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# Effect of Single-Sire and Multiple-Sire Natural Mating on Pregnancy Rate of Beef Cattle

Donald D. Lunstra<sup>1</sup>

## Introduction

Although artificial insemination (AI) is widely used in dairy cattle, AI has found only limited application in beef cattle. Use of bulls in natural mating programs accounts for more than 95 percent of the pregnancies achieved each year in the U.S. beef cattle industry. Success of such natural mating programs depends on the reproductive capacity and fertility of the individual herd sires used, but very little research on the natural mating fertility of beef bulls has been conducted. Because of the general lack of information on effective techniques for identifying sires with superior fertility, procedures currently used for selecting herd sires for natural mating are based on factors other than reproductive potential and include factors (such as body wt, growth rate, appearance, etc.) that have little relationship to bull fertility. It is not surprising that a large range in pregnancy rate of beef bulls used in single-sire natural mating has been reported, and commercial cattle producers have resorted to using multiple sires in pasture breeding, assuming that more fertile bulls compensate for less fertile bulls within multiple-sire groups. Conflicting reports exist in the available literature, with some results indicating that pregnancy rate may be higher during multiple-sire mating than during single-sire mating, while other reports indicate that pregnancy rates are not improved by multiple-sire breeding. Studies using AI indicate that increasing the number of inseminations per estrous female increases pregnancy rate, and that inseminating mixtures of semen from two or more bulls generally increases pregnancy rate. However, it is unknown if increasing the number of services per female or increasing the number of sires servicing each female results in increased pregnancy rate in natural mating programs.

This report presents results of a study conducted to determine the effect of number of services on natural-mating pregnancy rate and to investigate the effect of multiple-sire natural mating on pregnancy rate in beef cattle.

## Procedure

Twelve mature Angus bulls, 3 to 5 years of age, possessing acceptable semen quality and normal testicular size, were selected for use in breeding trials. Bulls were assigned letters A through L for the duration of the study, and the letter was painted prominently (24 in height) on each side of the bull for ease of identification. Bulls were examined and two semen samples collected and evaluated 2 wk before the beginning of the 60-day breeding period. The study was designed so that each bull was used every other day, and each bull completed seven services with five different estrous females every six days throughout the 60-day breeding period (Table 1).

To obtain females in estrus, 560 cyclic crossbred heifers averaging 16 months of age were observed for estrus twice daily for 60 days (7:00 a.m. and 7:00 p.m.). Six heifers exhibiting the strongest estrous behavior were selected daily (8:00 a.m.) from those heifers first detected in estrus that morning. The six heifers were placed in holding pens, and all scheduled services (Table 1) were completed within a 30 min time frame/heifer. Each estrous heifer received (1) one service by one bull (single-sire, single-service = SSSS), (2) three services by one bull (single-sire, multiple-service = SSMS), or (3) one service by each of three different bulls (multiple-sire, multiple-service = MSMS) according to the schedule shown in Table 1. For MSMS, bulls were used as four subgroups of three bulls each

(ABC, DEF, GHI, and JKL). While the original goal was to obtain 120 SSSS, 120 SSMS, and 120 MSMS mated heifers (360 heifers total), a total of 352 mated heifers (124 SSSS, 105 SSMS, and 123 MSMS) was achieved. This difference was due to natural variation in number of heifers in estrus on the morning of each day (occasionally less than six during the last 30 days of the study) and to low receptivity in some heifers (occurred most often in heifers scheduled for SSMS). After mating, heifers were placed in a separate pasture and pregnancy palpated at approximately 60 days postmating.

## Results

Average pregnancy rates of heifers mated by only one bull were essentially the same, regardless of whether heifers received one service (SSSS, 62.1 pct) or three services (SSMS, 62.9 pct) per bull (Table 2). These results indicate that increasing the number of services/female in single-sire matings did not increase pregnancy rate. However, all services were completed within a 30 min time frame/estrous female, and distributing services over a longer time frame (several hours) may increase pregnancy rate, although this effect was not tested in this study. For multiple-sire matings, average pregnancy rate of heifers mated by three bulls (MSMS, 74.0 pct) was 11 to 12 percent greater and significantly higher than the average pregnancy rate of heifers mated once (SSSS) or three times (SSMS) by only one bull. The range in pregnancy rate among subgroups of bulls used for multiple-sire matings was relatively small (ranged from 68 to 84 pct). In contrast, the range among bulls (0 to 95 pct) and among subgroups of bulls (49 to 80 pct) was much larger when used for single-sire matings. These data indicate that use of multiple sires in breeding programs should result in an increased average pregnancy rate/estrous female and less variation in pregnancy rate/multiple-sire pasture than could be achieved with single-sire breeding programs.

The large range in pregnancy rate among bulls used for single-sire matings (0 to 95 pct) offered an opportunity to study possible interrelationships to variation in testis size and semen quality. However, only low correlations were found between bull fertility (pregnancy rate) and scrotal circumference ( $r = .39$ ,  $P < .11$ ), percent motile sperm ( $r = .13$ , nonsignificant), percent abnormal sperm ( $r = -.43$ ,  $P < .10$ ), and percent sperm with intact acrosomes ( $r = .48$ ,  $P < .07$ ). These results indicate that considerable variation in single-sire fertility rate can be expected, even among bulls with acceptable testicular size and normal semen quality. However, the variation in fertility rate was reduced and average pregnancy rates were increased significantly when these same bulls were used for multiple-sire mating.

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**Table 1.—Design of single-service vs multiple-service and single-sire vs multiple-sire pregnancy rate study<sup>a</sup>**

Day of schedule <sup>a</sup>	Bulls used per day <sup>b</sup>	Number of services required per bull used per day <sup>c</sup>	Type of mating/estrous female <sup>d</sup>			Total heifers mated per day <sup>e</sup>
			Single-sire, single-service (SSSS)	Single-sire, multiple-service (SSMS)	Multiple-sire, multiple-service (MSMS)	
<b>Single sire:<sup>c</sup></b>						
Day 1	A,B,C,D,E,F	1	1 (1)	-----	-----	6
Day 2	G,H,I,J,K,L	1	1 (1)	-----	-----	6
Day 3	A,B,C,D,E,F	3	-----	1 (3)	-----	6
Day 4	G,H,I,J,K,L	3	-----	1 (3)	-----	6
<b>Multiple-sire:<sup>e</sup></b>						
Day 5	AxBxC, DxExF	3	-----	-----	3 (1)	6
Day 6	GxHxI, JxKxL	3	-----	-----	3 (1)	6

<sup>a</sup>The design was based on a 6-day cycle which was repeated ten times. Total duration of experiment was 60 days.

<sup>b</sup>Twelve mature Angus bulls, 3 to 5 years of age, designated A through L, were used for mating.

<sup>c</sup>Each bull was used every other day. Each bull was required to complete seven services with five different estrous females during each 6-day cycle of the experiment.

<sup>d</sup>Number of heifers mated/bull used/day is given. Number of services/bull/estrous female is given in parentheses.

<sup>e</sup>For multiple-sire matings, bulls were randomly assigned to one of four 3-bull subgroups (AxBxC, DxExF, GxHxI, JxKxL). Each heifer identified for multiple-sire mating received one service/bull from each of the three bulls in a subgroup.

**Table 2.—Pregnancy rates of heifers mated single-service vs multiple-service and single-sire vs multiple-sire**

Bulls in subgroup	Pregnancy rate (pct) and number of heifers per type of mating <sup>a</sup> :				Multiple-sire: Multiple-service(MSMS) <sup>b</sup>	All matings
	Single-service(SSSS) <sup>b</sup>	Multiple-service(SSMS) <sup>b</sup>	Combined (SSSS + SSMS) <sup>b</sup>	Range among bulls (pct)		
A,B,C	80.0(30)	63.3(30)	71.7(60)	62 to 80 pct	69.0(29)	70.8(89)
D,E,F	50.0(34)	50.0(24)	50.0(58)	12 to 63 pct	83.9(31) <sup>hi</sup>	61.8(80)
G,H,I	48.6(35)	68.4(19) <sup>c</sup>	55.6(54)	0 to 95 pct	67.7(31) <sup>di</sup>	60.0(85)
J,K,L	76.0(25)	68.8(32)	71.9(57)	61 to 77 pct	75.0(32)	73.0(89)
All bulls	62.1(124)	62.9(105)	62.4(229)	0 to 95 pct	74.0(123) <sup>gai</sup>	66.5(352)
Range among subgroups	49 to 80 pct	50 to 69 pct	49 to 80 pct	---	68 to 84 pct	49 to 84 pct

<sup>a</sup>Pregnancy rate is given as percent (pct pregnant = no. of heifers pregnant x 100/no. of heifers mated), and number of heifers mated is given in parentheses.

<sup>b</sup>Abbreviations: SSSS = single-sire, single-service mating; SSMS = single-sire, multiple-service mating (3 services by one bull/female); MSMS = multiple-sire, multiple-service mating (3 services/female via one service by each of the three bulls in a subgroup).

<sup>c</sup>Pregnancy rate for SSMS is higher (P < .10) than pregnancy rate for SSSS, within a row.

<sup>d</sup><sup>e</sup><sup>g</sup><sup>h</sup><sup>i</sup> Pregnancy rate for MSMS is higher than for pregnancy rate for SSSS (<sup>d</sup>P < .05, <sup>e</sup>P < .05, <sup>f</sup>P < .01), SSMS (<sup>g</sup>P < .05, <sup>h</sup>P < .01), and combined SSSS + SSMS (<sup>i</sup>P < .05, <sup>j</sup>P < .01) within a row.