J. Dairy Sci. 99:1–11
http://dx.doi.org/10.3168/jds.2015-10559

Effective lactation yield: A measure to compare milk yield between cows with different dry period lengths

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ABSTRACT

To compare milk yields between cows or management strategies, lactations are traditionally standardized to 305-d yields. The 305-d yield, however, gives no insight into the combined effect of additional milk yield before calving, decreased milk yield after calving, and a possible shorter calving interval in the case of a shortened dry period. We aimed to develop a measure that would enable the comparison of milk yield between cows with different dry period (DP) lengths. We assessed the importance of accounting for additional milk yield before calving and for differences in calving interval. The 305-d yield was compared with a 365-d yield, which included additional milk yield in the 60 d before calving. Next, an effective lactation yield was computed, defined as the daily yield from 60 d before calving to 60 d before the next calving, to account for additional milk yield before calving and for differences in calving interval. Test-day records and drying-off dates of 15 commercial farms were used to compute the 305-d, 365-d, and effective lactation yields for individual cows. We analyzed 817 second-parity lactations preceded by no DP, a short DP (20 to 40 d), or a conventional DP (49 to 90 d). Compared with cows with a conventional DP, the 305-d yield of cows with no DP was 7.0 kg of fat- and protein-corrected milk (FPCM) per day lower, and the 305-d yield of cows with a short DP was 2.3 kg of FPCM per day lower. Including additional milk yield before calving in the 365-d yield reduced this difference to 3.4 kg of FPCM per cow per day for cows with no DP and to 0.9 kg of FPCM per cow per day for cows with a short DP. Compared with cows with a conventional DP, median days open were reduced by 25 d for cows with no DP and by 18 d for cows with a short DP. Accounting for these differences in calving interval in the effective lactation yield further decreased yield reductions for cows with no DP or a short DP by 0.3 kg of FPCM per cow per day. At the herd level, estimated 365-d yield losses for cows with no DP or a short DP differed from effective lactation yield losses by 0.4 to −0.8 kg FPCM per cow per day. Accounting for additional milk yield before calving had a major and consistent effect on yield comparisons of cows with different DP lengths. The effect of correcting for calving interval was more variable between farms and will especially be important when calving interval is affected by DP length.
Key words: milk yield, dry period length, productivity, calving interval

INTRODUCTION

Milk yield of cows is an important determinant of the economic and environmental impact of management strategies in dairy farming. Milk yield directly relates to farm revenues (Santschi et al., 2011c), and environmental impacts per kilogram of milk often decrease when milk yield levels increase (Wall et al., 2010; van Middelaar et al., 2014). To compare milk yields between cows, lactations are traditionally standardized to 305-d yields (Ashton, 1956; Patton et al., 2006; Windig et al., 2006).

Recently, shortening the dry period (**DP**) has been suggested as a management strategy to reduce the negative energy balance in early lactation and to increase fertility in dairy cattle (Andersen et al., 2005; van Knegsel et al., 2013). Shortening the DP results in additional milk yield before calving but reduced milk yield after calving (Annen et al., 2004; Santschi et al., 2011a; van Knegsel et al., 2013, 2014). The additional milk yield before calving can be accredited to the choice of DP length. The 305-d yield does not include this additional milk yield, and, therefore, is less suitable for assessing the effect of DP length on milk yield.

Received October 25, 2015.
Accepted December 17, 2015.
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To compare milk yield between cows with different DP lengths, various lactation lengths and summations of milk yield before and after calving have been used (Annen et al., 2004; Santschi et al., 2011a; Steeneveld et al., 2014). Steeneveld et al. (2014), for example, accounted for additional milk yield by adding the milk yield from the 60 d before expected calving to the 305-d yield after calving.

Shortening the DP may also improve fertility (Gümen et al., 2005; Watters et al., 2009; Chen et al., 2015), although not all studies found this (Pezeshki et al., 2007; Santschi et al., 2011b). Improved fertility can partly compensate for milk losses related to a shortened DP if the calving interval is shortened (Inchaisri et al., 2010). To correct for calving interval while accounting for additional milk yield before calving, a measure of milk yield similar to a whole-lactation yield (i.e., milk yield from one calving to the next calving) is required. Santschi et al. (2011a) combined additional milk yield before calving and the lactation yield after calving in an expression of kilograms of milk per cow per year. However, because this measure included milk yield until drying off, it could lead to double counting of the additional milk yield if multiple consecutive lactations are assessed.

The first aim of this study was to develop a measure that would enable comparison of milk yields between cows with different DP lengths. The second aim was to assess the importance of accounting for additional milk yield before calving and for differences in calving interval when evaluating the effect of DP length on milk yield.

MATERIALS AND METHODS

Definition of Yield Measures

Three measures of milk yield were compared in this study: conventional 305-d yield, a 365-d yield, and an effective lactation yield. First, the conventional 305-d yield sums milk yield from calving to 305 DIM. Second, as an equivalent of the conventional 305-d yield that accounts for additional milk yield before calving, a 365-d yield was defined as the sum of the milk yield in the 60 d before calving and the 305-d yield after calving. We assumed that the conventional DP lasts 60 d (Bachman and Schairer, 2003). Milk produced from 60 d before calving until calving was therefore considered additional milk due to the decision to shorten the DP. Third, effective lactation yield was defined as milk yield from 60 d before calving to 60 d before the next calving, to adjust milk yield for length of calving interval. The effective lactation thus corresponds to the period from one dry period decision to the next dry period decision, as opposed to the period from calving to next calving. Milk yield in the last 60 d before next calving was considered attributable to the next dry period decision and was therefore excluded from the present effective lactation. Like the conventional whole-lactation yield, the duration of the effective lactation is equal to the calving interval. To facilitate comparison, all 3 measures of milk yield were standardized to kilograms of fat- and protein-corrected milk (**FPCM**) per day.

Application of Yield Measures

In total, 15 commercial Dutch farms that apply or recently applied a short DP or no DP provided their test-day milk records and drying off dates. Half of the farms (A, B, C, D, E, G, and H) applied one DP strategy at a time for all cows, whereas the other half (F, I, J, K, L, M, N, and O) selected cows with high yields and low SCC in late lactation for short or no (mainly farms F and I) DP. The farms differed in herd size, milk yield level, housing system, milking frequency, and diets. Diets mainly comprised grass, grass silage, and maize silage supplemented with concentrates. In total, 10 of 15 farmers applied no DP and 14 applied a short DP during the period of analysis. Table 1 shows the number of cows included in the analysis, median calving intervals, and first-lactation 305-d yields per farm.

Test-day milk records were recorded every 4 to 6 wk from January 2007 to September 2014 by the Dutch national milk recording organization (CRV, Arnhem, the Netherlands). These milk records were combined with drying-off records to compute lactation lengths and DP lengths. To clearly illustrate the effect of different measures of milk yield, strict selection criteria were applied to the data set. In short, lactations with implausible drying-off dates were excluded, and only second-parity lactations preceded by specific DP lengths and with regular milk records were included in the analysis. The final data set included 817 cows with 17,333 milk records on their complete first and second lactations.

Drying-Off Records. Drying-off records were combined with lactation data based on cow identity, parity, and calving date. These combinations were validated as follows. If milk records occurred after the date of drying-off, the date was assumed incorrect and the lactation was excluded. If no drying-off date was present and the farmer stated that he or she did not practice continuous milking, the drying-off date was considered missing and the lactation excluded. If continuous milking until parturition occasionally occurred, continuous milking was assumed if there was no drying-off date and no milk records were missing at the end of the