THE EFFECT OF ESTRUS SYNCHRONIZATION AND POST-PARTUM INTERVAL ON FERTILITY IN BEEF CATTLE

by

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LITERATURE REVIEW

Synchronization of estrus in beef cattle under ranch conditions would enable greater use of artificial insemination by reducing labor and associated costs. For this reason, investigators have worked for several years to develop successful synchronization treatments.

In 1948, Christian and Casida reported synchronizing estrus in heifers by giving 14 daily injections of 50 mg progesterone. A number of investigators later reported suppression of heat by injecting progesterone; however, fertility was usually low at the synchronized estrus (Willet, 1950; Ulberg et al., 1951; Trimberger and Hansel, 1955). Trimberger and Hansel (1955) reported cows exhibited estrus an average of 4.6 days after progesterone treatment. The interval of time between the last injection and onset of estrus decreased as the progesterone dosage level decreased (Ulberg et al., 1951).

A number of orally active progestogens (MAP, 6-methyl-17-acetoxyprogesterone; CAP, 6-chloro-6-dehydro-17-acetoxyprogesterone; DHPA, 16α-17-dihydroxyprogesterone acetophenonide; MGA, melengestrol acetate) have been fed to cows and heifers to synchronize estrus.

A high degree of estrus synchronization resulted after feeding MAP (Collins et al., 1961; Hansel et al., 1961; Nelms and Combs, 1961; Anderson et al., 1962), but fertility results were variable. Nelms and Combs (1961), Anderson et al. (1962)

and Dhindsa et al. (1967) reported conception rates similar to controls following treatment with MAP. However, Hansel et al. (1961) reported lowered fertility after MAP. Zimbelman (1963) determined that 135 mg daily was the minimum dose for synchronization of estrus in heifers with MAP. Dhindsia et al. (1967) reported the number of times per day that MAP was fed was insignificant, and a higher percentage of heifers than cows showed heat after MAP treatment. MAP fed at 240 mg per day for 18 days resulted in a significantly higher conception rate than CAP fed at 10 mg per day for 18 days (Hansel et al., 1966). Van Blake et al. (1963) reported synchronized estrus occurred 6 to 9 days after hormone withdrawal when heifers were fed 12 mg of CAP per day for 18 days, and conception rate equaled that of untreated controls. Grunert (1975) fed 10 mg of CAP per day for 18 days and administered 5 mg EB (estradiol benzoate) two days after CAP withdrawal. He reported an increase in estrus intensity, but no change in conception rate with EB; however, when he injected 1.5 mg of GnRH (gonadotropin releasing hormone) 5 hr before insemination, conception rate improved. HCG (human chorionic gonadotropin) administered after an 18 day CAP treatment reduced the percentage in estrus but increased conception rate (Baker and Coggins, 1968).

Feeding of MGA increases growth and improves feed efficiency in feedlot heifers (Bloss et al., 1966; O'Brien et al. 1968). MGA feeding also synchronizes estrus by suppressing heat in both heifers and cows, but like other progestogens,

lowers fertility at the synchronized estrus. Chakraborty et al. (1971) reported significantly lowered conception rate after feeding 1 mg of MGA per day for 14 days in dairy heifers. He also fed MGA from 90 days post-conception to 30 days post-partum and found no effect on gestation length or milk yield and milk fat during the subsequent lactation. Henricks et al. (1973) stated that both poor synchronization and poor fertility occurred when beef heifers were fed .5 mg of MGA per day for 14 days beginning on day 15 of the estrous cycle. These results are in agreement with those reported by Hill et al. (1971); heifers given MGA beginning on day 15 of the cycle had a lower pregnancy rate than heifers placed on MGA on day 4 of the cycle. A number of treatments have been used attempting to overcome the lowered fertility associated with MGA synchronized estrus. Boyd and Tasker (1971) injected HCG 72 hr after the last MGA feeding. They also administered EB on day 1 of MGA feeding, PMS (pregnant mare serum) 36 hr and HCG 72 hr after the last feeding. Neither treatment improved fertility. Boyd et al. (1973) attempted to overcome reduced conception rate with increased sperm numbers, but found no difference between inseminating with 15 million compared to 60 million. Zimbelman (1966) looked at the effects of MGA on ovarian and pituitary activities. He stated that MGA produced no demonstrable effect on follicular activity in the presence of a corpus luteum; however, follicular fluid weights increased up to three fold in the absence of a corpus luteum. Zimbelman

and Smith (1966) suggested MGA may prevent a release of LH in quantities needed for ovulation, but may allow low levels of LH to be released for synergism with FSH; thus follicular growth resulted.

Wiltbank et al. (1967) fed 500 mg of DHPA twice daily to beef heifers and reported estrus was 4.5 hr longer and more variable in untreated control heifers than in synchronized heifers. Moreover, ovulation occurred significantly longer after the end of estrus in synchronized heifers. Mauer et al. (1975) reported synchronization of estrus and ovulation using a PRID (progesterone releasing intravaginal device). Progesterone is released from a silicone rubber matrix attached to a stainless steel spiral. The device was placed in the cows for 21 days and 100 μg GnRH was given 28 to 30 hr after removal of the device. Breuer et al. (1977) inserted the PRID for 14 days and reported 75% of the cows showed estrus during a 3 day period following removal of the PRID. First service conception rates were 60% and 50% for the control and synchronized cows, respectively.

Progestogens or progesterone have been used in combination with estrogen to effectively synchronize estrus. Feeding 75 mg DHPA for 9 days and injecting 5 mg EV (estradiol valerate) on day 2 effectively synchronized heifers without lowering conception rate (Wiltbank and Kasson, 1968). This treatment is based on previous work (Wiltbank et al., 1961) which indicated estrogen administered early or mid cycle regressed the corpus

luteum. Wiltbank et al. (1971) implanted norethandrolone (17-ethyl-19-norestosterone) for 9 days and injected 5 mg EV at the time of implantation. Conception rate at the synchronized estrus was equal to controls in one group and lower than controls in another group. Another group received 2 mg of estradiol-17β 24 hr after implant removal. Although estrus and ovulation synchrony was increased following this treatment, fertility was lowered. Roche (1974c) placed silastic rubber implants containing progesterone in the dewlap of heifers for 9 days and injected 5 mg EB at the time of implantation. Heifers treated during the luteal phase had a high estrus response while those receiving implants on day 3 or 17 had lower response. When 50 mg of progesterone was injected with the EB, the estrus response of heifers treated on day 17 increased, while the estrus response of heifers treated on day 3 or during the luteal phase was not affected. He suggested that the progesterone injected with the estrogen prevented an immediate LH surge and ovulation in heifers injected on day 17. In another study, (Roche, 1974b) a similar treatment (progesterone implant for 10 days and 5 mg of EB at the time of implantation) was compared to a 20 day progesterone implant. The 20 day progesterone implant resulted in better estrus synchronization, but a lower conception rate.

Wiltbank and Gonzalez-Padilla (1975) synchronized estrus in cows and heifers by implanting norgestomet (SC21009) for 9 days and injecting 6 mg of EV and 3 mg of norgestomet at the

time of implantation (Syncro-Mate B, G. D. Searle and Co.). Fertility at the synchronized estrus was not different from that noted in the controls at first service in 4 of 7 trials. However, in three trials fertility was markedly lower. This treatment was also capable of inducing estrus in some prepuberal heifers.

Chupin et al. (1975) studied the influence of treatment (norgestomet implants and EV on first day) duration and norgestomet dose on fertility. Fertility increased with the dose (from 6 to 12 mg) and decreased with the duration of treatment (from 7 to 11 days).

Smith and Vincent (1973) reported that the combination of an estrogen injection and norgestomet implant did not effectively synchronize those heifers treated in the first 7 days of their estrous cycle. It appears that progestogen injected with the estrogen in this treatment may improve estrus synchronization possibly because progesterone injected early in the cycle shortens the life span of the corpus luteum (Woody et al., 1967).

Whitman et al. (1972) injected either 5, 6, 6.5 or 7.5 mg EV on the day of implantation with norgestomet and reported that 5 mg of EV in this treatment was insufficient to effectively synchronize estrus in cows; however, Burrel et al. (1972) reported that 5 mg EV injected at the time of implanting norgestomet was effective in synchronizing estrus in heifers.

Kiracofe et al. (1978) reported 25 day pregnancy rates were consistently higher in cows and heifers treated with Syncro-Mate B compared to controls. No differences were observed in treatments containing 5 and 6 mg EV.

Prostaglandins have been used to synchronize estrus in cattle. The natural prostaglandins are unsaturated hydroxy acids of 20 carbon atoms based on a 5-membered ring with two adjacent side chains. There are four main series, designated E, F, A and B, denoting differences in the ring. They occur widely in mammalian tissues but in very low concentrations except in the seminal fluid of certain species, including man (Walpole, 1975).

It is well established that the corpus luteum plays a major role in controlling the length of the estrous cycle and the time of ovulation in domestic livestock because its major secretory product, progesterone, inhibits the ovulatory surge of LH. In 1956, Wiltbank and Casida reported that hysterectomy prolonged the life span of corpora lutea in cows and ewes. Babcock (1966) first suggested that a prostaglandin from the uterus might be the agent which has a luteolytic effect. Phariss and Wyngarden (1969) postulated that PGF2α, a strong venoconstrictor in rats and dogs, might produce luteolysis as a result of a reduction in blood flow through the corpus luteum. Since that time, PGF2α has been shown to induce luteolysis in cattle (Rowson et al., 1972; Lauderdale, 1972; Liehr et al., 1972; Louis et al., 1972).

Liehr et al. (1972) placed 6 mg of PGF2α in the uterine horn ipsilateral to the ovary with a corpus luteum on day 9 of the cycle, and reported the average onset of estrus was 2.4 days post-injection. When 5 mg of PGF2α was placed in the contralateral horn on day 9, average onset of heat was 6.9 days post-injection. Progesterone levels dropped to non-detectable levels within 2 days after ipsilateral treatment, but remained relatively high after contralateral treatment. When 5 mg of PGF2α was infused ipsilaterally in Holstein cows on day 11 or 15, estrus began approximately 72 and ovulation 96 hr post-treatment (Louis et al., 1972).

Lauderdale (1972) injected beef heifers with 30 mg of PGF2α subcutaneously. Heifers injected on days 6, 7, 8 or 9 returned to estrus within 2-4 days and those injected on days 13, 14, 15 or 16 returned to estrus within 3-4 days. Heifers injected on day 2, 3 or 4 had normal length estrous cycles.

Hill et al. (1973) stated that PGF2α was effective in synchronizing estrus when given after day 4 of the estrous cycle. PMS given either 2 days prior to or on the same day as PGF2α resulted in multiple ovulation in most of the heifers.

Ellicot et al. (1974) observed that the LH peak occurred 2.3±.6 hr after onset of estrus in PGF2α-treated heifers and 2.4±1.2 hr after onset of estrus in untreated controls. They concluded that the LH peak was more closely synchronized with estrus in PGF2α-treated heifers than controls. Pregnancy rates were: PGF2α-treated, 57.5%; controls, 55%.

Roche (1974a), using only heifers in day 6-16 of the cycle, compared 20 mg PGF2α to 30 mg PGF2α and found no difference in fertility. Both treated groups had conception rates comparable to controls.

Lauderdale et al. (1974) injected 30 mg PGF2α im (intramuscularly) into heifers with palpable corpora lutea and reported no difference in pregnancy rate among controls (53.3%), heifers bred by heat (52.2%), and those time inseminated at 72 and 90 hr post-injection (55.8%).

Six mg norgestomet implants were placed in 50 heifers for 7 days and 30 mg of PGF2α was given im at the time of implant removal (Heersche, et al., 1974). Forty-seven of fifty heifers were in estrus between 36 and 120 hr post-injection. Conception rate was 63.8%.

Louis et al. (1975) reported that administration of 5 mg of PGF2α intrauterine to luteal phase cows resulted in a 50% decline in progesterone within 12 hr, doubling of estradiol within 24 hr, LH peak at 17 hr, onset of estrus at 72 hr and ovulation at 95 hr post-injection. Inseminations at predetermined intervals after treatment with PGF2α without regard to estrus detection resulted in fertility equivalent to that of control heifers and cows.

Lauderdale (1975) compared injecting PGF2α twice 11 days apart to feeding 1 mg of MGA per head per day for 5 days and injecting PGF2α on the last day of feeding. Similar pregnancy rates for the two groups were observed. He concluded

that either two injections of PGF2α about 11 days apart or 5 to 7 days of progestogen administration in conjunction with PGF2α on or about the last day of progestogen administration are two effective methods for synchronizing estrus during a predefined interval of 4 days in cattle which are having estrous cycles.

ProstaglandinF2α analogues have been used to synchronize estrus. Tervit et al. (1973) reported that the im injection of ICI 79939 on 2 consecutive days (750 μg on first day; 200 μg on second day) gave precise synchronization of estrus in PMSG-pretreated cattle. The sequence of changes of progesterone, estradiol 17β and LH were similar to those occurring around natural estrus after synchronization with ICI 79939 (Dobson et al., 1975).

ICI 80996 is similar to ICI 79939, but less toxic (Cooper, 1974). Cooper and Rowson (1975) treated 45 cycling Friesian heifers with two injections of 500 μg of ICI 80996 11 days apart. Most heifers showed estrus 48 to 72 hr and ovulated 72 to 96 hr after the second injection. The cycle following the synchronized estrus was of normal length.

Thimonier et al. (1975) reported that two im injections of 500 μg of ICI 80996 at an interval of 10 days or a subcutaneous implant of 12 mg of SC21009 for 10 days plus an im injection of ICI 80996 at implant removal gave similar degrees of synchronization.

Although a number of synchronization treatments appear to have some degree of effectiveness, none are as yet commercially available.

EXPERIMENT 1

FERTILITY AFTER SYNCHRONIZATION OF ESTRUS WITH PGF2α IN YEARLING HEIFERS

SUMMARY

Three hundred seventy-one Angus and crossbred Maine Anjou yearling heifers were allotted to three groups: (1) controls-untreated but selected to exhibit heat early in the breeding season; (2) injected with PGF2α 12 days and again 1 day prior to the breeding season; (3) injected with PGF2α 1 day prior to the breeding season and heifers that did not show estrus within 6 days were then reinjected. Both synchronized and control groups were bred approximately 12 hr after detected in estrus.

Percent in estrus in 5 days and percent first service conception was 78.9, 58.7; 67.3, 54.1; and 55.0, 54.5 for groups 1 to 3, respectively.

Fertility after two injections of PGF2α 11 days apart and one injection of PGF2α was similar to that for controls; however, fertility for those heifers exhibiting estrus after the second injection of PGF2α in group 3 was lower ($P<.05$).

INTRODUCTION

Synchronization of estrus in beef cattle would enable greater use of artificial insemination, allowing widespread use of superior sires.

Injecting progesterone or feeding MAP, CAP or MGA for the duration of the luteal phase have been successful synchronization procedures, but fertility at the first synchronized estrus has generally been low. Because of the reduced fertility associated with administration of progesterone or progestogens, other synchronization treatments have been developed.

PGF2α has been shown to induce luteolysis in cattle (Rowson et al., 1972; Lauderdale, 1972; Liehr et al., 1972; Louis et al., 1972), but only after day 4 of the cycle (Hill et al., 1973). Lauderdale (1975) injected PGF2α twice 11 days apart and reported effective estrus synchronization during a predefined interval of 4 days. PGF2α was also effective in synchronizing estrus with normal fertility when injected following a 7 day norgestomet implant (Heersche et al., 1974). Moody and Lauderdale (1977) reported fertility after two injections of PGF2α was comparable to controls for those bred by estrus, but lowered for those time inseminated 80 hr after the second PGF2α injection.

If and when PGF2α becomes commercially available, its cost will be a major consideration to cattlemen. A treatment involving only one injection of PGF2α might be more economical.

The objectives of this trial were: (1) to determine the efficacy of PGF2α as a synchronizing compound in two different treatment regimes and (2) to compare fertility after one injection of PGF2α to fertility after two injections of PGF2α.

MATERIALS AND METHODS

Three hundred seventy-one Angus and 1/2, 3/4 and 7/8 blood Maine Anjou yearling heifers were allotted to the following groups:

Group 1. Controls. Based on the previous estrus, 60 heifers were selected to exhibit estrus early in the breeding season and were bred according to standard AI (artificial insemination) procedures.

Group 2. One hundred sixty-three heifers were injected im (intramuscularly) with 25 mg PGF2α (The Upjohn Co., Kalamazoo, Michigan) 12 days and again 1 day prior to the breeding season.

Group 3. One hundred forty-eight heifers were injected im with 25 mg PGF2α 1 day prior to the breeding season. Heifers that did not show estrus within 6 days were then reinjected.

Both synchronized and control heifers were checked for estrus twice daily and inseminated approximately 12 hr after detected in estrus. Pregnancy was determined by rectal palpation 71 and 93 days after the onset of the breeding season.

Heifers were allotted by the ranch manager in this field trial. A higher percentage of Maine Anjou heifers were in group 3 than in groups 1 and 2 (Table 1). Average prebreeding weight was different ($P<.01$) among treatment groups. Heifers in group 3 were heavier than those in groups 1 and 2. However,

the weight difference was due to the breed difference. Maine Anjou heifers had a heavier ($P<.001$) average prebreeding weight than did the Angus heifers (Table 2). Age was not different among treatment groups or between breeds.

Data were analyzed by least squares analysis of variance (Kemp, 1972).

RESULTS AND DISCUSSION

A higher percentage of control heifers were in estrus in 5 days than in either treated group (Table 3). Of those heifers injected with PGF2α twice 11 days apart, 67.3% showed estrus in the first 5 days compared with 55.0% of those injected once. Hill et al. (1973) reported that PGF2α injected after day 4 of the cycle induced estrus. Therefore, two injections 11 days apart should synchronize almost all of the cycling heifers and one injection should synchronize approximately 80% of the cycling heifers. Based on this information, it appears that about 70% of the treated heifers were cycling at the time treatment began. Controls had a higher 25 day pregnancy rate (Table 3), which one would expect since all controls were cycling and were selected to cycle early in the breeding season.

First service conception rate for both treated groups at the synchronized estrus was comparable to control first service conception rate (Table 5). This is in agreement with data reported by Lauderdale (1975) and Moody and Lauderdale (1977) indicating that fertility following two injections of

PGF2α was equal to controls. Fertility on heifers not responding to the first injection of PGF2α in group 3 was lower ($P<.05$) than the other groups (Table 5), but when heifers responding to first and second injections in group 3 were combined, first service conception was still comparable to controls and two injections 11 days apart. The number of heifers exhibiting estrus after the second injection in group 3 was small.

A higher percentage ($P<.01$) of Angus heifers showed heat in the first 5 days than did Maine Anjou heifers. Both 5 day and first service conception rate was significantly higher for Angus heifers than Maine Anjou heifers (Table 6). No differences ($P>.1$) occurred between inseminators but sire differences were significant ($P<.05$).

In this trial, PGF2α injected twice 11 days apart or injected once followed by another injection 6 days later in heifers that did not exhibit estrus was effective in synchronizing estrus. Conception rate for those receiving two injections of PGF2α 11 days apart was similar to that for heifers receiving one injection of PGF2α. Neither treatment affected first service conception rate as compared with controls.

EXPERIMENT 2

FERTILITY IN BEEF COWS AFTER SYNCRO-MATE B TREATMENT WITH DIFFERENT LEVELS OF ESTRADIOL VALERATE AND DIFFERENT LENGTHS OF CALF REMOVAL

SUMMARY

Sixty-five lactating Hereford and Angus cows averaging 5 years of age and 66 days post-partum were randomly allotted to the following groups: (1) Controls-untreated; (2) Synchronized utilizing 5 mg EV and calf removal until immediately after breeding; (3) Synchronized utilizing 5 mg EV and calf removal until 5 hr post-breeding; (4) Synchronized utilizing 6 mg EV and calf removal until immediately after breeding; (5) Synchronized utilizing 6 mg EV and calf removal until 5 hr post-breeding. Treated cows were synchronized with Syncro-Mate B, calves were removed at the time of implant removal and cows were inseminated 48 hr later.

Controls had a significantly higher first service conception rate than treated groups. No differences in conception rate were observed between 5 and 6 mg EV or between calf removal groups. Five day, 25 day and 58 day pregnancy rates were similar for controls and synchronized groups.

INTRODUCTION

Estrus synchronization in beef cattle would enable greater use of artificial insemination, allowing widespread use of superior sires.

Successful synchronization has been achieved by injecting progesterone or feeding MAP, CAP or MGA for the duration of the luteal phase, but fertility at the synchronized estrus has generally been low. Because of the reduced fertility associated with administration of progesterone or progestogens, other synchronization treatments have been developed.

Syncro-Mate B treatment (ear implant of 6 mg norgestomet for 9 days and an injection of 3 mg norgestomet and 5 or 6 mg EV at the time of implantation, G. D. Searle and Co.) has been used to synchronize estrus (Wiltbank and Gonzalez-Padilla, 1975; Wiltbank, 1977; Mares et al., 1977; Kiracofe et al., 1978). Because suckling suppresses cycling, investigators have used calf removal for 48 hr at the time of implant removal to improve synchronization (Wiltbank, 1977), but fertility results have varied. Mares et al. (1977) reported cows receiving the Syncro-Mate B treatment with calf removal and inseminated 48 hr after explant had higher pregnancy rates at all stages of the breeding season than cows treated with Syncro-Mate B without calf removal. However, Kiracofe et al. (1978) found no difference in fertility between calf removal and no calf removal in Syncro-Mate B treated cows.

Results with Syncro-Mate B have been inconclusive, so an experiment was designed to further study Syncro-Mate B as a synchronizing agent. The objectives of this study were: (1) to determine effectiveness of Syncro-Mate B as an estrus synchronizing agent; (2) to compare calf removal for different

amounts of time in conjunction with Syncro-Mate B; (3) to compare 5 mg vs 6 mg EV in the Syncro-Mate B treatment.

MATERIALS AND METHODS

Sixty-five lactating Hereford and Angus cows averaging 5 years of age and 66 days post-partum were randomly allotted as follows:

Group 1. Controls. Twenty-one cows were bred according to standard AI procedures.

Groups 2-5. Estrus was synchronized with Syncro-Mate B (ear implant of 6 mg norgestomet for 9 days and an im injection of 3 mg norgestomet and 5 or 6 mg EV at time of implantation) and cows were time inseminated 48 hr after implant removal. Calves were separated from the cows at the time of implant removal and remained separated until immediately following insemination or approximately 5 hr post-insemination as shown below.

Time calf placed back with cow	Level of EV	
	5 mg	6 mg
Immediately post-breeding	Group 2 11 head	Group 4 11 head
Five hr post-breeding	Group 3 11 head	Group 5 11 head

Cows were bred artificially for 27 days and then exposed to bulls an additional 31 days. Conception date was determined by subsequent calving date assuming an average gestation length of 283 days.

Data were analyzed by least squares analysis of variance (Kemp, 1972).

RESULTS AND DISCUSSION

No differences in first service conception rate were observed among the treated groups (Table 7). However, controls had a higher ($P<.01$) first service conception rate than all synchronized groups. Controls had 5 day, 25 day and 58 day pregnancy rates similar to synchronized groups (Table 8). These results are different from those reported by Mares et al. (1977). He reported that cows synchronized with Syncro-Mate B plus calf removal and time inseminated 48 hr after explant had higher pregnancy rates at all stages of the breeding season. The reason for the low first service conception rate in the synchronized cows in this trial is difficult to determine. Number of cows cycling before treatment was not known, but 72.7% were detected in standing estrus and an additional 20.5% showed signs of estrus (mucous, swollen vulva, mud on sides) either on the day prior to or day of insemination. These data would indicate that time of insemination was probably not the factor that lowered conception rate. Percent of controls showing estrus in the first 25 days of the breeding season was 85.7%.

First service conception rate was similar for those cows placed with their calves immediately after breeding and those placed with their calves 5 hr post-breeding (Table 9). This design was based on the postulation that oxytocin is important in sperm transport (VanDemark, 1958). It is well established that blood levels of oxytocin in lactating cows rise shortly after the suckling stimulus is initiated. Possibly, this rise in oxytocin could improve sperm transport and conception. However, no significant benefit in terms of fertility was derived from placing calves on cows immediately after breeding.

Cows synchronized with Syncro-Mate B utilizing either 5 or 6 mg EV had similar first service conception rates. These data are not in agreement with those reported by Whitman et al. (1972) indicating that 6 mg EV was more effective in synchronizing estrus in the Syncro-Mate B treatment than 5 mg EV. Results of this trial are in agreement with those reported by Kiracofe et al. (1978) stating that no differences occurred between 5 and 6 mg of EV in the Syncro-Mate B treatment.

Syncro-Mate B treatment severely lowered first service conception rate in this trial (Table 7). No differences occurred between calf removal until immediately after breeding or until 5 hr post-breeding or between 5 and 6 mg EV in conjunction with Syncro-Mate B.

EXPERIMENT 3

EFFECT OF POST-PARTUM BREEDING INTERVAL ON CONCEPTION RATES IN BEEF COWS

SUMMARY

Data were analyzed on 1536 fall calving Angus cows to determine the effect of post-partum breeding interval on conception rates in beef cows. Highest conception rate occurred 100 to 109 days post-partum and lowest conception rate occurred 10 to 29 days post-partum. Normal fertility was observed for cows showing heat 40 or more days post-partum.

INTRODUCTION

Calving interval is an important economic consideration in a cow-calf operation. To maintain a yearly calving interval, management pressure must be placed on getting cows bred as early as possible after calving.

Beef cows have an indefinite non-cycling period after calving. Foote and Hunter (1964) reported that uterine involution was nearly complete by 40 days after parturition in beef cows. Morrow et al. (1966) reported that slow uterine regression occurred during the first 4 to 9 days after parturition followed by accelerated regression during the period 10 to 14 days, and that the main decrease in size of the pregnant horn was completed by 25 days post-partum in normal dairy cows. Marion et al. (1968) reported that average uterine regression

interval was 40.6 days for pluriparous cows and 34.0 days for primiparous cows and that season of the year affected interval to uterine involution.

VanDemark and Salisbury (1950) reported that only a small percentage of dairy cows showed heat prior to 20 days post-partum and that conception rate on cows less than 40 days post-partum was lower than that observed after 40 days post-partum.

Although information is available on the effect of post-partum breeding interval in dairy cows, less is known about beef cows.

This study was undertaken to determine the specific relationship between post-partum breeding interval and conception rate in beef cows.

MATERIALS AND METHODS

Breeding and calving records for 1970 to 1972 were provided by Ramsey Ranch, El Dorado, Kansas. Conception rate by post-partum interval was determined for 1536 fall calving Angus cows that were bred artificially or by a clean-up bull. Conception dates were verified by subsequent calving dates. Conception rate was defined as number of cows conceived/number of services. The chi-square test was used to determine if conception rates differed from that of 60 to 69 days post-partum which was designated the reference period.

RESULTS AND DISCUSSION

Conception rate for cows bred 100 to 109 days post-partum was higher ($P<.05$) and conception rate for cows bred 20 to 29 days post-partum was lower ($P<.05$) than that for those bred 60 to 69 days post-partum (Table 10). Conception rates were lowest and fewest cows showed heat 10 to 29 days post-partum. However, conception rate improved (51.1%) at 30 to 39 days post-partum and was high (63.0%) at 40 to 49 days post-partum. VanDemark and Salisbury (1950) reported that conception rate at 40 to 60 days post-partum was lower than that which occurred after 60 days post-partum in dairy cows. They also reported that the more highly fertile cows are selected out at each service by becoming pregnant. This might help explain why a relatively high (63.0%) conception rate occurred at 40 to 49 days post-partum. Possibly, a number of the highly fertile cows showed heat and conceived at this time. Conception rates were similar for the intervals occurring between 50 and 89 days post-partum, and the highest conception rates occurred 90 to 109 days post-partum. A decline in conception rate occurred 110 to 139 days post-partum.

In this study, normal fertility occurred when cows in heat were bred 40 or more days post-partum.

TABLE 1. HEIFER AGE, WEIGHT AND BREED BY TREATMENT GROUP

Group	Treatment	Age[a] (month)	Weight[a]* (kg)	Proportion of Angus*	Proportion of Maine Anjou*
1	Controls	14.7±.1	300.8±4.0	41/60	19/60
2	Two injections PGF2α 11 days apart	14.5±.1	303.4±2.4	109/163	54/163
3	One injection PGF2α plus another 6 days later for those not exhibiting estrus	14.6±.1	312.7±2.5	73/148	75/148

[a]Values are expressed as mean ± SE.

*P<.01.

TABLE 2. HEIFER WEIGHT AND AGE BY BREED

Breed	No.	Weight (kg)[a]*	Age (months)
Angus	223	294.4±1.8	14.6±.1
Main Anjou	148	325.1±2.2	14.5±.1

[a]Values are expressed as mean ± SE.

*P<.001.

TABLE 3. EFFECT OF PGF2α TREATMENT ON PERCENT IN ESTRUS AND PREGNANT[a]

Group	Treatment	No.	Estrus in 5 days(%)*	Pregnant 5 days(%)[b]	Pregnant 25 days(%)[c]*
1	Controls	60	78.9	41.5	68.6
2	Two injections PGF2α 11 days apart	163	67.3	38.7	58.1
3	One injection PGF2α plus another 6 days later for those not exhibiting estrus	148	55.0	33.0	43.0

[a]Percentages adjusted for age and weight by breed and treatment.

[b]Pregnant 5 days = number conceived first 5 days/number in group.

[c]Pregnant 25 days = number conceived first 25 days/number in group.

*P<.01.

TABLE 4. EFFECT OF HEIFER BREED ON PERCENT IN ESTRUS AND PREGNANT[a]

Breed	No.	Estrus in 5 days(%)*	Pregnant 5 days(%)[b]	Pregnant 25 days(%)[c]
Angus	223	74.5	41.1	58.1
Maine Anjou	148	59.5	34.5	55.0

[a]Percentages adjusted for age and weight by breed and treatment.

[b]Pregnant 5 days = number conceived first 5 days/number in group.

[c]Pregnant 25 days = number conceived first 25 days/number in group.

*$P<.01$.

TABLE 5. EFFECT OF PGF2α TREATMENT ON CONCEPTION RATE[a]

Group	Treatment	Proportion in estrus 5 days	Conc. rate 5 days(%)[c]	No. in estrus in 25 days	First service conc. first 25 days[e]
1	Controls	51/60	54.7	59	58.7
2	Two injections of PGF2α 11 days apart	121/163	61.2	138	54.1
3a	One injection of PGF2α	84/148	62.7	84	59.3[e]
3b	Two injections of PGF2α 6 days apart	---	---	18	22.8[e]*

[a]Conception rates adjusted for breed, sire, inseminator and weight and age by breed.

[b]Heifers in group 3a are those which showed estrus following the first injection of PGF2α. Heifers in group 3b did not show estrus within 5 days and were reinjected.

[c]Conception rate 5 days = number conceived in 5 days/number inseminated.

[d]First service conception first 25 days = number conceived on first service in first 25 days/number inseminated.

[e]Average first service conception for group 3 is 54.5% which is not different from groups 1 and 2.

*$P<.05$.

TABLE 6. EFFECT OF BREED ON OCCURRENCE OF ESTRUS AND CONCEPTION RATE[a]

Breed	Proportion in estrus 5 days	Conc. rate 5 days(%)[b]*	No. in estrus in 25 days	First service conc. first 25 days(%)[c]**
Angus	168/223	72.2	193	58.5
Maine Anjou	88/148	46.9	107	38.9

[a]Conception rates adjusted for treatment, sire, inseminator and weight and age by breed.

[b]Conception 5 days = number conceived in 5 days/number inseminated.

[c]First service conception first 25 days = number conceived on first service in first 25 days/number inseminated.

*P<.05.

**P<.01.

TABLE 7. EFFECT OF ESTRUS SYNCHRONIZATION TREATMENT ON CONCEPTION RATE[ab]

Group	Treatment	No.	First service conception(%)*
1	Controls-untreated	18	77.8
2	Five mg EV[c] and calf removal until immediately after breeding	11	23.6
3	Five mg EV and calf removal until 5 hr post-breeding	11	18.4
4	Six mg EV and calf removal until immediately after breeding	11	18.1
5	Six mg EV and calf removal until 5 hr post-breeding	11	18.3

[a]Cows were synchronized with Syncro-Mate B and inseminated 48 hr after implant removal while controls were inseminated 12 hr after detected estrus.

[b]First service conception rate is adjusted for breed, sire and inseminator.

[c]EV = estradiol valerate.

*$P<.01$.

TABLE 8. EFFECT OF ESTRUS SYNCHRONIZATION WITH SYNCRO-MATE B ON PREGNANCY RATES

Treatment	No.	Pregnant 5 days(%)	Pregnant 25 days (%)	Pregnant 58 days(%)
Controls-untreated	21	14.3	71.4	76.2
Synchronized plus calf removal[ab]	44	25.0	56.8	79.6

[a]Data from synchronized groups were pooled because no differences existed.

[b]Cows were synchronized with Syncro-Mate B and inseminated 48 hr after implant removal.

TABLE 9. EFFECT OF LEVEL OF ESTRADIOL VALERATE AND LENGTH OF CALF REMOVAL ON CONCEPTION RATE IN COWS SYNCHRONIZED WITH SYNCRO-MATE B

Treatment	No.	First service conception(%)
Synchronized plus calf removal until immediately after breeding	22	27.3
Synchronized plus calf removal until 5 hr post-breeding	22	22.7
Synchronized utilizing 5 mg EV	22	27.3
Synchronized utilizing 6 mg EV	22	22.7

[a]Cows were synchronized with Syncro-Mate B and inseminated 48 hr after implant removal.

[b]EV = estradiol valerate.

TABLE 10. EFFECT OF POST-PARTUM INTERVAL ON CONCEPTION RATE IN BEEF COWS

Days post-partum	Number of services	Number conceived	Conception rate (%)
10- 19	4	1	25.0
20- 29	22	8	36.4*
30- 39	45	23	51.1
40- 49	92	58	63.0
50- 59	175	97	55.4
60- 69[a]	253	148	58.5
70- 79	436	251	57.6
80- 89	419	255	60.9
90- 99	351	231	65.8
100-109	181	125	69.1*
110-119	127	75	59.1
120-129	72	35	48.6
130-139	39	17	43.6
Total	2216	1324	59.7 (average)

[a]Interval designated reference period.

*P<.05. Different from conception rate on reference period.

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THE EFFECT OF ESTRUS SYNCHRONIZATION AND POST-PARTUM INTERVAL ON FERTILITY IN BEEF CATTLE

by

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Estrus synchronization would enable greater use of artificial insemination, allowing widespread use of superior sires. Two treatments which have been used to synchronize estrus in beef cattle are prostaglandin F2α (PGF2α) and Syncro-Mate B. Two experiments were designed to further study these compounds as estrus synchronizing agents.

In the first trial, 371 Angus and crossbred Maine Anjou yearling heifers were allotted to three groups: (1) untreated controls selected to exhibit estrus early in the breeding season; (2) injected with PGF2α 12 days and again 1 day prior to the breeding season; (3) injected with PGF2α 1 day prior to the breeding season and heifers that did not show estrus within 6 days were reinjected. All injections were intramuscular. Both synchronized and control groups were bred approximately 12 hr after detected in estrus. Percent in estrus in 5 days and percent first service conception was: 78.9, 58.7; 67.3, 54.1; and 55.0, 54.5 for groups 1-3, respectively. Conception rate after two injections of PGF2α 11 days apart and one injection of PGF2α was similar to that for untreated controls (54.1, 59.3 vs 58.7%); however, conception rate for those heifers responding to the second injection of PGF2α in group 3 (22.8%) was lower ($P<.05$).

In the second experiment, 65 lactating Hereford and Angus cows averaging 5 years of age and 66 days post-partum were randomly allotted to the following groups: (1) untreated controls; (2) synchronized utilizing 5 mg EV (estradiol valerate) and

calf removal until immediately after breeding; (3) synchronized utilizing 5 mg EV and calf removal until 5 hr post-breeding; (4) synchronized utilizing 6 mg EV and calf removal until immediately after breeding; (5) synchronized utilizing 6 mg EV and calf removal until 5 hr post-breeding. Cows were synchronized with Syncro-Mate B (ear implant of 6 mg norgestomet for 9 days and an injection of 3 mg norgestomet and 5 or 6 mg EV at the time of implantation, G. D. Searle and Co.). Calves were removed at the time of implant removal and cows were inseminated 48 hr later. First service conception rates were: 77.8, 23.6, 18.4, 18.1 and 18.3 for groups 1-5, respectively. Controls had a significantly higher first service conception rate than treated groups. No differences in conception rate were observed between 5 and 6 mg EV or between calf removal until immediately after breeding or until 5 hr post-breeding. Five day, 25 day and 58 day pregnancy rates were similar for controls and synchronized groups (14.3, 71.4, 76.2% vs 25.0, 56.8, 79.6%).

Data were analyzed on 1536 fall calving Angus cows to determine the effect of post-partum breeding interval on conception rates in beef cows. Highest conception rate occurred 100 to 109 days post-partum and lowest conception rate occurred prior to 29 days post-partum. Normal fertility was observed for cows showing estrus 40 or more days post-partum.