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SYNCHRONIZATION OF ESTRUS IN SUCKLED POSTPARTUM BEEF COWS WITH MELENGESTROL ACETATE AND $PGF_{2\alpha}$

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ABSTRACT

A total of 402 two suckled postpartum beef cows at 2 locations (CSU and ECRC) were utilized in 3 trials to evaluate the effectiveness of a combination melengestrol acetate (MGA)-$PGF_{2\alpha}$ estrus synchronization system in spring-calving cows. The cows were allocatted by days post partum, body condition score (1 = emaciated; 9 = obese), sire breed, and dam age at the beginning of treatment to 1 of 2 treatments within location and trial: MGA-$PGF_{2\alpha}$ (0.5 mg MGA/head/d for 14 d with 25 mg of $PGF_{2\alpha}$ injected 17 d after MGA withdrawal), and unsynchronized controls. All cows were observed for estrus at 12-h intervals for at least 5 d post injection. Cows observed in standing estrus were inseminated 12 to 18 h later.

There was a location effect on response to treatment that was attributed to differences in body condition score between locations so data were analyzed within a location. Body condition score at the CSU location was 5.7 compared with 4.0 at the ECRC location. The CSU MGA-$PGF_{2\alpha}$ treated cows had higher ($P<0.05$) 5-day estrus and 5-d pregnancy rates (78.6 and 61.0%, respectively) than the CSU controls (11.1 and 6.9%, respectively). Similar results for 5-d estrus and pregnancy rates but of decreased magnitude were also observed for the ECRC MGA-$PGF_{2\alpha}$ treated (31.6 and 21.4%, respectively) cows compared with that of the ECRC controls (11.9 and 8.5%, respectively). The CSU MGA-$PGF_{2\alpha}$ treated cows had higher ($P<0.05$) 25- and 60-d pregnancy rates (82.5 and 94.8%) than the CSU controls (65.3 and 87.5%). The 25- and 60-d pregnancy rates were similar between the ECRC MGA-$PGF_{2\alpha}$ treated cows and ECRC control cows. The MGA-$PGF_{2\alpha}$ estrus synchronization system appears to contribute to pregnancy early in the breeding season in postpartum beef cows, although its effectiveness is limited by cow body condition.

Key words: estrus synchronization, melengestrol acetate, beef cow, prostaglandin $F_{2\alpha}$

INTRODUCTION

Most beef cows raised in the western United States are maintained under range conditions. Utilization of estrus synchronization and artificial insemination programs to take advantage of genetically superior sires requires a great deal of time, labor and management, which are often limiting factors in extensively managed beef cattle operations. Therefore, estrus synchronization systems need be developed which are economical and require minimal labor but which provide a fertile, closely synchronized estrus in a high percentage of the treated

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cattle. As a result, a producer could shorten both the breeding and calving seasons, thus decreasing expenditures while producing more uniform quality calves at weaning.

Melengestrol acetate (MGA), an orally active progestogen, has been shown to effectively suppress estrus in cattle (7,8,28) by inhibiting the ovulatory surge of LH (28). With long- term administration of MGA (10 to 18 d), an equivalent number of MGA-treated animals showed estrus during a 6-d synchronization period after MGA withdrawal when compared with a 20-d period in an untreated control group (27). However, the synchronized estrus following either short- ($\leq$ 9 d; 2,6) or long-term ($\geq$ 10 d; 8,27) MGA treatment was subfertile (2,6,8,27) compared with a spontaneous estrus in untreated cattle. This reduction in fertility was temporary and returned to normal at the subsequent estrus. Additional research has indicated that MGA induces cycling in some postpartum cows (3,4), but the results have been inconsistent.

The luteolytic property of prostaglandin $F_{2\alpha}$ ($PGF_{2\alpha}$) when injected during the luteal phase (Days 5 to 15) of the estrous cycle has been well documented. Consequently, $PGF_{2\alpha}$ has been used to effectively synchronize estrus in beef cattle. Related research has indicated that administering $PGF_{2\alpha}$ to cattle during the late luteal phase (Days 10 to 15) of the estrous cycle results in a higher estrous response than treating cattle earlier in the luteal phase (12,22). Watts and Fuquay (23) also reported increased fertility in heifers treated with $PGF_{2\alpha}$ during the late luteal phase.

Brown et al. (5) developed an estrus synchronization system for beef heifers that combines MGA supplementation of feed for 14 d followed by $PGF_{2\alpha}$ injection 16 or 17 d after the final day of the MGA administration. Therefore, heifers enter the later stages of the estrous cycle when $PGF_{2\alpha}$ is administered. Increased estrous response, degree of synchrony, and synchronized conception rate were all reported in the treated heifers compared with that of the unsynchronized heifers. King et al. (11) synchronized postpartum beef cows with a 14-d Norgestomet implant followed by an injection of alfaprostol (6 mg) given 16 d after implant removal. Increased estrous, synchronized conception and 25-d pregnancy rates were reported compared with those for the untreated controls.

Few studies have been conducted utilizing MGA for estrus synchronization in postpartum beef cows (3,4), and these studies utilized only 5-, 7- or 9- d MGA treatments with breeding at the estrus following MGA withdrawal. No studies to date have examined the effectiveness of the combined MGA-$PGF_{2\alpha}$ (5) system for synchronizing estrus in postpartum beef cows. Therefore, the objectives of this experiment were to determine the effectiveness of a 14-d MGA treatment followed by a $PGF_{2\alpha}$ injection 17 d after the final day of MGA supplementation in the diet for inducing and synchronizing estrus in suckled postpartum beef cows.

MATERIALS AND METHODS

Three trials utilizing 402 suckled postpartum beef cows were conducted in the spring of 2 consecutive years to evaluate the effectiveness of a combined MGA-$PGF_{2\alpha}$ estrus synchronization system (Table 1). Cows in Trial I and III were confined to a dry lot from calving through the treatment period and for the first 30 d of the breeding season. They were fed a corn silage, alfalfa hay ration to meet the NRC (17) protein and energy requirements for average milking cows. Cows in Trial II were maintained on native range and were fed alfalfa hay to meet the NRC (17) protein and energy requirements for average milking cows from calving to 1 wk prior to initiation of treatment, at which time all the cows were moved to native range and were given a supplement of a 20% crude protein cube to meet the NRC (17) protein requirements.

The cows were then allocatted to 1 of 2 treatments within location by days post partum and body condition score (19) at the beginning of treatment, by sire breed and by dam age. Two-thirds of the cows were allocatted to Treatment 1 and were administered MGA in the feed for 14 d at a rate of 0.5 mg/head/d; at 17 d after MGA removal, the cows were given an intramuscular injection of 25 mg of $PGF_{2\alpha}$ (MGA-$PGF_{2\alpha}$). The remaining cows were allocatted to Treatment 2 and served as the unsynchronized controls. The allocations allowed for optimal expression of the effectiveness of the MGA-$PGF_{2\alpha}$ treatment while maintaining an adequate number of unsynchronized controls for purposes of comparison.

Table 1. Summary of pertinent information on cows utilized for MGA-$PGF_{2\alpha}$ synchronization treatment and on control cows

Trial	Location[a]	n	Year	Average no. of days postpartum at beginning of treatment (range)	Average body condition score[b]	Breeds of cows[c]
I	CSU	115	1	47.4 (5 to 82)	5.7	A, H
II	ECRC	176	1	41.2 (6 to 76)	4.0	AX, HX, GX RAX, SX
III	CSU	111	2	47.5 (12 to 87)	5.6	A, H

[a] CSU=Colorado State University at Fort Collins; ECRC=Eastern Colorado Research Center at Akron.
[b] 1 = very thin, 5 = moderate, 9 = obese.
[c] A = Angus, H = Hereford, AX = Angus cross, HX = Hereford cross, GX = Gelbvieh cross, RAX = Red Angus Cross, SX = Simmental cross.

In Trials I and III, MGA was administered by top dressing corn silage with a corn based pellet containing 0.4 mg/lb MGA. Control cows received the same supplement without the MGA during the treatment period. In trial II MGA was administered within a 20% crude protein cube containing 0.4 mg/lb MGA. Control cows were also fed the range cube without MGA during the treatment period. All cows in Trial II received the range cube supplement without MGA 1 wk prior to the beginning of MGA treatment, to accustom them to the supplement.

The artificial insemination (AI) breeding season for both the MGA-$PGF_{2\alpha}$ treated cows and the controls began the day that the MGA-treated cows were given $PGF_{2\alpha}$.injections. In all trials, the cows were observed for estrus at 12-h intervals for at least 5 d following $PGF_{2\alpha}$ injection. Cows observed in standing estrus were artificially inseminated 12 to 18 h later. Following the 5-d synchronized breeding period, AI was continued for approximately 30 d in Trials I and III, at which time bulls were introduced. Cows in Trial II were exposed to bulls immediately after the synchronized breeding period. The breeding season for both groups was approximately 60 d. Pregnancy was determined by palpation per rectum approximately 60 and 150 d after the start of the breeding season.

The ability of the MGA treatment to induce cycling in anestrous cows was evaluated in Trial II. Blood samples were collected via jugular venipuncture from control and treated cows

1 wk prior to the beginning of MGA treatment and on the first day of treatment. Blood samples were also collected 1 wk prior to $PGF_{2\alpha}$ injection and again on the day of injection. Upon collection, blood samples were allowed to clot, they were then centrifuged, and the serum was harvested and stored at -20°C. Serum was assayed for progesterone by radioimmunoassay (16). Cows with progesterone concentrations $\geq$ 1 ng/ml at either collection before MGA treatment or $PGF_{2\alpha}$ injection were classified as cyclic. The number of noncylic cows prior to MGA treatment was then determined. From this group, the percentage of post-MGA treatment cyclic cows was determined for each treatment group.

Treatment effects were analyzed using the SAS General Linear Models procedure (20). Treatment and location were the independent variables tested, while the 5-d estrus rate (number of cows in estrus 5 d after treatment divided by the number in the group); the synchronized conception rate (number of cows pregnant at 5 d after treatment divided by the number inseminated); the 5-d pregnancy rate (number of cows pregnant at 5 d after treatment divided by the number in the group); the 25- and 60-d pregnancy rates and the average day of conception (ADC; average day of the breeding season, start of breeding season was Day 1, that cows in each group became pregnant) were the dependent variables tested. Degree of synchrony was determined by dividing the number of cows in estrus in the peak 24-h period of the 5-d synchronized period by the number of cows in estrus during the synchronized breeding period. Within the CSU location there was no significant difference among dependent variables between years, thus the data from Trials I and III were combined. Location was a significant source of variation affecting the response to MGA-$PGF_{2\alpha}$ treatment; therefore, locations were analyzed separately for all treatment responses. The effect of postpartum interval on response to MGA-$PGF_{2\alpha}$ treatment was also analyzed within location to determine its effect on subsequent reproductive performance. Two-year-old first calf heifers were not included in the postpartum interval data because they calved approximately 1 mo ahead of the cowherd and had longer postpartum intervals.

RESULTS

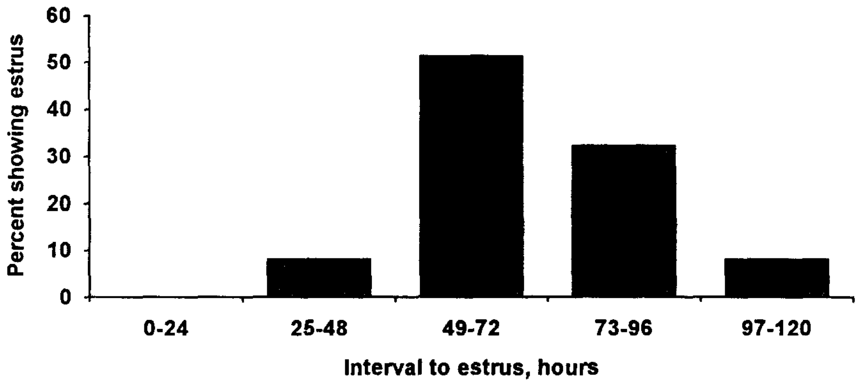
Location was a significant source of variation for all the dependent variables except for the synchronized conception rate, thus treatment means are presented by location (Table 2). Differences in response to treatment between locations was attributed to body condition differences. Body condition scores were was higher ($P<0.001$) at the CSU (5.7) location than at the ECRC (4.0) location. Therefore, each location served as an excellent indicator of how cows with diverse differences in body condition scores responded to treatment.

A greater ($P<0.001$) percentage of CSU (78.6%) and ECRC (31.6%) MGA-$PGF_{2\alpha}$-treated cows showed estrus in the first 5 d of the breeding season than CSU (11.1%) and ECRC (11.9%) control cows. The mean interval to estrus after $PGF_{2\alpha}$ injection was greater ($P<0.05$) for the CSU cows (84.1 h) than than ECRC (76.1 h) MGA-$PGF_{2\alpha}$-treated cows. The degree of estrus synchrony (measured by the percentage of cows in estrus during a peak 24-h period following treatment) within location is shown in Figure 1. There was no single 24-h period where a majority of cows within a location exhibited estrus. However, 83.8 and 77.6 % of the ECRC and CSU MGA-$PGF_{2\alpha}$-treated cows exhibited estrus between 49 and 96 h after $PGF_{2\alpha}$ injection. Synchronized conception rate, a measure of fertility of the synchronized estrus, did not differ within a location, and the means were of similar values between locations (Table 2).

More ($P<0.001$) CSU location MGA-$PGF_{2\alpha}$ cows (61.0%; Table 2) became pregnant in the first 5 d of the breeding season than CSU control cows (6.9%). Although fewer cows at the ECRC location became pregnant during the first 5 d of the breeding season compared with that of the CSU location, the 5-d pregnancy rate was higher ($P<0.05$) for ECRC MGA-$PGF_{2\alpha}$

(21.4%) treated cows than for the ECRC controls (8.5%). Both the 25-d (82.5 vs 65.3%; P<0.01) and 60-d (94.8 vs 87.55; P<0.05) pregnancy rates (Table 2) were higher for the CSU MGA-$PGF_{2\alpha}$-treated cows than the CSU controls. The 25-d and 60-d pregnancy rates were similar between the controls and MGA-$PGF_{2\alpha}$-treated cows at the ECRC location. The MGA-$PGF_{2\alpha}$ treated cows at the CSU location became pregnant, on the average, 8.5 d earlier (P<0.01) in the breeding season than the CSU controls while there was no difference in average day of conception (ADC) at the ECRC location (Table 2).

a)



b)

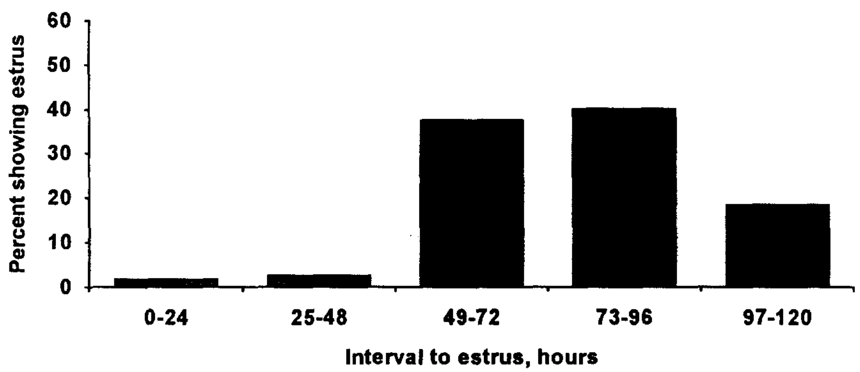


Figure 1. Interval to estrus after $PGF_{2\alpha}$ injection for ECRC (a) and CSU (b) MGA-$PGF_{2\alpha}$ treated cows.

Table 2. Least-squares means for location and treatment by location for body condition score, 5-day estrus rate, synchronized conception rate and pregnancy rate in suckled postpartum beef cows

Variable	n	Body condition score[a]	5 day estrous rate[b] (%)	Synchronized conception rate[c] (%)	5 day pregnancy rate[d] (%)	25 day pregnancy rate[d] (%)	60 day pregnancy rate[d] (%)	Average day of conception[e]
Location[f]		***	***		***	+	**	***
CSU	226	5.7	44.8	70.1	34.0	73.9	91.2	22.5
ECRC	176	4.0	21.7	69.5	14.9	65.1	82.5	16.7
Treatment x Location								
			***		***	**	*	**
Control by CSU	72	5.7	11.1	62.5	6.9	65.3	87.5	21.0
MGA-$PGF_{2\alpha}$ by CSU	154	5.7	78.6	77.7	61.0	82.5	94.8	12.5
			***		*			
Control x ECRC	59	4.0	11.9	71.4	8.5	67.8	86.4	22.6
MGA-$PGF_{2\alpha}$ by ECRC	117	4.0	31.6	67.6	21.4	62.4	78.6	22.5

[a] 1 = very thin, 5 = moderate, 9 = obese.
[b] Number of cows in estrus 5 days after treatment divided by the number in the group.
[c] Number of cows pregnant at 5 days after treatment divided by the number inseminated.
[d] Number of cows pregnant at 5, 25 and 60 days after treatment divided by the number in the group.
[e] Average day of the breeding season (start is Day 1) that cows in each group became pregnant.
[f] CSU=Colorado State University at Fort Collins; ECRC=Eastern Colorado Research Center at Akron.
+ $P<0.06$.
* $P<0.05$.
** $P<0.01$.
*** $P<0.001$.

Table 3. Effects of postpartum interval within a location on response to MGA-$PGF_{2\alpha}$ treatment in suckled post partum beef cows[a]

Location[b]	No. of days postpartum[c]	n	Body condition score[d]	5 day estrous rate[e] (%)	Synchronized conception rate[f] (%)	5 day pregnancy rate[g] (%)	25 day pregnancy rate[g] (%)	60 day pregnancy rate[g] (%)
ECRC								
	37-60	23	4.0	21.7	100.0	21.7	47.8^{h}	69.6^{h}
	61-75	43	3.9	30.2	53.8	16.3	74.4^{i}	88.4^{i}
	76-84	24	3.8	41.7	60.0	25.0	75.0^{i}	83.3^{i}
CSU								
	37-60	18	6.1	72.2^{h}	61.5	44.4^{h}	72.2^{h}	88.9^{h}
	61-75	28	5.7	85.7^{hi}	83.3	71.4^{i}	89.3^{i}	100.0^{i}
	76-103	69	5.8	89.9^{i}	75.8	68.1^{i}	88.4^{i}	100.0^{i}

[a] Includes cows ages 3 to 10 years.
[b] CSU=Colorado State University at Fort Collins; ECRC=Eastern Colorado Research Center at Akron.
[c] At the beginning of the breeding season.
[d] 1=very thin, 5 = moderate, 9 = obese.
[e] Number of cows in estrus 5 days after treatment divided by the number in the group.
[f] Number of cows pregnant at 5 days after treatment divided by the number of cows inseminated.
[g] Number pregnant at 5, 25 and 60 days after treatment divided by the number in the group.
[h,i] Values in a column (within a location) that do not have a common superscript differ ($P<0.05$).

Data from the MGA-PGF$_{2\alpha}$-treated cows was analyzed separately to determine if postpartum interval affected the reproductive performance of the cows in each respective location. At the ECRC location, days postpartum at the start of the breeding season did not influence the 5-d estrus rate or the 5-d pregnancy rate (Table 3). However, at the CSU location, more ($P<0.05$) cows showed estrus that were greater than 76 d post partum at the beginning of the breeding season than cows that were 37 to 60 d post partum. Cows that were 61 to 75 d post partum had a similar 5-d estrus response compared with cows that were 37 to 60 and 76 to 103 d post partum. Cows that were greater than 61 d post partum at the beginning of the breeding season had higher 5-d pregnancy rates than cows that were less than 61 d post partum. Irrespective of location, cows that were greater than 60 d post partum had higher ($P<0.05$) 25- and 60- d pregnancy rates than cows that were less than 61 d post partum at the beginning of the breeding season.

The final experimental objective was to determine if MGA treatment initiated cycling in Trial II cows. The percentage of noncylic cows at the beginning of treatment was > 85% (Table 4) for both MGA-PGF$_{2\alpha}$-treatmed and control cows. Of the noncylic cows prior to MGA treatment, the percentage of cyclic cows prior to PGF$_{2\alpha}$ treatment was similar between the MGA-PGF$_{2\alpha}$ (33.0%) and control (37.0%) cows.

Table 4. Effect of treatment on post-MGA treatment cycling status of anestrous suckled postpartum beef cows[ab]

Treatment	n	No. of anestrous cows pre-MGA treatment	Percentage of anestrous cows cyclic post-MGA treatment
Controls	59	54	37.0
MGA-PGF$_{2\alpha}$	117	100	33.0

[a] Cycling status was determined by measuring serum progesterone concentrations by radioimmunoassay. Cows with progesterone concentrations $\geq$ 1 ng/ml were classified as cyclic. Blood samples were taken from all cows 7 days prior to MGA treatment and PGF$_{2\alpha}$ injection and again on the first day of MGA treatment and on the first day of PGF$_{2\alpha}$ injection.
[b] All cows were located at the Eastern Colorado Research Center at Akron.

DISCUSSION

A greater percentage of CSU and ECRC location MGA-PGF$_{2\alpha}$-treated cows showed estrus within the first 5 d of the breeding season than did the controls. However, 47 % more CSU location MGA-PGF$_{2\alpha}$-treated cows showed estrus than ECRC location MGA-PGF$_{2\alpha}$-treated cows. This advantage was directly attributed to the increased body condition of the CSU cows (5.7) above that of the ECRC cows (4.0) at the beginning of treatment. The importance of body condition on reproductive function in postpartum beef cows has been well documented (9,19,21), and body condition is one of the most important factors influencing early return to estrus in postpartum beef cows (19,21). In heifers synchronized with the MGA-PGF$_{2\alpha}$ system, Brown et al. (5) reported 91.6 and 71.0%, respectively, 5-d synchronized estrus rates in cyclic and noncyclic heifers. The average heifer body condition score was 5.7. Mauck et al. (14) reported a combined 7-d synchronized estrus rate for cyclic and noncyclic heifers of 75.4%. King et al. (11) synchronized postpartum beef cows with a 14-d Norgestomet implant with alfaprostol administered 16 d after implant removal and reported a 5-d synchronized estrus rate of 64.0%. The 5-d estrus rates in the present study are comparable with those reported for Syncro-Mate B (13,15) and combined progestogen-prostaglandin treatment (1,3,4) in postpartum beef cows. Postpartum cows consistently have lower synchronized estrus rates than heifers, and this can be attributed to the levels of cyclicity (18). Cyclicity in heifers is influenced primarily by nutrition while both nutrition and suckling influence cyclicity in postpartum cows. This study provides further evidence of the importance of body condition on response to estrus synchronization in postpartum beef cows.

The mean interval to estrus was longer and the degree of synchrony was less defined at both locations under study than in postpartum cows synchronized with a similar synchronization regimen (11). There was no defined 24-h period in which most of the cows exhibited estrus at either one of the locations; therefore, the potential for using the combined MGA-$PGF_{2\alpha}$ system for timed insemination appears to be limited.

A significant increase was not observed in the synchronized conception rate of MGA-$PGF_{2\alpha}$-treated cows over that of the controls. This contrasts with reported increases in heifers (14) and postpartum cows (11) synchronized with a similar progestogen-prostaglandin system. Watts and Fuquay (23) reported that heifers treated with $PGF_{2\alpha}$ during late diestrus (Days 12 to 15) had higher conception rates than heifers treated during early diestrus (Days 5 to 7). However, the conception rates of treated cows in our present study were consistently higher than first service conception rates reported for Syncro-Mate B and for 5-, 7- and 9-d MGA treatments (18) followed by artifical insemination at the estrus immediately following the MGA treatment.

The best indicator of effectiveness of an estrus synchronization system is determined by the number of animals that become pregnant to the synchronized breeding period, and is expressed as the synchronized pregnancy rate (the 5-d pregnancy rate in present study). More CSU location MGA-$PGF_{2\alpha}$-treated cows showed estrus and became pregnant in the first 5 d of the breeding season than CSU control cows as was the case with the ECRC location MGA-$PGF_{2\alpha}$-treated cows but to a lesser extent than observed at the CSU location. King et al. (11) also reported a higher synchronized pregnancy rate in suckled postpartum cows treated with a similar progestogen-prostaglandin system than in the untreated cows. Five-day pregnancy rates in the present study were comparable with those reported for Syncro-Mate B (11,13,15) and progestogen prostaglandin combinations (1,3,4) in postpartum beef cows. In addition, more CSU location MGA-$PGF_{2\alpha}$-treated cows became pregnant in the first 25 d of the breeding season than ECRC location MGA-$PGF_{2\alpha}$-treated or control cows at either location. This increase is further reflected in the decreased ADC of CSU location MGA-$PGF_{2\alpha}$-treated cows. Thus, the MGA-$PGF_{2\alpha}$ estrus synchronization system supports pregnancy earlier in the breeding season than would occur in unsynchronized cows.

These and earlier data (9,19,21) show the importance of body condition, an implied measure of pre and postpartum nutritional status, on the response to MGA-$PGF_{2\alpha}$ synchronization and subsequent conception early in the breeding season. Furthermore, cow condition can also influence subsequent reproductive performance of cattle throughout the breeding season, as evidenced by increased 25-d pregnancy rates for cows in good body condition.

The postpartum data indicates that cows in poor body condition, regardless of the length of the postpartum interval, have a decreased likelihood of exhibiting estrus and becoming pregnant early in the breeding season. However, when in good body condition, cows with long postpartum intervals (> 60 d) are more likely to exhibit estrus and conceive earlier in the breeding season than cows with short postpartum intervals. Furthermore, cows with short postpartum intervals (< 60 d) in either good or poor body condition at the beginning of the breeding season have lower 60-d pregnancy rates. However, regardless of the length of the postpartum interval or of the body condition score, if a cow exhibits estrus she has a good chance of becoming pregnant to that estrus. This is supported by the similar synchronized conception rates reported for both locations in our study. Therefore, acceptable pregnancy rates can be achieved in cows that have calved as early as 6 d prior to the beginning of the treatment period. Similar results were reported by King et al. (11), in cows synchronized with a similar progestogen-prostaglandin system; however, body condition of the cows was not addressed in their study.

There was no indication that MGA-treated anestrous cows at the ECRC location began cycling in significant number. Beal and Good (3) reported that 5-, 7- and 9- d MGA treatments with prostaglandin administered on the last day of MGA administration initiated cycling in 65% of the noncycling cows. However, no direct comparison was made between noncyclic MGA-treated cows and noncyclic control cows, which would have allowed for the determination of the percentage of noncyclic controls that would have begun to cycle on their own at the beginning of the breeding season. Hence, the method used to evaluate the initiation of cycling needs to be consisered. The low numbers of animals responding to the MGA treatment in our present study may have been due to 1 of 2 factors. First, the cows were group-fed range cubes in the pasture; thus, adequate MGA consumption may not have occurred. Second, the cows were in a thin to borderline body condition at the beginning of treatment. The underconsumption of MGA appears to be unlikely since > 90% of the cows were observed consuming range cubes each day. Thus, the poor body condition of the cattle (score=4.0) was probably the reason for the low response to treatment. Williams (25) concluded that an estrus synchronization system cannot initiate cycling in anestrous cows if they are in poor body condition. The present experiment and current literature suggest that a minimum body condition score of 5 at or near the start of the breeding season is needed for effective rebreeding (10,19,26). Furthermore, Wettemann (28) concluded that treatment of anestrous postpartum cows with progestogens may reduce the postpartum anestrous interval in some cows; however, this must occur near the time when ovarian activity would normally commence in these cows. Such may have been the case with the CSU cows since the same percentage of controls exhibited estrus in the first 5 d of the breeding season as at the ECRC location; however, the level of cyclicity was not determined at the CSU location.

The MGA-$PGF_{2\alpha}$ system appears to be an effective method for synchronizing estrus in postpartum cows, although its effectiveness is limited by body condition of the cows. A condition score of 5 at the initiation of treatment allows for an adequate number of animals to exhibit estrus and become pregnant early in the breeding season. Cows in poor body condition, regardless of the length of their postpartum interval, have a decreased liklihood of becoming pregnant early in the breeding season. The MGA treatment did not initiate cycling in a significant number of anestrous cows.

The MGA-$PGF_{2\alpha}$ synchronization system was found to be a useful synchronization program for beef cow operations that use high protein range cubes as part of their postcalving nutritional program since no extra labor is required to administer the MGA. Moreover, the animals would only have to handled to administer a $PGF_{2\alpha}$ injection and then again to be artifically inseminated. Our system results in a fertile and closely synchronized estrus that allows for an increase in pregnancy rates early in the breeding season. However, the effectiveness of the system is dependent upon the body condition of the cows.

REFERENCES

1. Beal W E. A note on synchronization of oestrus in postpartum cows with prostaglandin $F_{2\alpha}$ and a progesterone releasing device. Anim Prod 1983 37:305.
2. Beal WE, Chenault JR, Day ML , Corah LR. Variation in conception rates following synchronization of estrus with melengestrol acetate and prostaglandin $F_{2\alpha}$. J Anim Sci 1988;66:599-602.
3. Beal WE, Good GA. Synchronization of estrus in postpartum beef cows with melengestrol acetate and prostaglandin $F_{2\alpha}$. J Anim Sci 1986;63:343-347.
4. Boyd GW, Corah LR. Synchronization of estrus in cyclic and noncyclic heifers and cows using melengestrol acetate and prostaglandin. J Anim Sci 1986;63 (Suppl 1):353 abstr.
5. Brown LN, Odde KG, King ME, LeFever DG, Neubauer CJ. Comparison of melengestrol acetate-prostaglandin $F_{2\alpha}$ to Syncro-Mate B for estrus synchronization in beef heifers. Theriogenology 1988;30:1-12.
6. Chenault JR, McAllister JF, Kason CW. Synchronization of estrus with melengestrol acetate and prostaglandin $F_{2\alpha}$ in beef and dairy heifers. J Anim Sci 1990;68:296-303.
7. Chow LA, Thatcher WW, Kalra PS, Wilcox CJ, Chenault JR. Peripheral progesterone, estradiol and luteinizing hormone plasma levels during and after estrus synchronization in dairy heifers with melengestrol acetate. Arq Esc Vet 1982; 34:545-558.
8. DeBois CHW, Bierschwal CJ Jr. Estrous cycle synchronization in dairy cattle given a 14-day treatment of melengestrol acetate. Amer J Vet Res 1970; 31:1545-1548.
9. Dunn TG, Kaltenbach CC. Nutrition and the postaprtum interval of the ewe, sow, and cow. J Anim Sci 1980;51(Suppl 2):29.
10. Dzuik PJ, Bellows RA. Management of reproduction of beef, sheep and pigs. J Anim Sci 1983; 57(Suppl II):355-379.
11. King ME, Holland MD, Mauck HS, LeFever DG, Odde KG. Synchronization of estrus in beef cows with norgestomet-alfaprostol or Syncro-Mate B. Theriogeneology 1988;30:785-795.
12. King ME, Kiracofe GH, Stevenson JS, Schalles RR. Effect of stage of the estrous cycle on interval to estrus after $PGF_{2\alpha}$ in beef cattle. Theriogenology 1982;18:191-200.
13. Kiser TE, Dunlap SE, Benyshek LL., Mares SE. The effect of calf removal on estrous response and preganancy rate of beef cows after Syncro-Mate B treatment. Theriogenology 1980;13:381-389.
14. Mauck HS, Holland MD, King ME, LeFever DG, Odde KG. Effectiveness of two MGA-$PGF_{2\alpha}$ combinations for estrous synchronization of beef heifers. Proc West Sec Amer Soc Anim.Sci 1988;39:283-286.
15. Mikcsh ED, LeFever DG, Mukembo G, Spitzer JC, Wiltbank JN. Synchronization of estrus in beef cattle. II. Effect of an injection of norgestomet and an estrogen in conjunction with a norgestomet implant in heifers and cows. Theriogenology 1978;10:201-221.
16. Niswender GD. Influence of site of conjugation on the specificity of antibodies to progesterone. Steroids 1973;22:413-424.
17. NRC. Nutrient requirements of beef cattle. National Research Council. 1984.
18. Odde KG. A review of synchronization of estrus in postpartum cattle. J Anim Sci 1989;67:817-830.
19. Richards MW, Spitzer JC, Warner MB. Effect of varying levels of postpartum nutrition and body condition at calving on subsequent reproductive performance in beef cattle. J Anim Sci 1986;62:300-306.
20. Statistical Analysis System (SAS) Procedures Guide for Personal Computers. Version 6. SAS Institute, Cary, NC, 1986.
21. Selk GE, Wettemann RP, Lusby KS, Oltjen JW,.Mobley SL, Rasby RJ, Garmendia JC. Relationships amoung body weight change, body conditionand reproductive performance of range beef cows. J Anim Sci 1988;66:3153-3159.
22. Tanabe TY, Hann RC. Synchronized estrus and subsequent conception in dairy heifers treated with prostaglandin $F_{2\alpha}$. I. Influence of stage of cycle at treatment. J Anim Sci 1984;58:805-811.
23. Watts TL, Fuquay JW. Response and fertility of dairy heifers following injection with prostaglandin $F_{2\alpha}$ during early, middle and late diestrus. Theriogenology 1985; 23:655-661.
24. Wettemann RP. Postpartum endocrine function of cattle, sheep and swine. J Anim Sci 1980; 51(Suppl. II):2-15.

25. Williams GL. Suckling as a regulator of postpartum rebreeding in cattle: A Review. J Anim Sci 1990;68:831-852.
26. Wiltbank JN. Changing reproductive performance in beef cow herds. Proc Annul Conference Artificial Insemination and Embryo Transfer in Beef Cattle. 1985;15-27.
27. Zimbelman RG, Lauderdale JW, Sokolowski JH, Schalk TG. Safety and pharmacologic evaluations of melengestrol acetate in cattle and other animals: A review. J Amer Vet Med Assoc 1970;157:1528-1536.
28. Zimbelman RG, Smith LW. Control of ovulation in cattle with melengestrol acetate. I. Effect of dosage and route of administration. J Reprod Fertil 1966;11:185-191.