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Economic performance of lactating dairy cows submitted for first service timed artificial insemination after a voluntary waiting period of 60 or 88 days

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ABSTRACT

The objective of this study was to evaluate the economic performance of dairy cows managed with a voluntary waiting period (VWP) of 60 or 88 d. A secondary objective was estimating variation in cash flow under different input pricing scenarios through stochastic Monte Carlo simulations. Lactating Holstein cows from 3 commercial farms were blocked by parity group and total milk yield in their previous lactation and then randomly assigned to a VWP of 60 (VWP60; n = 1,352) or 88 d (VWP88; n = 1,359). All cows received timed-artificial insemination (TAI) for first service after synchronization of ovulation with the Double-Ovsynch protocol. For second and greater services, cows received artificial insemination (AI) after detection of estrus or the Ovsynch protocol initiated 32 ± 3 d after AI. Two analyses were performed: (1) cash flow per cow for the calving interval of the experimental lactation and (2) cash flow per slot occupied by each cow enrolled in the experiment for an 18-mo period after calving in the experimental lactation. Extending the VWP from 60 to 88 d delayed time to pregnancy during lactation (~20 d) and increased the risk of leaving the herd for multiparous cows (hazard ratio = 1.21). As a result, a smaller proportion of multiparous cows calved again and had a subsequent lactation (−6%). The shift in time to pregnancy combined with the herd exit dynamics resulted in longer lactation length for primiparous (22 d) but not multiparous cows. Longer lactations led to greater milk income over feed cost and a tendency for greater cash flow during the experimental lactation for primiparous but not multiparous cows in the VWP88 group. On the other hand, profitability per slot for the 18-mo period was numerically greater ($68 slot/18 mo) for primiparous cows but numerically reduced (−$85 slot/18 mo) for multiparous cows in the VWP88 treatment. For primiparous cows most of the difference in cash flow was explained by replacement cost, whereas for multiparous cows it was mostly explained by differences in replacement cost and income over feed cost. Under variable input pricing conditions generated through stochastic simulations, the longer VWP treatment always increased cash flow per 18 mo for primiparous and reduced cash flow for multiparous cows. In conclusion, extending the duration of the VWP from 60 to 88 d numerically increased profitability of primiparous cows and reduced profitability of multiparous cows. Such an effect depended mostly on the herd replacement dynamics and milk production efficiency.
Key words: voluntary waiting period, profitability, dairy cow, timed AI

INTRODUCTION

Achieving pregnancy for lactating dairy cows at a range of DIM that optimizes profitability for most cows depends upon the duration of the voluntary waiting period (**VWP**) and reducing the number and variation of days to conception after cows become eligible for pregnancy. Through the implementation of reproductive management programs and technologies that better control AI submission rates and substantially increase pregnancies per AI (**P/AI**) for first and subsequent AI services (Stevenson and Britt, 2017), it is possible to attain a pregnancy risk after the end of VWP that drastically reduces time to pregnancy. Thus, coupling an effective management program with a duration of the VWP that optimizes time to pregnancy during lactation may be a feasible strategy to increase dairy herd profitability.

In spite of the relevance of the VWP duration on timing of pregnancy and dairy cow profitability, limited data are available about the effect of manipulating the duration of the VWP on dairy herd performance. In addition, data available from the few experiments conducted have been inconsistent. For instance, Arbel et al. (2001), using only high-producing cows under Israeli conditions, reported an economic advantage after extending the VWP from 90 to 150 DIM for

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primiparous and from 60 to 120 DIM for multiparous cows. Conversely, Gobikrushanth et al. (2014), using a combination of retrospective data analysis and simulation, reported that extending the duration of VWP from 60 (range = 57–63 DIM) to 83 DIM (range = 64 to 121 DIM) during summer in Florida did not affect cow profitability during the experimental lactation, the subsequent lactation, or during a period of 6 yr. Furthermore, a simulation study conducted to represent dairy farms under conditions of milk production quota in the Netherlands suggested that a VWP of 6 wk was optimal and that economic losses increased gradually after extending the VWP beyond 6 wk (Inchaisri et al., 2011). These inconsistent results may be explained by differences in study design (e.g., simulation, observational study, or randomized-control experiment), inclusion criteria (e.g., only high-yielding cows that did not calve during summer, only cows that calved during summer), or other study-specific conditions (e.g., farm location, quota systems). Collectively, the lack of sufficient experimental data or variation in experimental design and results from previous research do not allow decisive conclusions about the effect of the duration of the VWP on dairy herd profitability.

Thus, the primary objective of our experiment was to compare cash flow for dairy cows managed with a VWP of 60 or 88 d. Productive performance, reproductive performance, and herd exit dynamics data from an experiment that compared a VWP of 60 or 88 d (Stangaferro et al., 2018) were used for our study. We evaluated individual cow cash flow during the calving interval in which the VWP was extended and for a fixed period of time (18 mo) after calving in the experimental calving interval. A secondary objective was estimating variation in cash flow under different input pricing scenarios through stochastic Monte Carlo simulation.

MATERIALS AND METHODS

Farms and Animals

All procedures performed with cows were approved by the Animal Care and Use Committee of Cornell University. Information about farms, animals, and experimental procedures are described in detail in Stangaferro et al. (2018). Briefly, lactating Holstein cows (n = 2,711) from 3 commercial dairy farms (A, B, and C) located in New York State were enrolled in this experiment from March 2014 to March 2015. All cows remained in the experiment for up to 18 mo after their calving date unless they left the herd due to sale or death. Average number of milking cows and 305-d milk yield during the experiment were 1,034 cows and 11,067 kg in farm A, 1,248 cows and 11,065 kg in farm B, and 793 cows and 12,221 kg in farm C. Cows were housed in freestall barns with 4 or 6 rows of stalls covered with either mattresses and sawdust bedding (farms A and B) or deep sand bedding (farms A, B and C). Barns had concrete flooring in the feedline and alleyways, self-locking headgates, and fans and sprinklers in the feedline

Cows in farm A were milked twice daily (approximately every 12 h) until February 2015 and thrice daily thereafter. Cows in farms B and C were milked thrice daily (approximately every 8 h). All farms supplemented cows with recombinant bovine somatotropin (**rbST**; Sometribove zinc, Posilac, Elanco Animal Health, Indianapolis, IN) on a 10- and 11-d schedule until dry off, beginning at 120 (farm A), 110 (farm B), or 65 (farm C) DIM.

Experimental Procedures and Data Collection

The experiment followed a randomized complete block design using parity (primiparous vs. multiparous) as a blocking factor. At 7 ± 3 DIM, cows were blocked by parity and stratified by milk production in the previous lactation (multiparous only), and then randomly assigned to receive first service through timed-artificial insemination (**TAI**) after a VWP of 60 (**VWP60**; n = 1,352) or 88 d (**VWP88**; n = 1,359). The total number of cows enrolled in the experiment were 1,153 in farm A, 920 in farm B, and 638 in farm C.

Synchronization of ovulation for first service was performed with the Double-Ovsynch (**DO**) protocol (GnRH—7 d—$PGF_{2\alpha}$—3 d—GnRH—7 d—GnRH—7 d—$PGF_{2\alpha}$—56 h—GnRH—16 to 20 h—TAI; Souza et al., 2008). Cows were enrolled on a weekly basis (i.e., Fridays on all farms) at 33 ± 3 and 61 ± 3 DIM for the VWP60 and VWP88 treatments, respectively. Thus, cows received TAI at 60 ± 3 and 88 ± 3 DIM in the VWP60 and VWP88 treatments, respectively. For second and greater AI services, cows were inseminated after detection of estrus through visual observation (farms A and C) or a combination of visual observation and physical activity monitoring (farm B) using neck-mounted activity tags (DeLaval Activity Meter System, DeLaval International AB, Tumba, Sweden). Cows failing to conceive to a previous insemination and not reinseminated at a detected estrus 32 ± 3 d after their previous AI were enrolled in the Ovsynch protocol (**D32-Resynch**; GnRH—7 d—$PGF_{2\alpha}$—56 h—GnRH—16 to 20 h—TAI) for resynchronization of ovulation. On farm C, cows without a corpus luteum ≥15 mm in diameter at the time of nonpregnancy diagnosis received the Ovsynch protocol with proges-