Natural Mating of Estrus-synchronized Heifers and Indicators of Bull Fertility[1]

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Summary

In six trials involving 486 heifers and 23 bulls, we studied factors affecting pregnancy rates of estrus-synchronized heifers mated naturally and evaluated indicators of bull fertility. Heavier heifers and those in fleshier condition had a higher response to estrus synchronization with Lutalyse. Heifers serviced more than once did not have higher pregnancy rates. Pregnancy rates achieved by bulls ejaculating up to 32 times in 2 1/2 days decreased only slightly as the number of ejaculations increased. There was considerable variation in pregnancy rates and the number of ejaculations achieved by individual bulls. Sex drive measured by a 30-minute serving-capacity test was positively correlated with the number of ejaculations during the mating period and the number of heifers pregnant per bull. None of the variables studied could adequately explain the wide variation in pregnancy rates attributed to individual bulls.

Introduction

Since Lutalyse has been cleared for synchronizing estrus in cattle, some producers have been interested in breeding synchronized females naturally. The purpose of these trials was to 1) study feasibility of using bulls naturally on synchronized females, 2) study factors affecting pregnancy rates in such a system, and 3) evaluate indicators of bull fertility.

Experimental Procedure

Three trials at the Kansas State Beef Research Unit and three field trials involved 486 heifers and 23 bulls. Table 28.1 shows the number of animals, breeds, and procedures in each trial. Two injections of prostoglandin $F2_{\alpha}$ (Lutalyse) 11 days apart were used in trials 1 through 5. A single injection was used in trial 6 after 5 days of estrus detection and artificial insemination. The last injection in each trial was given between 7 and 10 a.m. In the three trials at Kansas State University, heifers were checked for estrus twice daily beginning at least 21 days before the first injection. The Kansas State heifers were weighed and hip heights were recorded at the first injection. Weight-height ratios were used to estimate body condition; larger ratios indicate fatter heifers.

[1]Appreciation is expressed to the UpJohn Company for making Lutalyse available and partial funding support.

Scrotal circumference was measured on each bull except in trial 5. Bulls in trial 1 through 5 were given a 30-minute serving-capacity test. Each bull was penned with a heifer in estrus for 30 minutes and the number of mounts and services and other sexual activity were recorded. A libido score of 1 to 10 was given for the first 10 minutes of the test (1 = no interest, 10 = 2 services followed by further interest). The test was conducted at least 1 week before the synchronized mating.

During the synchronized mating period, heifers were observed at least hourly during the daylight. When detected in standing estrus, they were penned with one bull until serviced 1, 2, or 3 times. In the three Kansas State trials, semen was collected with an artifical vagina from each bull after he had served once and then after about every six ejaculations; the semen quality was evaluated. In the trials at Kansas State, bulls were allowed to service as many heifers as they could. In the other three trials, the number of services per bull was limited by the number of heifers in estrus. Heifers were pregnancy-checked 60-90 days after synchronization.

Results and Discussion

Table 28.1 shows that the percentage of serviced heifers pregnant ranged from 28.8 to 75.0%. The percentage injected heifers pregnant was low in trials 1 through 3, but the number of females in estrus was intentionally larger than the bulls could service. The distribution of the onset of estrus for 7 days after the last injection is shown in Table 28.2 for trials 1 through 3. In that 13.1% of these heifers were in estrus on the fourth to the sixth day after the last injection, we probably underestimated the percentage responding to Lutalyse in the trials in which estrus detection was for a shorter period.

Table 28.3 shows the influence of weight and weight-height ratio on the percentage of heifers in estrus, percentage pregnant, and the time from the last injection to the onset of estrus for trials 1 through 3. As weight and weight-height ratio increased, so did the percentage responding to synchronization, probably because more heifers had reached puberty and were cycling. Weight or weight-height ratio did not affect the time from the last injection to estrus.

Table 28.4 shows that heifers served more than once did not have higher pregnancy rates. For bulls that ejaculated at least 16 or 24 times, pregnancy rates were only slightly lower for later services (Table 28.5). Although the overall pregnancy rates that could be attributed to bulls ejaculating at least 32 times was low, the decrease was slight if we compare the first eight ejaculations with the 24th to the 32nd ejaculations. That indicates that the number of females pregnant was limited by sex drive or physical stamina of the bull rather than by semen depletion or reduction in semen quality.

The means and ranges of bull performance in Table 28.6 show considerable variability in both pregnancy rates achieved by individual bulls and number of ejaculations per bull. Because the number of services per heifer was controlled and semen collections were also made, both the number of heifers serviced and the number of pregnant heifers per bull were limited. If we estimate the number of possible pregnancies per bull by multiplying the number of ejaculations by the percent pregnant, the average for all 23 bulls would be 10.3 (0 to 23). The average for the 12 bulls used to their capacity would be 9.4 (0 to 21).

The residual correlations in Table 28.7 show that activity during the serving-capacity test was not significantly related to the percentage of heifers pregnant but was important in predicting the number of ejaculactions of an individual bull during the synchronized mating. The number of mounts during the test was positively correlated to the number of heifers pregnant per bull, but the number of services during the test and the libido score were not. The 30-minute serving-capacity test was more highly correlated to breeding performance than it would have been if the test had been conducted for only 10 minutes. We did not find scrotal circumference to be significantly correlated to pregnancy rates, contrary to other research. Based on the Breeding Soundness Exam of the Society for Theriogenology, these bulls rated "good" or "very good" for scrotal circumference. Based on 11 bulls from trials 1 through 3, semen characteristics from the first collection were not related to the percentage of heifers pregnant. The only semen characteristic significantly correlated to the number pregnant per bull was the number of normal sperm in an ejaculate (r = .66).

Three of 11 bulls in trials 1 through 3 were classified as "questionable potential breeders" according to the Breeding Soundness Exam. They were responsible for pregnancy rates of 17, 21, and 57%. Four of eight bulls classified as "satisfactory" achieved pregnancy rates of less than 50% (6, 13, 16, and 33%) compared with 58, 56, 50, and 50% for the other "satisfactory" bulls. If we eliminate four bulls classified "fair" or "poor" for percentage of abnormal sperm or sperm motility, pregnancy rates would be 11.4% higher. Thus, the Breeding Soundness Exam can eliminate some low-fertility bulls, but cannot predict the breeding performance of the remainder.

Table 28.1. Trial procedures and summary of results

	Trial number						
	1	2	3	4	5	6	Average
Location	KSU	KSU	KSU	field trial	field trial	field trial	
Number of heifers injected	103	105	116	51	43	68	
Breed of heifers	Crossbred	Crossbred	Crossbred	Crossbred	Hereford	Polled Hereford	
Number of bulls	4	4	4	2	3	6	
Breed of bulls	Hereford	Angus	1 Hereford 3 Angus	Angus	Hereford	Polled Hereford	
Age of bulls	>3 years	>3 years	>3 years	1 18 mo. 1 >3 years	1 yearling 2 >3 years	>3 years	
Time from last injection to end of estrus detection	7 d	7 d	7 d	84 hr	120 hr	84 hr	
Time from last injection until mating stopped	84 hr	108 hr	108 hr	84 hr	120 hr	84 hr	
No. services/heifer	1, 2, or 3	1, 2, or 3	1, 2, or 3	1, 2, or 3	1 or 2	1 or 2	
% in estrus during entire heat-detection period	74.2	79.1	86.2	54.9	67.4	57.4	70.0
% in estrus 84 hr after last injection	59.2	66.7	74.3	54.9	48.9	57.4	60.2
Ratio of bulls to females in estrus	1:18	1:20	1:25	1:14	1:10	1:6	1:16
Number serviced	46	64	71	25	29	39	46
% pregnant of serviced	41.3	31.7	28.8	76.0	75.9	75.0	54.8
% pregnant of injected[1]	18.4	18.8	17.1	37.3	51.2	42.2	30.8

[1]The number of females in estrus was intentionally more than the bulls could service in trials 1-3.

Table 28.2. Distribution of the onset of estrus for 7 days after second injection of Lutalyse (Trials 1-3)

Day after injection[1]		Number in estrus	%
2	AM	108	41.5
	PM	64	24.6
3	AM	38	14.6
	PM	16	6.2
4	AM	24	9.2
	PM	4	1.5
5	AM	3	1.2
	PM	1	.4
6	AM	2	.8
	PM	0	0
7	AM	0	0
	PM	0	0
Total period		260	100.0

[1]Day of injection = day 0.

Table 28.3. The effect of weight and weight-height ratio on percentage of heifers in estrus and pregnancy rates (Trial 1-3)

	Number heifers	% in estrus	Number serviced	% pregnant of serviced	Hours from injection to estrus
Weight at first injection, lb					
<683	108	67.6[a]	44	40.9	65.3
683-791	108	81.5[b]	48	39.6	64.0
>791	107	91.6[b]	79	25.3	60.6
Weight-height ratio, lb/inch[1]					
< 15.1	119	65.6[a]	46	37.0	65.4
15.1-17.3	101	87.1[b]	51	39.2	63.0
> 17.3	103	90.3[b]	74	25.7	61.3

[1]Weight-height ratio = weight ÷ height and is used as a measure of body condition. A higher ratio indicates fatter heifers.

[a,b](P<.05).

Table 28.4. The number of times serviced and pregnancy rates

	All trials		Trials 1-4[1]		
Times serviced	1	2	1	2	3
Number of heifers	95	85	52	48	40
% pregnant	49.5	47.1	46.2	41.7	45.0

[1]Heifers were serviced only 1 or 2 times in trials 5 and 6.

Table 28.5. The effect of the number of ejaculations of individual bulls on pregnancy rates

	Ejaculation	Number of heifers	% pregnant
Based on 16 bulls ejaculating at least 16 times	1st-8th	50	55.2
	9th-16th	67	46.3
Based on 11 bulls ejaculating at least 24 times	1st-8th	34	50.0
	9th-16th	40	37.5
	17th-24th	47	44.7
Based on 5 bulls ejaculating at least 32 times	1st-8th	15	26.7
	9th-16th	16	18.8
	17th-24th	19	31.6
	24th-32nd	17	23.5

Table 28.6. Bull performance

	All 23 bulls		12 bulls used to capacity[1]	
	Mean	(Range)	Mean	(Range)
Number of ejaculations	22.6	(2-62)	29.2	(2-62)
Number of heifers serviced[2]	13.7	(1-27)	15.1	(1-27
% pregnant	52.3	(0-83.3)	21.4	(0-58.3)
Number of pregnant heifers per bull[2]	5.6	(0-10)	4.8	(0-9)

[1]These are bulls used in trials 1-3 where the number of heifers in estrus did not limit bull performance.

[2]In all trials the number of heifers serviced and number pregnant were limited by the controlled number of services per female.

Table 28.7. Residual correlations of predictors of breeding performance and actual performance[1]

	% pregnant	Number of ejaculations[2]	Number of heifers pregnant per bull[2]
Serving capacity test			
Mounts during 1st 10 minutes	.13	.33	.58*
Services during 1st 10 minutes	-.23	.56*	.03
Libido score for 1st 10 minutes	-.20	.59*	.08
Mounts during 30 minutes	.17	.48	.64**
Services during 30 minutes	-.07	.66**	.30
Scrotal circumference	.12	.20	.20

[1]The statistical model included trial as an independent variable.

[2]Includes only bulls used to capacity.

*P<.10

**P<.05