

# How Many Clean-up Bulls Are Needed after Estrus Synchronization and Artificial Insemination?

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## Summary

To evaluate the ideal number of bulls to use following estrus synchronization and artificial insemination (AI), research reporting AI and final pregnancy rates and bull to female ratio in *Bos taurus* cattle was reviewed and summarized. Pregnancy rate means were weighted based on the number of females in each study. Final pregnancy rates for a normal bull to female ratio (1:20 to 30) in a natural service setting were 87.8%. In comparison, final pregnancy rates following estrus synchronization and AI for a normal, intermediate (1:31 to 49), and half the number of bulls (1:50 to 60) were 87.8, 82.6, and 89.2%, respectively.

## Introduction

One of the benefits of estrus synchronization and AI is purchasing and maintaining fewer bulls. However, an idea has been circulating that synchronized females not becoming pregnant to AI will return to estrus at the same time and require the same number of bulls as a natural service pasture would require.

Larson et al., (*Journal of Animal Science*, 2009, 87:941–921) observed cows not conceiving to AI will return to estrus over a 12 d period following a single timed AI. The most active d had 18% of the herd in estrus, with the remainder of the distribution a bell curve (Figure 1). Each cow's estrous cycle is slightly different. Some cows have 2 follicular waves during the estrous cycle, while others have 3. This results in a natural variation in cycle length, causing the non-pregnant cows' return to estrus to vary more than may be anticipated.

No effect of bull to female ratio or number of females expressing estrus per bull on pregnancy rate was found when comparing bull to heifer ratios ranging from 1:7 to 1:51 in heifers synchronized with Synchro-Mate B (*Theriogenology*, 1990, 34(6):1069–

1070). In a comparison of bull to heifer ratios ranging from 1:16 to 1:50 in herds of 100 heifers synchronized with melengestrol acetate (MGA)-PG and immediately exposed to bulls, the optimal bull to heifer ratio for synchronized heifers was 1:25 based on both biological and economic criteria (*Journal of Animal Science*, 1993, 71:291–297). If the optimal bull to heifer ratio in a synchronized natural service setting is 1:25, it can be extrapolated with a hypothetical AI pregnancy rate of 50%, the number of clean-up bulls needed is decreased by 50%.

A study comparing bull to female ratios following estrus synchronization and AI is needed. However, considering the breadth of research documenting bull to female ratios, AI pregnancy rates, and final pregnancy rates and the need for this information as soon as possible; the authors have chosen to summarize available data to provide a preliminary answer to this industry-relevant question.

## Procedure

Data was collected from published studies reporting AI and final pregnancy rates, and bull to female ratio. The synchronization protocol utilized, number of females in the herd, and breeding season length

were also collected. The studies collected were limited to those evaluating *Bos taurus* cattle. Of the data collected, studies were divided into bull to female ratio groups including Normal-Natural Service (NS, 1:20 to 30 bull to female ratio), and 3 groups following estrus synchronization and AI; normal (NORM, 1:20 to 30), intermediate (INT, 1:31 to 49), and half (HALF, 1:50 to 60). A summary of the mean AI and final pregnancy rates, weighted by number of females in each study, are presented.

## Results

The weighted means of each bull ratio group are presented in Table 1. The final pregnancy rate of a normal bull to heifer ratio in a natural service setting was 87.8%. Pregnancy rate to AI in the NORM was 56.1% and final pregnancy rate was 87.7%. The INT AI pregnancy rate was 46.5% with a final pregnancy rate of 82.6%. Pregnancy rate to AI in the HALF was 55.6% and had a final pregnancy rate of 89.2%. Bulls turned in at half the normal bull to female ratio following estrus synchronization and AI resulted in final pregnancy rates similar to normal bull to female ratio both in a natural service situation and following estrus synchronization and AI.

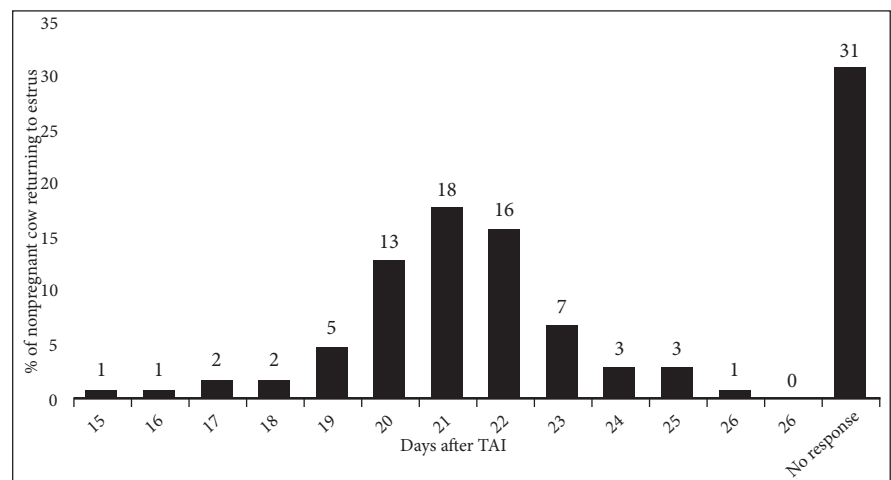


Figure 1. Distribution of estrus of nonpregnant cows following TAI (adapted from Larson et al., 2009).

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Table 1. Summary of AI and final pregnancy rates of varying bull to female ratios obtained in cited studies<sup>a</sup>

Synchronization Protocol	AI Method <sup>b</sup>	Female age <sup>c</sup>	Number of females	Breeding Season Length	AI Preg Rate, % <sup>d</sup>	Final Preg Rate, % <sup>e</sup>	Reference
<b>NORMAL-NS<sup>f</sup></b>							
1 shot PG	NS	cows	201	64	—	89.0	Engle et al., 2007
None	NS	cows	72	60	—	81.0	Sanson and Coombs, 2003
None	NS	cows	295	90	—	91.5	Whitworth et al., 2008
None or CIDR for 7 d	NS	cows	2,033	90–120	—	88.8	Lamb et al., 2008
None	NS	heifers	1,381	85	—	85.8	Gutierrez et al., 2015
<b>NORMAL-NS Mean</b>			<b>3,982</b>		<b>NA</b>	<b>87.8</b>	
<b>NORMAL<sup>g</sup></b>							
7 day CIDR + PG (no GnRH)	HD	cows	96	30	43.1	76.4	Lake et al., 2005
16 d CIDR + GnRH (2d) + PG (1wk)	HD	heifers	65	28	40.8	72.8	Devine et al., 2015
Synchromate B	HD	cows	89	65	52.7	79.7	Fanning et al., 1995
MGA + PG	HD	cows	50	62	44.3	87.3	Berke et al., 2001
Select Synch	HD + TAI	heifers and cows	80	46	56.3	92.1	Ahola et al., 2005
Co-Synch + CIDR	TAI	cows	194	50	NR <sup>j</sup>	91.7	Cooke et al., 2012
Co Synch + CIDR	TAI	heifers	88	50	NR <sup>j</sup>	82.5	Cooke et al., 2012
Synchromate B	TAI	heifers	239	42	NR <sup>j</sup>	73.5	Mulliniks et al., 2013
Co Synch + CIDR	TAI	cows	188	50	47.5	97.4	Thomas et al., 2009
MGA of 14 day CIDR	TAI	heifers	1,385	50	61.5	91.5	Vraspir et al., 2013
Co-Synch + CIDR	TAI	heifers	80	53	48.0	91.5	Bryant et al., 2011
Co-Synch + CIDR	TAI	cows	102	—	41.4	70.2	Moriel et al., 2012
Norgestomate + estradiol valerate	TAI, TAI + HD, NS	cows	150	90	52.5	88.2	Sa Filho et al., 2013
<b>NORMAL Mean</b>			<b>2,806</b>		<b>56.1</b>	<b>87.8</b>	
<b>INTERMEDIATE<sup>h</sup></b>							
MGA-PG	HD	heifers	104	60	67.0	92.0	Harris et al., 2008
5 or 7 d CIDR	TAI	cows	138	40	55.8	77.5	Gunn et al., 2011
MGA-PG	HD + TAI	heifers	500	61	49.7	93.0	Funston and Meyer, 2012
2 shot PG	HD	cows	34	30	54.5	90.9	Alexander et al., 2002
8d half-cuemate	TAI	heifers	316	50	29.8	64.6	Butler et al., 2011
<b>INTERMEDIATE Mean</b>			<b>1,092</b>		<b>46.5</b>	<b>82.6</b>	
<b>HALF<sup>i</sup></b>							
MGA-PG	HD	heifers	399	60	72.5	94.0	Summers et al. 2014
Co Synch + CIDR	TAI	heifers	191	45	NR <sup>o</sup>	88.7	Mulliniks et al., 2013
MGA-PG	HD	heifers	100	60	46.0	90.0	Harris et al., 2008
MGA-PG	HD	heifers	100	60	59.0	90.0	Harris et al., 2008
MGA-PG	TAI or HD	heifers	299	60	59.0	93.0	Funston and Larson, 2011
MGA-PG	HD	heifers	1,005	60	58.7	91.0	Vraspir et al., 2013
MGA-PG	HD + TAI	cows	121	60	48.5	87.0	Post et al., 2005
MGA-PG	HD	heifers	64	29	NR <sup>j</sup>	82.1	Sexten et al., 2005
MGA + 2 shots EB	TAI	heifers	118	39	37.2	73.5	Baptiste et al., 2005
5 or 7 d CO synch + CIDR	TAI or HD	heifers	2,660	85	52.8	88.3	Gutierrez et al., 2014
<b>HALF Mean</b>			<b>5,057</b>		<b>55.6</b>	<b>89.2</b>	

<sup>a</sup>Studies reporting bull to female ratio, AI and final pregnancy rates evaluating *Bos Taurus* cattle were utilized.

<sup>b</sup>NS = natural service; HD = heat detect; TAI = time artificial insemination.

<sup>c</sup>Female age reported as either heifers or cows.

<sup>d</sup>Percentage of females that conceived to AI.

<sup>e</sup>Percentage of females determined pregnant at the end of the breeding season.

<sup>f</sup>NORMAL-NS = bull to female ratio was 1:20 to 30 in a natural service setting.

<sup>g</sup>NORMAL = 1:20 to 30 bull to female ratio following estrus synchronization and AI.

<sup>h</sup>INTERMEDIATE = 1:31 to 49 bull to female ratio following estrus synchronization and AI.

<sup>i</sup>HALF = 1:50 to 60 bull to female ratio following estrus synchronization and AI.

<sup>j</sup>NR = AI pregnancy rates not reported.

A consideration to make prior to choosing a bull to female ratio is bull age. Experienced bulls are more efficient breeders, while yearling bulls are less experienced. Another consideration is pasture size and terrain; a rugged, multi-windmill pasture may demand more from a bull than a flat

single-windmill pasture. In conclusion, producers utilizing estrus synchronization and AI should keep in mind the similarity between final pregnancy rates when using a 1:25 bull to female ratio and 1:50 bull to female ratio. Producers need to evaluate the cost difference of purchasing and main-

taining twice as many bulls to maintain a 1:25 bull to female ratio following estrus synchronization and AI.

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