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

Hazy R. Nielson and Rick N. Funston

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-

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.

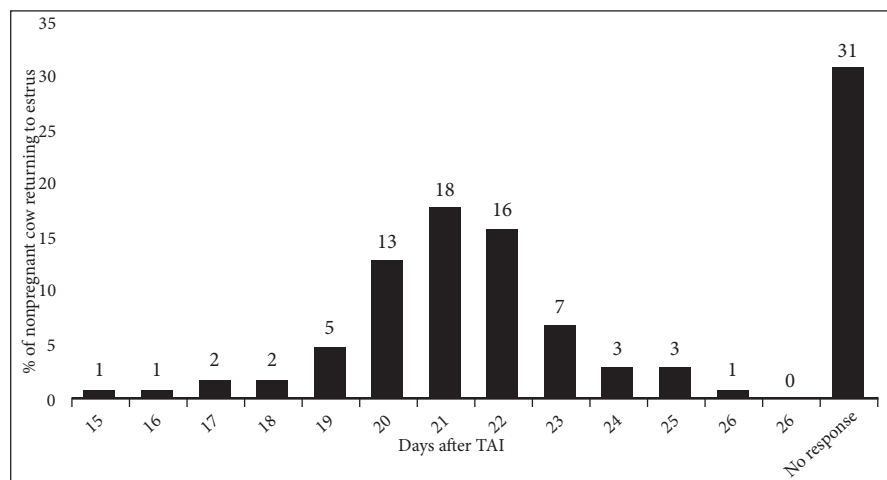


Figure 1. Distribution of estrus of nonpregnant cows following TAI (adapted from Larson et al., 2009).

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

| Synchronization Protocol | AI Method ^b | Female age ^c | Number of females | Breeding Season Length | AI Preg Rate, % ^d | Final Preg Rate, % ^e | Reference |
|-----------------------------------|------------------------|-------------------------|-------------------|------------------------|------------------------------|---------------------------------|--------------------------|
| NORMAL-NS^f | | | | | | | |
| 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 |
| NORMAL-NS Mean | | | 3,982 | | NA | 87.8 | |
| NORMAL^g | | | | | | | |
| 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 ^j | 91.7 | Cooke et al., 2012 |
| Co Synch + CIDR | TAI | heifers | 88 | 50 | NR ^j | 82.5 | Cooke et al., 2012 |
| Synchromate B | TAI | heifers | 239 | 42 | NR ^j | 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 |
| NORMAL Mean | | | 2,806 | | 56.1 | 87.8 | |
| INTERMEDIATE^h | | | | | | | |
| 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 |
| INTERMEDIATE Mean | | | 1,092 | | 46.5 | 82.6 | |
| HALFⁱ | | | | | | | |
| MGA-PG | HD | heifers | 399 | 60 | 72.5 | 94.0 | Summers et al. 2014 |
| Co Synch + CIDR | TAI | heifers | 191 | 45 | NR ^o | 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 ^j | 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 |
| HALF Mean | | | 5,057 | | 55.6 | 89.2 | |

^aStudies reporting bull to female ratio, AI and final pregnancy rates evaluating *Bos Taurus* cattle were utilized.

^bNS = natural service; HD = heat detect; TAI = time artificial insemination.

^cFemale age reported as either heifers or cows.

^dPercentage of females that conceived to AI.

^ePercentage of females determined pregnant at the end of the breeding season.

^fNORMAL-NS = bull to female ratio was 1:20 to 30 in a natural service setting.

^gNORMAL = 1:20 to 30 bull to female ratio following estrus synchronization and AI.

^hINTERMEDIATE = 1:31 to 49 bull to female ratio following estrus synchronization and AI.

ⁱHALF = 1:50 to 60 bull to female ratio following estrus synchronization and AI.

^jNR = 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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