J. Dairy Sci. 99:1–10
http://dx.doi.org/10.3168/jds.2015-9809

Incidence rate of pathogen-specific clinical mastitis on conventional and organic Canadian dairy farms

L. J. Levison,* E. K. Miller-Cushon,† A. L. Tucker,* R. Bergeron,‡ K. E. Leslie,§ H. W. Barkema,# and T. J. DeVries*[1]
*Department of Animal and Biosciences, University of Guelph, Guelph, ON, N1G 2W1, Canada
†Department of Animal Sciences, University of Florida, Gainesville 32611
‡Department of Animal and Biosciences, University of Guelph, Alfred, ON, K0B 1A0, Canada
§Department of Population Medicine, University of Guelph, Guelph, ON, N1G 2W1, Canada
#Department of Production Animal Health, Faculty of Veterinary Medicine, University of Calgary, Calgary, Alberta T2N 4N1, Canada

ABSTRACT

Mastitis is a common and costly production disease on dairy farms. In Canada, the incidence rate of clinical mastitis (IRCM) has been determined for conventionally managed dairy farms; however, no studies to date have assessed rates in organically managed systems. The objectives of this observational study were (1) to determine the producer-reported IRCM and predominant pathogen types on conventional and organic dairy farms in Southern Ontario, Canada, and (2) to evaluate the association of both mean overall IRCM and pathogen-specific IRCM with management system, housing type, and pasture access. Data from 59 dairy farms in Southern Ontario, Canada, distributed across conventional (n = 41) and organic management (n = 18) systems, were collected from April 2011 to May 2012. In addition to management system, farms were categorized by housing method (loose or tie-stall) and pasture access for lactating cows. Participating producers identified and collected samples from 936 cases of clinical mastitis. The most frequently isolated mastitis pathogens were coagulase-negative staphylococci, *Bacillus* spp., *Streptococcus* spp., *Staphylococcus aureus*, and *Escherichia coli*. The IRCM was higher on conventional farms than organic (23.7 vs. 13.2 cases per 100 cow-years) and was not associated with housing type (loose or tie-stall), pasture access, or herd-average milk yield. Bulk tank somatic cell count tended to be lower on conventional farms than organic (222,000 vs. 272,000 cells/mL). Pathogen-specific IRCM attributed to *Staph. aureus*, *Bacillus* spp., and *E. coli* was greater on conventional than organic farms, but was not associated with housing or any other factors. In conclusion, organic management was associated with reduced overall and pathogen-specific IRCM.

Key words: clinical mastitis, dairy cow, organic, pathogens

INTRODUCTION

Mastitis is the most common and costly production disease on dairy farms worldwide (Reyher et al., 2011), resulting in production losses (Auldist and Hubble, 1998), decreased milk quality (Barbano et al., 2006), and a negative effect on cow welfare by inciting pain, especially during episodes of severe clinical mastitis (Kemp et al., 2008; Siivonen et al., 2011; Leslie and Petersson-Wolfe, 2012). Whereas mastitis control can be difficult regardless of system type (organic or conventional) under which the farm is managed (Marley et al., 2010), mastitis management in organic herds poses a particular challenge because of the restrictions on antibiotic use (Marley et al., 2010). Producers must alter treatment strategies from conventional industry norms to comply with organic regulations (Ruegg, 2009). Further, low veterinary medicine inputs are important aims in organic livestock farming (Ivemeyer et al., 2011).

Some concerns have been expressed particularly regarding the welfare of cattle in organic systems (Vaarst et al., 2001) due to the restricted use of antibiotics and possible delay in treatment (Hovi et al., 2003; Marley et al., 2010). Recent studies have compared udder health and milk quality on organic and conventional herds in different regions. Studies conducted in the United States have reported that organic dairy herds have reduced incidence rate of clinical mastitis (**IRCM**; Richert et al., 2013), whereas the incidence rate of subclinical mastitis has been reported to be similar between organic and conventional farms (Mullen et al., 2013). Most studies have reported no consistent difference in the bulk tank SCC (**BTSCC**) of milk from organic and conventional farms (Fall et al., 2008; Cicconi-Hogan et al., 2013a; Stiglbauer at al., 2013), but some reports were found of higher SCC on organic farms (Nauta et al., 2006; Roesch et al., 2007). Whereas several recent studies

Received May 12, 2015.
Accepted October 14, 2015.
[1]Corresponding author: tdevries@uoguelph.ca

have assessed IRCM on conventional and organic herds across regions in the United States (Mullen et al., 2013; Richert et al., 2013), studies on clinical mastitis rates and pathogens in Canadian dairies have not specifically included certified organic farms (Sargeant et al., 1998; McLaren et al., 2006; Olde Riekerink et al., 2008). The reported IRCM has been similar across conventional farms in Canadian studies, with reports of a 20 to 22% lactational incidence risk (Sargeant et al., 1998; McLaren et al., 2006) or 23 to 26 cases per 100 cow-years at risk (Olde Riekerink et al., 2008; Thompson-Crispi et al., 2013).

Standards for organic farming differ widely between different countries, and it is unclear whether comparative studies conducted in other regions are reflective of management-specific differences in Canada (Barkema et al., 2015). Comparing udder health between different management systems is further complicated by the variety of on-farm factors that also influence IRCM, including herd size (Hill et al., 2009), as well as cow cleanliness and housing style. For instance, herds housed in tie-stalls have been found to have higher IRCM than freestall-housed herds (Olde Riekerink et al., 2008; Richert et al., 2013). The risk of clinical mastitis also relates to pasture access, decreasing when cows have pasture access at night (Barkema et al., 1999) and with a specific rotation pattern of pasture use during the dry period (Green et al., 2007). High levels of milk production are also positively associated with IRCM (Barkema et al., 1999); rations that are higher in forage and lower in concentrate may result in lower milk production, as has been observed in organic farms (Sato et al., 2005; Hamilton et al., 2006). It is important to understand the effect of management strategies on herd IRCM in both conventional and organic herds, and it is likely that these factors will differ by region.

The objectives of this study were to determine the producer-reported overall and pathogen-specific IRCM on conventional and organic dairies in Southern Ontario, Canada, and to investigate the associations between IRCM and herd-level factors including management system, housing style, pasture access, BTSCC, and milk yield.

MATERIALS AND METHODS

Herd Selection

Mail-outs through CanWest DHI (Guelph, ON, Canada) were sent to 505 producers (both conventional and organic) in Southern Ontario. Focused mail-outs were also sent to 47 organic producers in the same region (some of these organic producers targeted by focused mail-outs may have also received mail-outs through CanWest DHI). An initial questionnaire in the mail-out was used to identify interested producers. The initial response rate was 19%, and after willingness and eligibility to participate were confirmed, 59 herds were selected for participation.

Sample size (target of 60 herds) was determined through power analysis using the Power Analysis and Sample Size software program (PASS, Kaysville, UT; Hintze, 2008). The estimate of variation for the primary response variable, IRCM, was based on that previously reported (Olde Riekerink et al., 2008). An estimated sample size of 60 herds, with 20 organic and 40 conventional (split between those with and without pasture access), was determined to be sufficient to detect a difference of 30% in IRCM. All willing organic producers were enrolled (18 organic farms) and conventional farms were selected with an attempt to distribute farms between similar herd size strata compared with organic farms ($<$49 cows, 50–79 cows, $\geq$80 cows). Upon enrollment, other herd characteristics were recorded, including housing (loose housing or tie-stall) and pasture access (Table 1). Pasture access was considered present when lactating cows had regular access (as reported by the producer; usually daily) to a grass-based field with the opportunity to graze when seasonally appropriate (in spring and summer months). Freestall and bedded pack barns were grouped together into the category of loose housing. All participating conventional herds consisted predominantly of Holstein-Friesian cows; occasionally a small number of other breeds (e.g., Jersey, Ayrshire) were present in these herds. Organic herds had greater breed variability of milking cows. One organic farm milked strictly Brown Swiss, and another Jersey cattle. The other 16 organic herds were composed of primarily Holstein-Friesian cows, with a mixture of other breeds included (e.g., Ayrshire, Brown Swiss, Jersey, Montbéliarde) or crossbred animals. Herds participated in the study between March 2011 and May 2012. All herds remained enrolled for the entire study duration.

Sampling

Participating producers were asked to aseptically collect milk samples from every quarter demonstrating signs of clinical mastitis, before treatment was given. Clinical mastitis was defined to the producers as any change to the normal appearance of milk, which could include flakes, clots, blood, or a watery consistency (Olde Riekerink et al., 2008); however, protocol for inspecting abnormal milk (e.g., use of fore-stripping) was not dictated to producers. Sample collection techniques were discussed and demonstrated with each producer during an initial farm visit conducted by study personnel (the same person visited each farm), and a written