-PMS estrus, 33 conceived at a later estrus for an overall conception rate of 83.1 percent.

Conception rate at the first post-PMS estrus was higher in treatment I (66.7 percent) than in the estrus synchronized groups (31.3, 18.8 and 16.7 percent for treatments, II, III and IV, respectively). However, each of the latter three treatment groups produced at least two sets of multiples.

Liveability was better for the single born calves (89 percent) than for twins (78.6 percent), triplets (75.0 percent) or quadruplets (50.0 percent). Single born calves reared as singles were heavier at weaning than were multiple born calves reared as twins. Weaning weights were: singles, 497 lbs.; twins, 380 lbs.; triplets, 382 lbs.; and quadruplets 348 lbs.

Despite the low conception rate in the synchronized groups and reduced survival of multiple birth calves, calving rate was markedly influenced by multiple births in this study. A total of 61 calves were

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weaned resulting in a calving rate of 142.9 percent based on the 21 cows conceiving at the first post-PMS estrus, 113.0 percent based on the 54 pregnant cows wintered, or 93.8 percent based on the 65 cows originally treated.

## Introduction

The major portion of the commercial cattleman's overhead expenses is the result of the combination of high maintenance costs and relatively low productivity of the beef cow. Not only is she, at best, limited to one saleable commodity or product per year, namely her calf, but 10-20 percent of the cows in the herd do not even produce a calf. Combine this with the long gestation period of those that do produce and it becomes apparent that the beef cow is one of the most inefficient of our farm animals.

The vital importance of increasing the productivity of beef cow herds has stimulated considerable research. One very promising field of such research has been in the area of seeking to increase the occurrence of multiple births. Previous work at Oklahoma State University has clearly demonstrated that one way in which the incidence of multiple births in beef cattle can be greatly increased is by the injections of the gonadotropic hormone preparations pregnant mare serum (PMS) and human chorionic gonadotropin (HCG). In these studies the hormone injections were timed from day of estrus in each cow and were followed by natural service.

Therefore, although successful, one big limitation to the use of these treatments in practical production is the large labor requirements to detect heat and to give the injections on an individual cow basis. Other studies at OSU have shown that multiple births could be produced if these hormone injections were given at a synchronized estrus. Thus, a considerable reduction in labor requirements should be obtained if a large portion of the cow herd would come in heat on some predictable day so there would be no necessity to check for the occurrence of estrus and all could be given their injections on the same day.

This paper presents the results of a study based on the most promising of the previous studies and was designed to test a practical procedure for inducing multiple births in which the injections of gonadotropic hormones were combined with estrus synchronization and artificial insemination.

## Methods and Materials

This study was conducted at the Fort Reno Research Station from May, 1970 to October, 1971, using a herd of 65 lactating cows of mixed

ages consisting of straightbred Herefords and Hereford X Angus or Angus X Holstein crossbreds. The cows had calved in February, March and April and were assigned to one of four different treatment groups on the basis of breeding and age of cows, and age and sex of calf. No cow was started on treatment earlier than 50 days after calving in an attempt to obtain maximum response to the oral progestogen used in estrus synchronization.

The treatments used in this study are described in Table 1. All cows received two injections of PMS<sup>1</sup> subcutaneously in the neck region, 1080 IU given early in the cycle (first PMS) and 1440 IU given late in the cycle (second PMS). AH HCG<sup>2</sup> injections were at a level of 2500 IU given intravenously. The individual doses of PMS and HCG were suspended in 10 ml. distilled water or saline, respectively, just prior to time of injection.

Treatment Group I was considered to be the control group for this study since it was a repeat of the most successful treatment used in past studies at Fort Reno. The cows were not estrus synchronized and were given their first PMS injection on day-5 and their second PMS on day-17 of the estrus cycle timed from the previous estrus of each cow with the day of that estrus counted as day-0 of the cycle. On the day of estrus following the second PMS injection each cow was bred by natural service and injected with HCG.

In the three remaining groups of cows, estrus was synchronized by feeding an oral progestogen, 6-chloro- $\Delta^4$ -17 acetoxyprogesterone (CAP)<sup>3</sup>,

<sup>1</sup> Lyophilized powder containing 72 IU PMS/mg. supplied by Eli Lilly Company, Greenfield Laboratories, Greenfield, Indiana.

<sup>2</sup> Lyophilized powder containing 80 IU HCG/mg. supplied by Eli Lilly Company, Greenfield Laboratories, Greenfield, Indiana.

Table 1. Schedule of Treatments.

Treatment Group	No. Cows	Synchronized (CAP) <sup>1</sup>	Day of PMS Injections <sup>2</sup>		Day of HCG <sup>2</sup> (2500 I.U.) and Breeding	Type of Breeding
			(Post-Estrus or Post-CAP) 1080 I.U.	1440 I.U.		
I	15	No	Day-5 <sup>3</sup>	Day-17 <sup>3</sup>	Day of Estrus	Natural
II	16	Yes	Day-8 <sup>4</sup>	Day-20 <sup>4</sup>	Day of Estrus	Natural
III	16	Yes	Day-8 <sup>4</sup>	Day-20 <sup>4</sup>	Day of Estrus	A.I.
IV	18	Yes	Day-8 <sup>4</sup>	Day-20 <sup>4</sup>	Day-3 Post-PMS	A.I.

<sup>1</sup> 10 mg. head/day for 16 days then 5 mg./head/day for 2 days.

<sup>2</sup> PMS injections subcutaneous, HCG injections intravenous.

<sup>3</sup> Post-Estrus, with day of estrus counted as day-0.

<sup>4</sup> Post-CAP, with last day of CAP feeding counted as day-0.

<sup>5</sup> Eli Lilly Company, Greenfield Laboratories, Greenfield, Indiana.

for 18 days at a level of 10 mg./cow/day for 16 days followed by 5 mg./cow/day for 2 days. All cows were started on individual feeding of CAP at the same time with no regard for the stage of the estrual cycle of the cow. Previous work had indicated that most cows would be expected to be in estrus on days-2, -3, or -4 following the last feeding of CAP. Therefore, day-3 was designated as the average day of estrus in all cows and was counted as day-0 of the synchronized cycle for the purpose of timing the two PMS injections. All cows received their first PMS injection on day-8 and their second PMS on day-20 following the last day on which CAP was fed. If counted from the average day of estrus of the synchronized cycles these injections were given on days -5 and 17.

Following the second PMS injections the further treatments scheduled for cows of Groups II and III were imposed on day of estrus. At this time the cows of both groups were injected with HCG and the cows of Group II bred by natural service and the cows of Group III by artificial insemination.

Following the second PMS injections the additional treatments scheduled for Group IV were imposed at a set time with no regard to the occurrence of estrus. On the third day post-PMS all cows were injected with HCG followed by artificial insemination of all cows at that time and 24 hours later.

Detection of estrus in all groups was facilitated by the use of sterilized bulls. All artificial inseminations were made with frozen Angus bull semen obtained from a commercial bull stud. Angus bulls of proven fertility were used for natural service at the first post-PMS estrus. Following the post-PMS mating all cows ran in a pasture with Hereford bulls until September 1, resulting in a total breeding season of 60 to 90 days.

The pregnant cows were wintered on native grass pastures at Fort Reno. During approximately the last three months of gestation, or from January to calving, the cattle were supplemented at the rate of about 2.5 lbs. of 21 percent alfalfa-cottonseed meal pellets and 20 lbs. of alfalfa and bermuda grass hay per head per day in an effort to insure that cows pregnant with multiples received ample feed.

With the exception of one cow who was permitted to raise her own triplets, no cows reared more than twins. An effort was made to insure that as many as possible of the cows that calved multiple births reared twins by grafting calves from triplet sets to cows losing all but one calf of their set of multiples. Cows rearing twins ran in a different pasture than did cows rearing singles. No creep feed was provided for any of the calves.

## Results and Discussion

Table 2 presents the breeding and calving performance of the cows in this study. Of the 65 cows treated, 21 (32.3 percent) conceived at the first post-PMS estrus, 33 (50.8 percent) conceived at a later heat period, and 11 (16.9 percent) were still open at the end of the 60-90 day breeding season. Fifty-two of the 54 pregnant cows that were wintered calved. With the exception of one cow in Group I, all cows that conceived at the first post-PMS estrus subsequently calved. Since this is the only group of cows that would be expected to have been stimulated by the PMS to produce multiple births, they are the only group of cows for which calving results are listed in Table 2. Twelve of the 20 cows calving in this group, or 60 percent, produced a multiple birth.

Although no untreated controls were included in this study to permit a comparison, the multiple birth rate of 18.5 percent of the total cows treated is well above the 0.55 percent which is commonly reported as the twinning rate for beef cow herds in the United States. The fact that the multiple births listed in Table 2 were predominately twins and triplets, with only one set of quadruplets, suggests that the lower dosage level of PMS used in this study may be more desirable from a practical standpoint than that used in the previous work at Fort Reno. Earlier studies had used levels of 1500 IU and 2000 IU for the first and second PMS injections. The results obtained in Groups II, and III and IV demonstrate that PMS injections can be effectively timed from a synchronized estrus. The results obtained in Group IV, although too limited to be practical, are very encouraging. If additional research can determine dose levels and schedules for injections and inseminations that will improve the level of response, the practical implications of eliminating completely the need for heat detection should be obvious.

Table 2. Summary of the Breeding Performance of All Cows Treated and the Calving Performance of Cows Conceiving at First Post-PMS Estrus.

Treatment Group	Total Cows	No. Cows Conceiving		No. Cows that Conceived at 1st Post-PMS Estrus Producing			
		1st Post-PMS Estrus	No. Open <sup>1</sup>	Singles	Twins	Trips.	Quads.
I	15	10	0	5	2	1	1
II	16	5	2	1	3	1	0
III	16	3	5	1	1	1	0
IV	18	3	4	1	1	1	0
Totals	65	21	11	8	7	4	1

<sup>1</sup> Following 60-90 day breeding season.

The results obtained in Group I are very similar to those obtained in previous years with the same treatment. As shown in Table 2, 66.7 percent of the cows conceived at the first post-PMS estrus, with 40.0 percent of these cows producing multiple births. When compared to the three estrus synchronized groups, cows of Treatment I were superior in conception rate both at the first post-PMS estrus and over the entire breeding season. However, a higher percentage of the cows conceiving at the first post-PMS estrus in the estrus synchronized groups produced multiples (72.7 percent vs 40.0 percent).

The reduced conception rate at the time first post-PMS estrus in Groups II (31.3 percent), III (18.8 percent), and IV (16.7 percent) probably reflect an effect due to the progestogen used for estrus synchronization. Most estrus synchronization studies with beef cows have reported reduced fertility at the synchronized estrus but not at the second or later post-synchronization heat periods. The cows in this study were not bred at the synchronized estrus but rather at the second estrus after synchronization. The results, therefore, suggest that the combination of PMS and progestogens may adversely affect fertility more than does either alone. It will require additional study to learn whether this is the case. There is also the suggestion that artificial insemination technique had a further adverse effect on fertility in Groups III and IV.

The incidence of open cows in Groups II (12.5 percent), III (31.2 percent), and IV (22.2 percent) may also have been influenced by the progestogen used for estrus synchronization and/or by artificial insemination technique. However, it is possible that the large number of open cows was the result of a reduced number of cows conceiving early in the breeding season with the result that most of the cows in these groups were being bred during the more unfavorable part of the breeding season (July and August) when temperatures were high. The detrimental effect of high ambient temperatures on fertility is well known. Again, however, additional study is necessary to determine how the treatments imposed in Groups II, III and IV affected numbers of open cows.

The calving performance of the cows conceiving at the first post-PMS estrus is presented in Table 3. Poor survival rates have proven to be a problem with multiple births, primarily because of losses associated with triplet and larger litters. In this study survival rates were 100 percent for single, 78.6 percent for twins, 75.0 percent for triplets and 50.0 percent for quadruplets. If calves from all cows that calved, regardless of time of conception, are considered, the survival rate for singles was 89 percent. Most losses occurred at time of calving and none later than 4 days after calving. The death loss charged against twins included one set aborted at about 7 months of pregnancy. If survival of twins is restricted to those carried full term the rate becomes 91.7 percent which is

**Table 3. The Calving Performance of the Cows that Conceived At the First Post-PMS Estrus.**

Item	Type of Birth			
	Singles	Twins	Trips.	Quads.
No. Sets	8	7 <sup>1</sup>	4	1
Live Calves	8	11	9	2
Birth Wt. (lbs.)				
Males	85.0	60.2	56.2	33.1
Females	73.6	62.6	48.5	32.0
Gestation (days)	283.6	281.7	271.0	272.0
Retained Placentas (%)	0	50.0	75.0	0

<sup>1</sup> One set aborted — data on 6 sets only.

comparable to that obtained in previous studies. The results reported in Table 3 are similar to those of previous years relative to survival rates of triplets and quadruplets and reemphasizes the desirability of restricting multiple sets to twins.

As shown in Table 3 shorter gestations were associated with multiple births, especially for triplets and quadruplets. Also, as might be expected, single birth calves were heavier at birth than were multiple birth calves. Within multiple birth sets, twins were heavier than triplets and both twins and triplets were heavier than quadruplets.

Multiple births, whether natural or induced by hormone treatments, have always been associated with a higher incidence of retained placentas. This was the case in this study where 6 (54.5 percent) of the 11 cows producing multiple births had retained placentas compared to none of the cows producing single births (Table 3). There was also a trend for a greater incidence of retained placentas in heavier litters rather than in those litters of larger numbers.

Table 4 presents the performance of calves from calving until weaning. All calves surviving the first 4 days of life were alive at time of weaning in the fall. As might be predicted, weaning weights were lighter for multiple born-twin reared calves than for single born-single reared calves. However, when expressed as total pounds of calf per cow, all multiple births resulted in more total pounds of calf weaned per cow even after adjusting for the higher death loss of multiples. This supports the results of previous years.

One of the possible problem areas associated with multiple births is the possibility that cows producing and rearing multiples may either be delayed in rebreeding or fail to rebreed. In this study 54.5 percent of the cows producing and rearing multiples failed to rebreed following calving in 1971 compared to 15.4 percent of the cows producing and rearing singles. These high figures are probably the result of using a

Table 4. Pre-weaning Performance of Calves Produced by Cows Conceiving at the First Post-PMS Estrus.

Item	Type of Birth			
	Singles	Twins	Trips.	Quads.
Total Sets	8	7	4	1
Live Calves	8	11	9	2
Calves Weaned	8	11	9	2
Adj. 205 Day Wt. (Lb.)	496	380	382	348
Lb. Calf per Cow	496	736	860	697

short breeding season of 60-70 days in an effort to move the average date of calving earlier in 1972. It is likely that more of the cows would have settled had the season been of a normal length. However, it is obvious that the cows producing and rearing multiples would have been delayed in rebreeding compared to the cows rearing singles. The factors associated with rebreeding following multiple births is an important area needing further research.

Despite the low conception rate of cows in Groups II, III and IV calving rate was markedly affected by multiple births in this study. A total of 61 live calves were obtained resulting in a calving rate of 142.9 percent for the 21 cows conceiving at the first estrus after PMS, 113.0 percent for the 54 cows wintered, or 93.8 percent for the total group of 65 cows treated. As a result of the treatments used in Group I, an additional weaner calf was obtained for every three cows treated.

There can be no doubt that the hormonal induction of multiple births has great potential for increasing the productivity of beef cow herds. However, there still remains a number of important questions that need to be answered by additional research before it can be recommended for use in commercial production.