

## Estrous Synchronization and Equation of Reproduction in Beef Operations Percentage of the Herd Detected in Estrus

Estrous synchronization is an effective way to minimize the time and labor required to detect standing estrus in cattle that are going to be artificially inseminated. In addition, estrous synchronization can be a benefit to overall herd management. Cows that respond and conceive to a synchronized estrus have the following advantages:

- 1) exhibit standing estrus at a predicted time
- 2) conceive earlier in the breeding season
- 3) calve earlier in the calving season
- 4) wean older and heavier calves at weaning.

Some protocols can induce noncycling cows and heifers to start cycling, decreasing the postpartum anestrus interval and allowing more opportunities for cows to conceive during a defined breeding season.

Numerous factors contribute to the success or failure of estrous synchronization and artificial insemination. These factors make up the **Equation of Reproduction**, which is derived of four components:

- A) percentage of the herd detected in estrus
- B) efficiency/ability of the inseminator
- C) fertility of the herd
- D) fertility of the semen

The product of these four factors determines the success of the reproductive management program as pregnancy rates (i.e.,  $A \times B \times C \times D = \text{percent pregnant}$ ). This Techline focuses on factor A (the percentage of the herd detected in estrus).

### Characteristics of Estrus/Heat

For successful insemination of cattle to occur, animals must be detected in standing estrus. In cattle, the estrous cycle normally varies from 17 to 24 days and the length of time that cows may be in estrus is generally 10 to 18 hours; however, considerable variation exists among individual animals and has been reported to range from as little as one hour to more than 30 hours. The primary sign of estrus in cattle is standing to be mounted, whereas the secondary signs of estrus include frequent mounting, watery mucus from the vulva, and restlessness. Some common estrus detection aids are pressure mount detectors, tail chalk/paint, androgenized cows, teaser bulls, and Heatwatch system. However, these aids should not be used to replace visual observation, but simply serve to assist in identifying females in estrus.

### Defining Pregnancy Rate

The success of an estrous synchronization protocol can be interpreted in many ways, but the most valuable method is by assessing pregnancy rate in relationship to all of the females synchronized. Pregnancy rate is the product of the synchronization rate and conception rate, taking into account females that were not detected in estrus or inseminated. Producers should calculate pregnancy rate to assess the success of their system (Figure 1). The definitions are as follows:

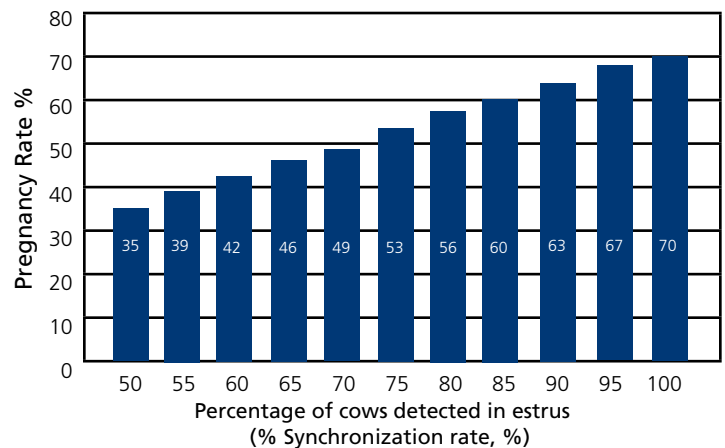
**Synchronization rate** = the percentage of females detected in estrus compared to the total number of females synchronized

**Conception rate** = the percentage of females pregnant compared to the number of females inseminated

**Pregnancy rate** = the percentage of females pregnant compared to the total number of females synchronized and inseminated

In a fixed-time artificial insemination protocol conception rate and pregnancy rate are the same value because every female is synchronized and inseminated (i.e., the synchronization rate = 100%).

**Figure 1: Effects of synchronization rate on pregnancy rates assuming that conception rates remain 70%**



### Enhancing Detection of Estrus/Heat

In many instances detecting cows in estrus is an art or is carefully orchestrated to increase the opportunity of detecting those females that display the signs of estrus. It is important to note

that the person who is responsible for detecting heat is replacing the heat detection normally performed by a bull that is present with the females 24 hours a day. When females were monitored for standing estrus 24 hours a day versus females detected twice a day for 30 minutes, within 5 days after estrous synchronization, 95% of animals monitored 24 hours a day were detected in standing estrus, whereas only 56% of animals observed twice a day for 30 minutes were detected in standing estrus (Downing et al., 1998). In addition, continuous observation of beef cows has indicated that 56% of cows initiate estrus between 6 p.m. and 6 a.m. (Perry et al., 2008). When observing estrus three times a day (early in the morning at mid-day and in the evening) the synchronization rate increased by 10% compared to once in the morning and once in the evening. When a fourth observation was added at midnight the synchronization rate was increased by 19% compared to twice a day (Perry et al., 2008)

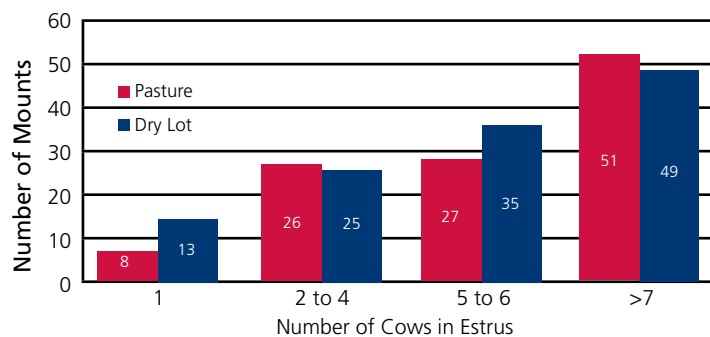
The number of mounts per female when she is in estrus increases as the number of females in estrus increases (Figure 2). This is likely due to the formation of sexually active groups of cattle which is known to increase the number of mounts per female (Smith et al., 2008). In nonsynchronized cattle there will be fewer sexually active groups (or fewer animals per group) and less mounting activity. Therefore, improved detection of estrus efficiency is an advantage when using an estrous synchronization program.

Research has shown increased handling and restraint of heifers during a synchronized estrus decreased the number of mounts per estrus. Depending upon the estrous synchronization protocol, a fixed-time insemination protocol should reduce the amount of animal handling associated with sorting heifers detected in heat at the time of insemination.

## Summary

Enhancing the percentage of females that are detected in estrus and artificially inseminated will increase the overall success of a breeding program. Accurately detecting estrus will ensure the correct females are submitted to artificial insemination and have the opportunity to conceive. However, successful heat detection is time consuming and requires patience. When using a synchronization system that requires heat detection, producers should be aware of the additional time and labor expectations associated with detecting females in estrus.

**Figure 2: Influence of the number of cows in estrus by the number of times cows are mounted in drylot or pasture.**



## References

- Downing, E. R., D. Schutz, D. Couch, D. G. LeFever, J. C. Whittier, and T. W. Geary. 1998. Methods of estrous detection to increase pregnancies using the select synch protocol., Colorado State University Beef Program Report.
- Perry, G.A., J. C. Dalton, and T. W. Geary. 2008. Management factors influencing fertility in synchronized and natural breeding programs. In. Proceedings, 9th Applied Reproductive Strategies in Beef Cattle, Fort Collins, CO.
- Smith, M.F., G.A. Perry, J.A. Atkins, M. E. Risley, D.C. Busch, and D.J. Patterson. 2008. Physiological principles underlying synchronization of estrus. In. Proceedings, 9th Applied Reproductive Strategies in Beef Cattle, Fort Collins, CO.