55th Annual Meeting of the European Association
for Animal Production
Bled (Slovenia), 05 - 09 September 2004

M4.1

Milk yield of cows and Bovine Viral Diarrhoea Virus (BVDV) infection in 7,252 dairy herds in Bretagne (western France)

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Abstract

Few studies have investigated the possible differences in milk yield associated with BVDV-infection in commercial dairy herds. This study aimed at quantifying the reduction in test-day milk yield (TDMY) of dairy cows according to BVDV-infection status of their herd. Five BVDV-infection statuses were defined, based on levels of BVDV-antibodies measured in bulk tank milk twice four months apart (BVDV-status definition-period): presumed (1) not-infected for a long time, (2) not recently-infected, (3) past-infected recently-recovered, (4) past-but-still-infected, (5) recently-infected. A total of 982,745 test-days in 7,252 herds located in Bretagne were considered. The effect on TDMY of the BVDV-status, adjusted for herd (random), lactation number and days in milk was assessed using a mixed linear model. The BVDV-status was significantly associated with TDMY. Considering test-days within the BVDV-status definition-period, the reduction in milk yield was 0.41 ($P<0.001$), 0.58 ($P<0.001$) and 0.02 ($P=0.97$) kg/day for cows in past-infected recently-recovered, past-but-still-infected and recently-infected herds respectively, compared with cows in not recently-infected herds. A carry-over effect (at least 1 year) of BVDV-infection on TDMY was also evidenced in past-infected recently-recovered, past-but-still-infected and recently-infected herds, possibly in relation to the increased incidence of health disorders (e.g. intramammary infections) due to the BVDV-immunodepressive effect.

Keywords: Dairy Cows, Milk yield, Bovine Viral Diarrhoea Virus

1. Introduction

In order to assess *ex-ante* the profitability of control schemes for BVDV-infection, quantitative information on its production effects are needed. Production effects in case herds with acute infection were described, but very few studies investigated the possible difference in milk yield associated with BVDV-infection in commercial dairy herds with different BVDV status.

For a cow with a post-natal infection, the question is raised on both the magnitude and the duration of the possible drop in milk yield associated with BVDV-infection. A decrease in average annual milk yield per cow of about 100 kg was reported in herds experiencing a BVDV-circulation (Lindberg and Emanuelson, 1997; Valle, 2000). These estimates were assessed at herd level on a yearly basis (based on level of BVDV-specific-antibodies in bulk tank milk measured at twelve-months intervals), whereas the viral circulation may be limited in time at the herd level.

This study aimed at quantifying the reduction in individual test-day milk yield (TDMY) of cows according to BVDV-infection status of their herd in French farming conditions, focussing on both the magnitude and the duration of this effect.

2. Materials and methods

2.1. Herds and animals

Data came from all the Holstein herds located in Brittany (Western France) and enrolled in the Milk Recording Scheme on December 31, 2001 (14,653 herds). These herds participated in a periodic (4-months apart) testing to measure the level of BVDV-specific-antibodies in bulk tank milk. For each herd, information on milk production performance of lactating cows was recorded. Data were first validated and events that were considered not biologically plausible were excluded.

2.2. BVDV-infection herd-status

Herd-statuses concerning BVDV-infection were defined based on the level of BVDV-specific-antibodies in bulk tank milk, which was previously found to be closely related to the within-herd proportion of antibody-positive lactating cows (Niskanen et al., 1993 ; Beaudeau et al., 2001a). This level was measured using the LSI BVD/BD NS2-3 blocking ELISA test (Laboratoire Service International (LSI), Lissieu, France) and expressed as a standardised percentage inhibition (SPI) (in standard deviation units). This ELISA test has been previously evaluated at both the herd and animal levels (Beaudeau et al., 2001a ; b). Based on the dynamic of four consecutive SPI results obtained in a given herd (which were randomly selected among the five obtained at a 4-month interval from June 2000 to October 2001), five BVDV-infection-herd-statuses were determined (Robert et al., 2004) based on the SPI thresholds derived from Beaudeau et al. (2001a). Herds with a steady low within-herd proportion of antibody-positive lactating cows have shown to have their four SPIs < - 0.55; then they were classified as Steady-Low (SL). Among these herds, those with their four SPIs < - 1.25 were classified as Steady-Very-Low (SVL). In contrast, herds with a steady high within-herd proportion of antibody-positive lactating cows have shown to have their four SPIs > + 0.55; then they were classified as Steady-High (SH). Among these herds, those with their four SPIs > + 1.25 were classified as Steady-Very-High (SVH). Finally, herds with an increase in their within-herd proportion of antibody-positive lactating cows have shown to have an increased SPI; then they were classified as Recently-Increasing (RI) and they have shown to have their two first SPIs < - 0.55, their fourth one > + 0.55 and either their third > + 0.1 or delta > + 1.25 (delta being the difference between the third and the second SPI results). Other herd situations were not taken into account. Herds in the SL status were presumed not-recently-infected and those in the SVL status were presumed non-infected at least for a long time. Those in the SH status were presumed past-infected-recently-recovered. Those of the SVH status were presumed past-steadily-infected. Finally, those of the RI status were presumed recently-infected.

2.3. Modelling

The effect on TDMY of the BVDV-infection herd-status was assessed using a mixed linear model (MIXED procedure, Littell et al., 1996; SAS Inst. Inc., 1996), after adjustment for herd (random), lactation number and days in milk on test day. The BVDV-infection-herd-status taken as reference was NRI.

Strategy of analysis included two steps. First, the effect was quantified considering test-days within the BVDV-status definition-period [Period A] (either October 2000 to February 2001 or February to June 2001). In a second stage, a possible carry-over effect of BVDV-infection was investigated considering all test-days occurring from either October 2000 to February 2002 or from February 2001 to June 2002 (that is within the BVDV-status definition-period plus one year) [period B].

3. Results

A total of 982,745 and 3,758,837 test-days in 7,252 herds located in Bretagne were considered for analysis in periods A and B respectively.

The number and percentage of herds and median SPI results in each herd-status are shown in Table 1.

The BVDV-status was significantly associated with TDMY (Table 2). Considering test-days within the BVDV-status definition-period, the reduction in milk yield was 0.41 (P<0.001), 0.58 (P<0.001) and 0.02 (NS) kg/day for cows in SH, SVH and RI herds respectively, compared with cows in NRI herds. A carry-over effect (of at least one year) of BVDV-infection on TDMY was also evidenced in SH, SVH and RI herds (Table 2).

Table 1. Number and percentage of herds and median results of standardised percentage inhibition in bulk tank milk of herds according to BVDV-infection-herd-status (122,697 cows in 6,149 dairy herds; 2000-2001)

BVDV-infection-herd-status	Herd		Standardised percentage inhibition (median in standard units)			
	n	%	First result	Second result	Third result	Fourth result
SVL [a]	574	7.92	-1.58	-1.52	-1.55	-1.61
SL	2,727	37.60	-1.17	-1.20	-1.21	-1.22
SH	3,608	49.75	1.11	1.11	1.08	1.04
SVH	246	3.39	1.48	1.48	1.43	1.39
RI	97	1.34	-1.17	-1.17	0.73	0.97

[a] SVL: Steady-Very-Low; SL: Steady-Low; SH: Steady-High; SVH: Steady-Very-High; RI: Recently-Increasing

Table 2. Average milk yield, adjusted loss (and confidence interval) within either period A [a] or period B [a] according to BVDV-infection-herd-status (7,252 dairy herds; 2000-2001)

BVDV-infection-herd-status	[Period A]			[Period B]		
	AMY[c]	Loss[d]	95 CI[e]	AMY	Loss	95 CI
SVL [b]	24.1	-0.11	-0.44 - 0.22	24.1	-0.16	-0.47 - 0.14
SL	23.8	0	-	23.9	0	-
SH	23.5	0.41	0.22 - 0.59	23.5	0.43	0.26 - 0.60
SVH	23.3	0.58	0.09 - 1.06	23.4	0.58	0.14 - 1.02
RI	24.0	0.02	-0.74 - 0.77	23.5	0.30	-0.38 - 0.99

[a] period A: BVDV-status definition-period; period B: BVDV-status definition-period plus one year.
[b] SVL: Steady-Very-Low; SL: Steady-Low; SH: Steady-High; SVH: Steady-Very-High; RI: Recently-Increasing
[c] average milk yield (crude data in kg/d)
[d] reduction in milk yield (in kg/d)
[e] 95 % Confidence Interval

4. Discussion

Milk yield was not significantly different for cows in herds presumed non-infected for a long time (SVL status) and in those presumed not-recently-infected (SL status). This suggests *a posteriori* the

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absence of any recent viral circulation in herds classified in the SL status. Therefore this status was an adequate reference to investigate the effect associated with a recent or ongoing BVDV-infection.

In the present study, cows from herds presumed past-infected-recently recovered and past-steadily-infected (SH and SVH status) had a significantly reduced milk yield within the BVDV-status definition-period and in the year next to that period, in comparison to those in herds not-recently-infected (SL status here). A postponed effect of BVDV-infection on TDMY was also evidenced in herds experiencing a current BVDV-infection (having a RI status). These results were consistent (in magnitude and duration) with findings by Lindberg and Emanuelson (1997) and Valle (2000) who reported a decrease in average annual milk yield per cow in the current year or in the one next to the detection of BVDV-infection.

This suggests that BVDV-infection had a long-term impact on milk yield. The effect of BVDV-infection on milk yield could be mostly indirect, probably in relation to an increased susceptibility to infectious health disorders (e.g. intramammary infections, e.g. Niskanen et al., 1995; Lindberg and Emanuelson, 1997), due to the known BVDV-immunodepressive effect (Potgieter, 1988).

The putative mediating role of intramammary infections (measured by milk somatic cell counts) in the relationship between BVDV-infection and milk yield needs further investigations.

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