

## **FERTILITY OF NATURAL VS SYNCHRONIZED ESTRUS**

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### **Introduction**

Synchronizing estrus is an effective way to maximize the use of time and labor required to detect standing estrus in cattle. However, estrous synchronization can also benefit overall herd management. Cows that are synchronized 1) exhibit standing estrus at a predicted time, 2) conceive earlier in the breeding season, 3) calve earlier in the calving season, and 4) wean calves that are older and heavier at weaning. In addition, some estrous synchronization protocols can induce a proportion of anestrous cows to begin estrous cycles. This will decrease the anestrous postpartum interval and allow for more chances for cows to conceive during a defined breeding season.

The term “Estrous Synchronization” simply implies the estrous cycle is manipulated to cause a large group of cows to exhibit standing estrus around the same time. However, the question is often asked, “Do estrous synchronization protocols increase or decrease fertility?” To answer this question a measurement of fertility must be defined (see below) and then compared between non-synchronized and synchronized females.

### **Fertility of Synchronized and Non-synchronized Females**

The final goal of any breeding protocol is to maximize the number of females that become pregnant in the shortest period of time; therefore, this review will use pregnancy rates over specific days of the breeding season to analyze differences in fertility. Since, pregnancy rates are influenced by both estrous detection rates and conception rates, comparisons will be made between synchronized and non-synchronized cows bred by natural service or by artificial insemination.

#### **Natural Service**

When cows are inseminated by natural service, the serving capacity of the bull becomes a critical management consideration. Recommendations for when cows are not synchronized and bred by natural service range from a bull to female ratio of 1:10 to 1:60. No differences were detected between a bull to female ratio of 1:25 and 1:60 for estrous detection or pregnancy rates in the first 21 days of the breeding season when bulls were highly fertile with large scrotal circumferences (Rupp et al., 1977). When cows are synchronized and bred by natural service, management considerations should be made for the serving capacity of the bull. Healy et al., (1993) reported a tendency ( $P < 0.10$ ) for pregnancy rates over a 28-day synchronized breeding season to be reduced when a bull to female ratio of 1:50 (77%) was used compared to a bull to female ratio of 1:16 (84%), but no difference was detected between a bull to female ratio of 1:16

and 1:25 (84% and 83%, respectively). In the following studies, a bull to female ratio of up to 1:25 was used.

When cows are bred by natural service, the time required to detect estrus is not a concern, since the bull will be detecting the cows exhibiting estrus. However, other management benefits can be gained through estrous synchronization with natural service. A study conducted at Colorado State University indicated cows that conceived to a synchronized estrus calved on average 13 days earlier and weaned calves 41 pounds heavier than cows that were not synchronized (Schafer et al., 1990).

A single injection of prostaglandin  $F_{2\alpha}$  (**PG**) on day 4 of the breeding season resulted in more cycling cows becoming pregnant during days 5 to 9 of the breeding season compared to cycling cows not injected with PG (55.7 vs. 25.0%, respectively; Whittier et al., 1991). In addition, pregnancy rates were similar ( $P > 0.10$ ) for cows in which estrus was synchronized with a single injection of PG and exposed to a bull for 80 hours (19%) compared to non-synchronized cows exposed to a bull for 21 days (33%, Landivar et al., 1985). Following a single injection of PG on day 4 of the breeding season, there were no differences in pregnancy rates over the first 25 days of the breeding season (1 cycle) between synchronized and non-synchronized cows (Whittier et al., 1991). Therefore, the greatest benefit of estrous synchronization with natural service is the ability to get more cows pregnant during the first 5 to 7 days of the breeding season (**Table 1**). Cows that exhibit estrus early in the breeding season may have additional chances to conceive during a defined breeding season. The average estrous cycle is 21 days (range 18 to 23 days), allowing one chance every 21 days for a cow to conceive. During a 65-day breeding season, cows that cycle naturally have only three chances to conceive, but cows that are synchronized and show estrus the first few days of the breeding season have up to four chances to conceive.

Some estrous synchronization protocols that utilize progesterone (CIDR), norgestomet (Syncro-Mate B), or GnRH can initiate estrous cycles resulting in a shorter anestrous postpartum period or earlier onset of puberty. Heifers synchronized by progestin exposure [norgestomet (Syncro-Mate B)], which is capable of hastening the onset of puberty, resulted in more ( $P < 0.01$ ) heifers becoming pregnant (67%) during the first 7 days of the breeding season compared to non-synchronized heifers (23%, Plugge et al., 1989), but when a single injection of PG was administered to a group of anestrous cows, no difference was detected between synchronized and non-synchronized cows (13.6% and 22.7%, respectively, Whittier et al., 1991). Therefore, estrous synchronization protocols capable of inducing puberty and shortening the anestrous postpartum period can result in an even greater percentage of cows having a chance to become pregnant during the first few days of the breeding season. In a small study, peripubertal heifers were treated with melengestrol acetate (**MGA**, an orally active progestin) for 10 days and a similar number of heifers attained puberty by day 7 after MGA withdrawal compared to control heifers. However, by day 10 following MGA treatment, 50% more of the treated heifers attained puberty compared to the control animals (Imwalle et al., 1998).

**Table 1.** Comparison between synchronized and non-synchronized pregnancy rates when bred by natural service in cows and heifers

Study	Cows/ Heifers	Period of Time	Synchronization Method	Pregnancy Rate	
				Anestrual	Estrual
Whittier et al., 1991	Cows	4 days	1 shot PG	13.6%	55.7% <sup>a</sup>
			Not synchronized	22.7%	25.0% <sup>b</sup>
Plugge et al., 1989	Heifers	7 days	MGA + PG		62% <sup>a</sup>
			Syncro-Mate B		67% <sup>a</sup>
Landivar et al., 1985	Cows	80 hours	1 shot PG		19%
		21 days	Not synchronized		33%
Whittier et al., 1991	Cows	25 days	1 shot PG	59.1%	86.1%
			Not synchronized	59.1%	76.3%

Pregnancy rates within a study and estrous cycling status having different superscripts are different <sup>ab</sup> $P < 0.01$

### Artificial Insemination

Artificial insemination (**AI**) with semen collected from genetically superior sires is the most efficient and economical method for the genetic improvement of economically important traits in the beef industry. Estrous synchronization makes AI more feasible due to the reduction in time and labor required for estrous detection. Therefore, it is also necessary to compare fertility between synchronized and non-synchronized females bred by AI (**Tables 2 and 3**). When AI is combined with estrous synchronization the limitation on serving capacity of a single bull is removed, and a large number of females can be bred to a single sire during the first few days of the breeding season. This can result in a more uniform calf crop that is older and heavier at weaning.

Cows synchronized with a single injection of PG and artificially inseminated for an 80 hour period had similar ( $P > 0.10$ ) pregnancy rates (19%) compared to cows artificially inseminated for a 21 day period (30%, Landivar et al., 1985). However, when fertility is compared over the synchronized period, a single injection of PG 2 days before the start of the AI breeding season resulted in more ( $P < 0.01$ ) cows pregnant during the first 3 days of the breeding season (22%) compared to non-synchronized females (7%, Lucy et al., 2001). Furthermore, cows synchronized with two injections of PG 11 days apart also resulted in more ( $P < 0.01$ ) cows pregnant (28%) during the first 5 days of the breeding season compared to non-synchronized cows (10%, Beal, 1983).

**Table 2.** Comparison between synchronized and non-synchronized pregnancy rates when bred by artificial insemination during the synchronized period

Study	Cows/ Heifers	Period of Time	Synchronization Method	Pregnancy Rate	
				Anestrual	Estrual
Lucy et al., 2001	Cows	3 days	1 shot PG	11% <sup>b</sup>	34% <sup>c</sup>
			Progesterone + PG Not synchronized	26% <sup>a</sup> 4% <sup>c</sup>	46% <sup>b</sup> 11% <sup>a</sup>
Lucy et al., 2001	Heifers	3 days	1 shot PG	6% <sup>b</sup>	19% <sup>b</sup>
			Progesterone + PG Not synchronized	28% <sup>a</sup> 6% <sup>b</sup>	49% <sup>a</sup> 9% <sup>c</sup>
Landivar et al., 1985	Cows	80 hours	1 shot PG		19%
		21 days	Not synchronized		30%
Heersche et al., 1979	Heifers	5 days	Norgestomet + PG		60%
		21 days	Not synchronized		61%
Beal et al., 1988	Cows/ Heifers	7 days	MGA-PG		40% <sup>a</sup>
			Not synchronized		24% <sup>b</sup>
Beal, 1983	Cows	5 days	2 shots PG	28% <sup>ab</sup>	
			Progesterone + PG Not synchronized	49% <sup>a</sup> 10% <sup>c</sup>	
Miksch et al., 1978	Heifers	5 days	Syncro-Mate B	36% <sup>b</sup>	
			Not Synchronized	17% <sup>c</sup>	
Miksch et al., 1978	Heifers	5 days	Syncro-Mate B	39%	
			Not Synchronized	28%	
Miksch et al., 1978	Cows	5 days	Syncro-Mate B	48% <sup>a</sup>	64% <sup>a</sup>
			Not Synchronized	8% <sup>b</sup>	20% <sup>b</sup>
King et al., 1988	Cows	5 days	Syncro-Mate B	50% <sup>a</sup>	
			Not Synchronized	16% <sup>b</sup>	

Pregnancy rates within a study and estrous cycling status having different superscripts are different <sup>ab; ac</sup> $P < 0.01$  <sup>bc</sup> $P < 0.05$

When estrous synchronization protocols are used that will initiate estrous cycles [progesterone (CIDR), norgestomet (Syncro-mate-B), and GnRH protocols], an even greater benefit can be realized. Cows treated with a CIDR for 7 days before the start of the breeding season and an injection of PG at time of CIDR removal resulted in 26% of anestrus and 46% of estrous cycling cows becoming pregnant during the first 3 days of the breeding season compared to only 4% of anestrus and 11% of estrous cycling control cows (Lucy et al., 2001). Cows synchronized with Syncro-Mate B (SMB) resulted in more cycling and anestrus cows pregnant ( $P < 0.01$ ; 64% and 48%, respectively) during the first 5 days of the breeding season compared to cycling and anestrus non-synchronized cows (20% and 8% respectively, Miksch et al., 1978). Furthermore, when heifers were synchronized with SMB, a greater ( $P < 0.05$ ) percentage became

pregnant (36%) during the first 5 days of the breeding season compared to non-synchronized heifers (17%, Miksch et al., 1978). Estrous synchronization protocols that utilize GnRH are also able to initiate estrous cycles in anestrus cows. When a GnRH based protocol (Ovsynch; 100 µg GnRH, i.m. on d -9; 25 mg PG, i.m. on d -2; and 100 µg GnRH, i.m. on d 0 timed AI on day 1) was compared to SMB with timed-AI, similar pregnancy rates were obtained ( $P > 0.10$ ) by both protocols among anestrus cows (43% and 49%, respectively; Geary et al., 1998). Therefore, estrous synchronization protocols capable of inducing puberty and shortening the anestrus postpartum period can result in anestrus cows having a chance to become pregnant during the first few days of the breeding season and more opportunities to conceive during the breeding season.

### Initiation of Estrous Cycles

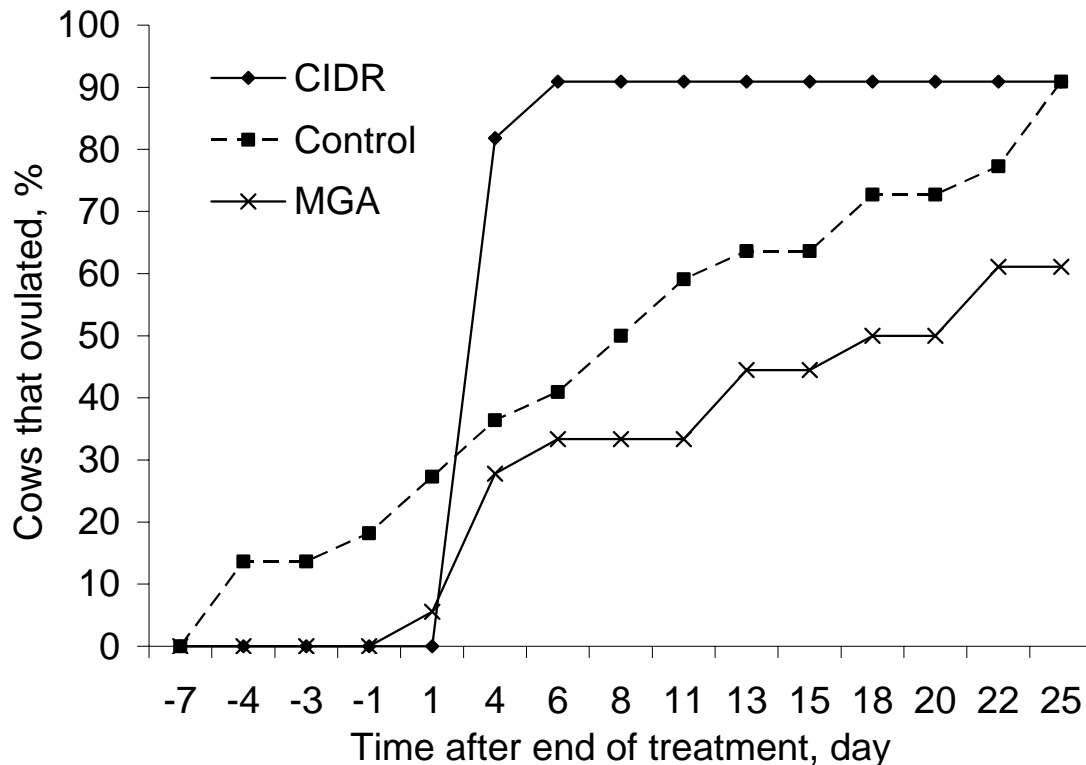
The anestrus postpartum interval is a major contributing factor to cows failing to become pregnant and calve on a yearly interval (Short et al., 1990; Yavas and Walton, 2000b). However, treatment with some progestins can induce ovulation in anestrus postpartum cows (Yavas and Walton, 2000a; Lucy et al., 2001; Perry et al., 2004a) thereby, shortening the anestrus postpartum interval. Consequently, many estrous synchronization protocols include progestin exposure. However, all progestins are not equally effective at inducing ovulation in anestrus postpartum cows. Evidence for this difference is based on differences in the ability of progesterone and MGA to induce ovulation in anestrus cows (**Figure 1**). Fewer anestrus cows treated with MGA ( $0.5 \text{ mg MGA} \cdot \text{cow}^{-1} \cdot \text{d}^{-1}$ ) ovulated compared to progesterone-treated [1.9 g of progesterone contained in a controlled internal drug releasing device (**CIDR**)] cows (33% and 91%, respectively, Perry et al., 2004a), and fewer MGA-treated anestrus cows exhibited normal length luteal phases when induced (46%) or spontaneously (23%) ovulating compared to progesterone-treated cows (100% and 100%, Smith et al., 1987; Perry et al., 2004a).

By day 22 after treatment withdrawal there was no difference ( $P > 0.05$ ) between the percentage of CIDR treated cows that had ovulated (91%) and the percentage of MGA treated cows that had ovulated (61%, **Figure 1**, Perry et al., 2004a). This indicates following a CIDR protocol (7 days of progesterone exposure) a large percentage of cows should exhibit estrus, and following a MGA protocol (14 day of MGA and an injection of PG on day 33) an equally large percentage of cows should exhibit estrus. For example, when heifers were synchronized by progestin exposure (MGA or norgestomet), more heifers became pregnant ( $P < 0.01$ , MGA 62% and SMB 67%) during the first 7 days of the breeding season compared to non-synchronized heifers (23%), but there was no difference between MGA and norgestomet in the percentage of heifers pregnant during the first 7 days of the breeding season (Plugge et al., 1989). Furthermore, when a group of cycling cows and heifers were synchronized with a 7-day MGA protocol (MGA-PG), pregnancy rates after 7 days (40%) of artificial insemination were greater in synchronized animals compared to non-synchronized animals (24%, Beal et al., 1988).

**Table 3.** Comparison between synchronized and non-synchronized pregnancy rates when bred by artificial insemination during the first cycle of the breeding season

Study	Cows/ Heifers	Period of Time	Synchronization Method	Pregnancy Rate	
				Anestrual	Estrual
Lucy et al., 2001	Cows	31 days	1 shot PG	47% <sup>a</sup>	65%
			Progesterone + PG	46%	71% <sup>a</sup>
			Not synchronized	42%	58% <sup>c</sup>
Lucy et al., 2001	Heifers	31 days	1 shot PG	25% <sup>b</sup>	56% <sup>c</sup>
			Progesterone + PG	50% <sup>a</sup>	69% <sup>a</sup>
			Not synchronized	31% <sup>b</sup>	64% <sup>c</sup>
Beal et al., 1988	Cows/ Heifers	30 days	MGA-PG		72%
			Not synchronized		69%
Beal, 1983	Cows	24 days	2 shots PG	52%	
			Progesterone	53%	
			Not synchronized	56%	
Miksch et al., 1978	Heifers	27 days	Syncro-Mate B	64%	
			Not Synchronized	62%	
Miksch et al., 1978	Heifers	27 days	Syncro-Mate B	74%	
			Not Synchronized	67%	
Miksch et al., 1978	Cows	21 days	Syncro-Mate B	67%	79%
			Not Synchronized	45%	76%
King et al., 1988	Cows	21 days	Syncro-Mate B	67% <sup>a</sup>	
			Not Synchronized	56% <sup>c</sup>	
King et al., 1988	Cows	25 days	Syncro-Mate B	75% <sup>a</sup>	
			Not Synchronized	61% <sup>b</sup>	

Pregnancy rates within a study and estrous cycling status having different superscripts are different <sup>ab</sup> $P < 0.01$ ; <sup>ac</sup> $P < 0.05$



**Figure 1.** Effect of treatment on the cumulative percent of animals that had ovulated (ovulation is shown as having occurred 4 days before the first day circulating concentrations of progesterone were > 1 ng/mL) by day of treatment (day 0 = last day of feeding melengestrol acetate [MGA], and day of controlled internal drug-releasing device [CIDR] removal). Treatment  $P < 0.01$ ; Day  $P < 0.01$ ; Treatment x Day  $P < 0.01$ . (Perry et al., 2004a)

### Estrous Detection

No difference ( $P > 0.10$ ) was detected between synchronized pregnancy rates when cows were bred by AI or natural service (Plugge et al., 1989). However, for successful artificial insemination of cattle to occur, the producer (herd manager) must take the place of the herd bull in detecting the cows/heifers ready to be inseminated. Detecting standing estrus (also referred to as heat detection or detecting standing heat) is simply looking for the changes in animal behavior associated with a cow/heifer standing to be mounted by a bull or another cow/heifer. Detecting animals in standing estrus is the goal of good estrous detection and plays a vital role in the success of any artificial insemination program.

In a study conducted at Colorado State University, animals were administered an estrous synchronization protocol, then monitored for standing estrus 24 hours a day or twice a day for 30 minutes. By day 5 after estrous synchronization, 95% of animals monitored 24 hours a day were detected in standing estrus, while only 56% of animals observed twice a day for 30 minutes were detected in standing estrus (Downing et al., 1998). With a 95% estrous detection rate and a 70% conception rate ( $95\% \times 70\% = 67\%$ ), 67% of the animals will be pregnant, whereas only a 39% ( $55\% \times 70\% = 39\%$ ) pregnancy rate will occur with a 55% estrus detection rate (**Table 4**). Therefore, a successful artificial insemination program requires good estrous detection.

**Table 4.** Effect of estrous detection rate on increasing pregnancy rate.

<b>Estrous Detection Rate</b>	<b>55%</b>	<b>60%</b>	<b>65%</b>	<b>70%</b>	<b>75%</b>	<b>80%</b>	<b>85%</b>	<b>90%</b>	<b>95%</b>
Conception Rate	70%	70%	70%	70%	70%	70%	70%	70%	70%
<b>Pregnancy Rate</b>	<b>39%</b>	<b>42%</b>	<b>46%</b>	<b>49%</b>	<b>53%</b>	<b>56%</b>	<b>60%</b>	<b>63%</b>	<b>67%</b>

To maximize detection of standing estrus, it is extremely important to visually monitor cattle as much as possible. Observations should occur as early and as late as possible as well as during the middle of the day. Continuous observation of over 500 animals exhibiting natural estrus in 3 separate studies indicated 55.9% of cows initiated standing estrus from 6 p.m. to 6 a.m. (**Table 5**). Furthermore, when cows were observed for standing estrus every 6 hours (6 a.m., noon, 6 p.m., and midnight), estrous detection increased by 10% at mid-day, and by 19% when observed four times daily (every 6 hours) compared to detecting standing estrus at 6 a.m. and 6 p.m. alone (Hall et al., 1959).

**Table 5.** Time of day when cows exhibit standing estrus.

<b>Time of day</b>	<b>Cows exhibiting standing estrus</b>
6 a.m. to 12 noon	26.0 %
12 noon to 6 p.m.	18.1 %
6 p.m. to midnight	26.9 %
Midnight to 6 a.m.	29.0 %

Data adapted from (Hurnik and King, 1987; Xu et al., 1998, G.A. Perry unpublished data).

### **Fixed-Time Insemination**

To expand the use of artificial insemination and increase the adoption rate of other emerging reproductive technologies, precise methods of controlling ovulation must be developed. Therefore, numerous studies have been conducted to induce ovulation in cattle at a specific time, thereby eliminating the time and labor required to detect estrus. Methods of inseminating cattle at a fixed-time with consistently high pregnancy rates may be a reality in the near future. Stevenson et al. (2000) reported higher pregnancy rates ( $P < 0.05$ ) for cattle artificially inseminated following detection of standing estrus (44%; Select Synch - GnRH on day -9, PG on day -2 and detect estrus) compared to cattle bred by timed AI (33%; CO-Synch – Select Synch with timed insemination and a second injection of GnRH on day 0). However, Lemaster et al., (2001) reported higher ( $P < 0.05$ ) pregnancy rates for timed AI following the CO-Synch protocol (31%) compared to AI following estrus detection with the Select Synch protocol (21%).

Currently, most fixed-time insemination protocols (ovulation synchronization protocols) utilize GnRH to ovulate a dominant follicle around the time of insemination. The Ovsynch (Pursley et al., 1998) and CO-Synch (Geary and Whittier, 1998) protocols include the same hormonal treatments to synchronize ovulation [on day -9, GnRH is administered, on day -2, PG is administered, and 48 hours later (day 0) GnRH is administered to induce ovulation around the time of insemination]. The MGA-select timed-AI protocol (MGA is fed for 14 days, on day 26 GnRH is administered, on day 33 PG is administered, and 80 hours later GnRH is administered to induce ovulation around the time of insemination, Perry et al., 2002b) also utilizes GnRH to induce ovulation around the time of insemination. The use of GnRH at the time of insemination

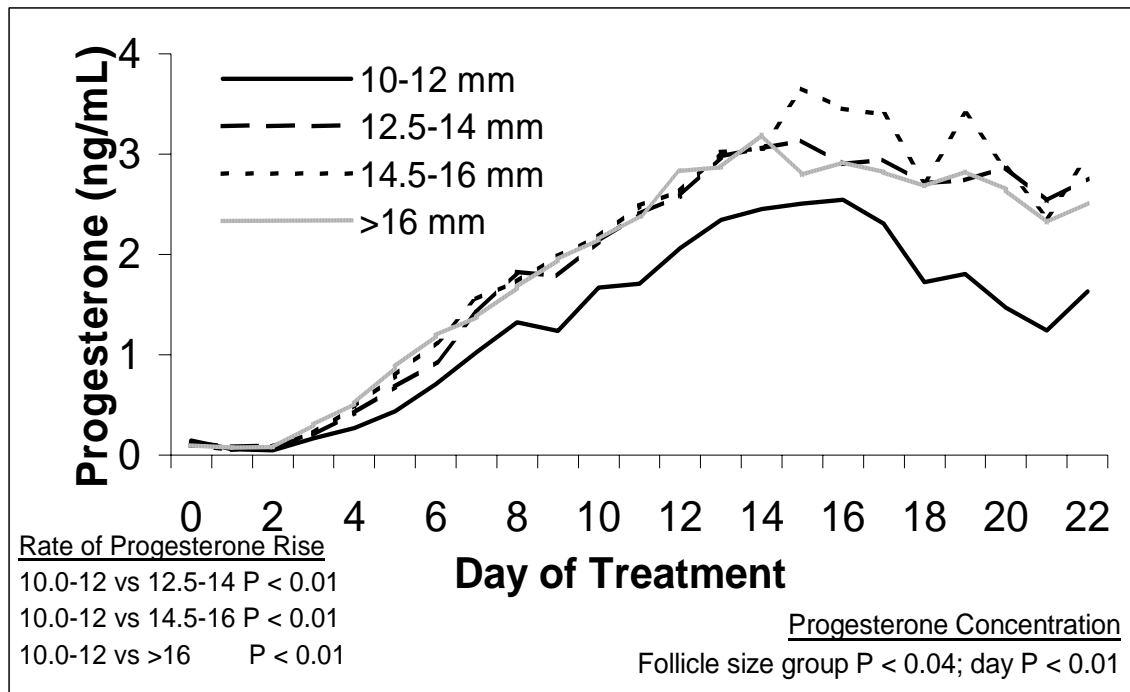


resulted in a wide range of follicle sizes being induced to ovulate (Perry et al., 2002a; Perry et al., 2003), and although all dominant bovine follicles ( $\geq 10$  mm) have the ability to ovulate in response to a GnRH-induced gonadotropin surge, a larger dose of LH was required to induce ovulation of a 10 mm follicle compared to larger follicles (Sartori et al., 2001).

A decrease in pregnancy rates occurred when small follicles were induced to ovulate following fixed-time AI in both heifers and cows (CIDR Protocol – Lamb et al., 2001; T.W. Geary unpublished data; CO-Synch protocol – Perry et al., 2002a; Perry et al., 2003; Perry et al., 2004b). In addition, when the length of proestrus was varied to induce ovulation of small ( $< 12$  mm) or large ( $\geq 12$  mm) follicles, pregnancy rates were decreased in animals induced to ovulate small follicles compared to animals induced to ovulate large follicles (Mussard et al., 2003). The ovulatory follicle may affect fertility through the preparation of the oocyte for embryonic development, preparation of follicular cells for luteinization, and/or preparation of the uterine environment for the establishment and maintenance of pregnancy. However, when embryos of similar quality were transferred into cows induced to ovulate small ( $< 12$  mm) or large ( $> 12$  mm) follicles, cows induced to ovulate small follicles had significantly lower pregnancy rates compared to cows induced to ovulate large follicles (Mussard et al., 2003). The preceding study indicates the uterine environment is likely a major factor in decreased fertility following induced ovulation of small dominant follicles.

Luteal secretion of progesterone is required for the survival of the embryo/fetus (McDonald et al., 1952), and has been associated with fertility in cattle by stimulating uterine secretions (Geisert et al., 1992) and by stimulating embryonic growth and development (Garrett et al., 1988; Mann et al., 1996). Uterine secretions including nutrients, growth factors, immunosuppressive agents, enzymes, ions, and steroids contribute to early conceptus growth/survival (Geisert et al., 1992; Gray et al., 2001). Cows with normal developing embryos had higher concentrations of progesterone on days 3 and 6 after insemination compared to cows with degenerating embryos (Maurer and Echternkemp, 1982). Following timed-AI protocols, serum concentrations of progesterone were affected ( $P < 0.04$ ) by the size of the dominant follicle induced to ovulate (**Figure 2**). More specifically, the rise of progesterone following GnRH-induced ovulation was decreased ( $P < 0.01$ ) in cows that ovulated  $\leq 12$  mm follicles compared to cows that ovulated larger follicles. Furthermore, cows induced to ovulate  $\leq 12$  mm follicles had decreased ( $P < 0.05$ ) pregnancy rates compared to cows induced to ovulate larger follicles (29% vs. 71%, respectively, Perry et al., 2002a).

Variation does exist in the proportion of animals induced to ovulate small follicles by different fixed-time insemination protocols. Following the CO-Synch protocol 30% of cows and 52% of heifers (G.A. Perry unpublished data) were induced to ovulate follicles  $< 11.5$  mm in diameter. However, when fixed-timed AI was performed in cows with or without a CIDR from day -9 to -2 [on day -9, GnRH was administered, on day -2, PG was administered, and 48 hours later (day 0) GnRH was administered and animals were inseminated], the percentage of cows that ovulated follicles  $< 11.5$  mm was 7% for CIDR treated cows and 15% for cows not receiving a CIDR (T.W. Geary unpublished data). Therefore, different timed-insemination protocols are more effective at reducing the percentage of small follicles induced to ovulate. However, regardless of synchronization protocol, reduced fertility does appear to occur whenever small follicles are induced to ovulate.



**Figure 2.** Effect of ovulatory follicle size, across both anestrus and cycling cows, on mean serum concentrations of progesterone from day 0 (second GnRH injection) through day 22, and rate of progesterone increase from day 0 to peak progesterone concentration. (Perry et al., 2002a)

### Implications

Synchronizing estrus in cows and heifers is an effective way to maximize the use of time and labor required to detect standing estrus in cattle. In addition, by using estrous synchronization more cows can conceive and become pregnant early in the breeding season with no decrease in fertility. Some estrous synchronization protocols can even induce estrous cycles and shorten the anestrus postpartum period allowing cows to conceive earlier in the breeding season. However, when estrous synchronization is used together with artificial insemination, one of the largest factors that influences fertility is efficiency and accuracy of estrous detection. With fixed-timed insemination protocols, fertility can be reduced in a proportion of animals (cows induced to ovulated follicles < 11.5 mm). However, if the appropriate amount of time and effort cannot be spent detecting estrus, fixed timed-insemination protocols may result in overall greater pregnancy rates. In conclusion, when fertility is defined as the percentage of cows that conceive in the first few days of the breeding season, synchronized cows will have increased fertility compared to non-synchronized cows. When fertility is defined as the percentage of cows bred during the first cycle (first 21 to 25 days) of the breeding season, estrous synchronized females will have similar or better fertility than non-synchronized females depending on the percent of animals that are anestrus or prepubertal and the synchronization protocol used. Therefore, estrous synchronization can be a tremendous management tool to get more cows pregnant early in the breeding season.

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