UF IFAS Extension UNIVERSITY of FLORIDA

VM198

What Is the Most Cost-Effective Breeding Program for Lactating Dairy Cows—Timed AI, Estrous Detection, or a Combination of Both?[1]

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Introduction

As any other business enterprise, the sustainability of a dairy farm is highly dependent on economics. In order to obtain a profitable return on assets, there is a constant need to maximize outputs and, oftentimes, to minimize inputs. In a conventional dairy farm, most of the cash receipts (about 88%) come from milk sales, and a smaller portion (about 12%) results from animal sales, including those destined for dairy production (Santos et al. 2010). On the other hand, feed cost of lactating dairy cows account for roughly 50% of total cost of production, whereas rearing replacement heifers account for about 23% of the cost of producing milk. Reproduction influences both milk production and number of replacement heifers available on a farm; therefore, reproductive efficiency becomes a key determinant of dairy cow profitability (Britt 1985; Meadows et al. 2005; De Vries 2006; De Vries et al. 2006).

Several parameters affect reproductive performance, such as voluntary waiting period (VWP), service rate (SR), conception rate (CR), and pregnancy loss (Galvão et al. 2013). Pregnancy rate (PR) is the combination of SR and CR, and it is believed to be one of the best comprehensive measures of reproductive performance (Santos et al. 2010). Depending on the dairy, one or more of these factors may be a problem. Artificial insemination upon natural estrus is still the main method to breed cows (54.7% and 39.6% for first and subsequent services, respectively [USDA 2009]). However, with the advent of synchronization of ovulation for timed AI (Pursley et al. 1995; Moreira et al. 2001), dairies are increasingly adopting these protocols as part of their reproductive programs (Caraviello et al. 2006; USDA 2009). For the most part, synchronization protocols are used in combination with estrus detection (Caraviello et al. 2006; USDA 2009). Nonetheless, in an attempt to tightly control service rate and to eliminate the need for estrus detection, many herds (9.9%–13.2% for first and subsequent services, respectively) are opting for the use of timed AI exclusively (USDA 2009; Giordano et al. 2011).

Therefore, the objective of this publication is to present information from recently published articles by Giordano et al. (2011) and Galvão et al. (2013) that looked at the economics of different reproductive programs for breeding dairy cows that use estrus detection only (ED), timed AI only (TAI), or a combination of both (ED-TAI).

1. This document is VM198, one of a series of the Veterinary Medicine—Large Animal Clinical Sciences Department, UF/IFAS Extension. Original publication date May 2014. Visit the EDIS website at http://edis.ifas.ufl.edu.

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Giordano et al. (2011) Study Findings

Giordano et al. (2011) evaluated three reproductive programs for lactating dairy cows—AI based on detection of estrus (**DE**), the double Ovsynch program for first AI followed by resynchronization of nonpregnant cows with Ovsynch starting on day 32 after the previous AI (**DO-Res**), and the double Ovsynch program for first and subsequent AI (**DO-DO**). Although the cost for implementation of timed AI programs were $17 (DO-Res) and $21 (DO-DO) more expensive/cow/year than for estrous detection program, they resulted in $45 and $69 more income per cow/year. In Giordano et al. (2011), the authors assumed pregnancy per AI at first AI of 45%, 45%, and 33% and for subsequent AI of 30%, 39%, and 30% for DO-Res, DO-DO, and DE, respectively. This difference in pregnancy per AI is the major factor leading to greater profitability for the DO-DO program. Nevertheless, most studies in the literature do no support major increments in pregnancy per AI, when cows are subjected to timed AI compared with AI based on DE (Chebel and Santos 2010; Santos et al. 2009; Tenhagen et al. 2004). Because the benefits of getting a cow pregnant, in general, outweigh potential expenses with more costly reproductive programs when fertility is improved, it is expected that the simulations presented by Giordano et al. (2011) would favor the exclusive timed AI programs.

In most farms in the United States, timed AI is used concurrently with insemination following synchronized or spontaneous estrus. In fact, more than 55% of the farms rely primarily on detection of estrus as the major method to inseminate cows (NAHMS 2009). Because cows inseminated on estrus have similar fertility to that of cows inseminated following timed AI (Chebel and Santos 2010; Santos et al. 2009; Tenhagen et al. 2004), it is unreasonable to believe delaying insemination of cows that spontaneously return to estrus to enroll them in a timed AI program would be economically more advantageous, unless insemination early postpartum is not desirable. Except when efficacy and accuracy of detection of estrus are poor, it is anticipated that rebreeding cows that spontaneously return to estrus should complement the benefits of timed AI programs.

Galvão et al. (2013) Study Findings

Galvão et al. (2013) recently modeled reproductive performance and economics of dairy farms that adopt different breeding programs. The authors evaluated breeding strategy (ED or TAI), efficiency of ED (40% vs. 60%), accuracy of ED (85% vs. 95%), compliance with each injection of the synchronization protocol (85% vs. 95%), and milk price ($0.33/kg vs. $0.44/kg). The programs proposed were:

1. Detection of estrus at 40% with 85% accuracy
2. Detection of estrus at 40% with 95% accuracy
3. Detection of estrus at 60% with 85% accuracy
4. Detection of estrus at 60% with 95% accuracy
5. Timed AI for all AI with 85% compliance of treatments
6. Timed AI for all AI with 95% compliance of treatments
7. Timed AI for first AI with 85% compliance of treatments followed by detection of estrus at 40% with 85% accuracy
8. Timed AI for first AI with 95% compliance of treatments followed by detection of estrus at 40% with 85% accuracy
9. Timed AI for first AI with 85% compliance of treatments followed by detection of estrus at 60% with 85% accuracy
10. Timed AI for first AI with 95% compliance of treatments followed by detection of estrus at 60% with 95% accuracy

The authors assumed that pregnancy to first AI was 33.9%, and then decreased by 2.6% for every subsequent insemination. Pregnancy loss was set at 11.3%. Cows were not inseminated after 366 days postpartum, and nonpregnant cows were culled after 450 days postpartum. Culled cows were immediately replaced to maintain a herd of 1,000 cows, including lactating and dry cows, with a dry period of 60 days. The model accounted for all incomes and costs. The authors assumed that replacement animals would be obtained by purchasing a pregnant heifer at $1,600. Feeding costs were $0.25/kg of lactating cow diet dry matter and $0.15/kg of dry cow diet dry matter; breeding cost was $0.10/cow/day for detection of estrus; prostaglandin $F_{2\alpha}$ was $2.65/dose; GnRH was $2.40/dose; hormonal administration was $0.25/injection; pregnancy diagnosis was $3/pregnancy; and other costs were $2.50/cow/day to account for labor, veterinary costs, and fixed costs. Income was calculated based on daily milk yield with milk priced at $0.33/kg or $0.44/kg, cow sale at $0.65/kg of live weight, and calf sale at $140/calf. Figure 1 depicts the profit per cow/year when milk price is $0.33/kg (Figure 1A) or $0.44/kg (Figure 1B). Under the assumptions of Galvão et al. (2013), the highest 21-day-cycle pregnancy rate was when cows were subjected to program 10 (Figure 1A), timed AI

for first AI with 95% compliance of treatments followed by detection of estrus at 60% with 95% accuracy. This same program resulted in the shortest median days to pregnancy (113; Figure 1B), and the greatest profit per cow/year with both milk price scenarios, $0.33/kg of milk (profit of $375/cow) or $0.44/kg of milk (profit of $1,616/cow). Therefore, a timed AI program with good compliance combined with ED with good accuracy results in the greatest reproductive performance and profitability.

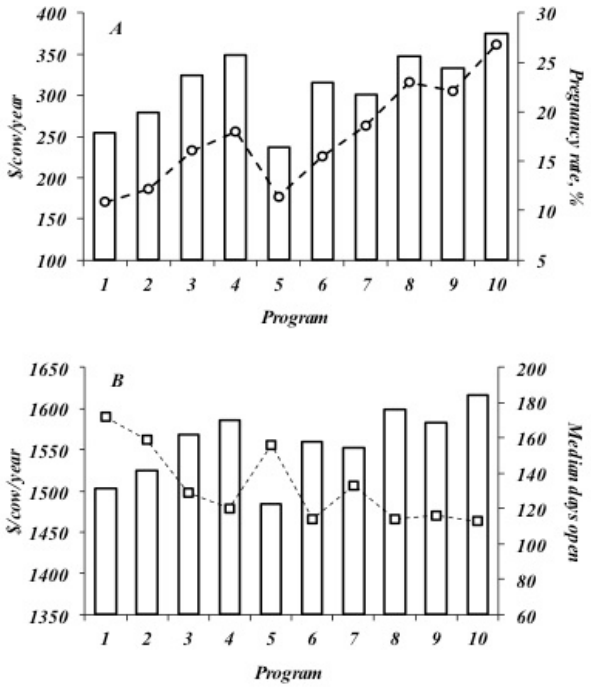

Figure 1. Profits per cow per year ($/cow/year) of cows subjected to one of the 10 proposed breeding programs. Bars represent the profit per cow per year according to each reproductive program calculated using milk price at $0.33/kg (panel A) or $0.44/kg (panel B). Dashed lines represent either the 21-day cycle pregnancy rate (panel A) or median days open (panel B).
Credits: Adapted from Galvão et al. (2013)

Conclusion

In general, incorporating timed AI for first AI followed by an aggressive and accurate estrous detection program to reinseminate cows that spontaneously return to estrus, concurrent with routine non-pregnancy diagnosis and resynchronization of non-pregnant cows, will improve pregnancy rate, reduce days open, and increase profit per cow.

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