

A Longitudinal Study of Mastitis on an Experimental Farm with Two Herds, One Managed Organically, the other Conventionally

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Abstract

Mastitis in two herds managed as a comparison between organic and conventional dairy farming systems was monitored for 4 years utilising regular bacterial culture of milk samples, individual and bulk somatic cell counts and observation by farm staff. The objective was to develop strategies for the control of mastitis in organic cows without the use of antibiotics. The herds showed differences in clinical mastitis incidence, subclinical mastitis prevalence and bulk milk somatic cell count. Despite these differences, the level of mastitis in the organic herd remained manageable.

Introduction

In 2001, Massey University set up its Dairy Cattle Research Unit (DCRU) as a system comparison between organic and conventional farming. It is the only comparative grassland-based open grazing dairy study in the world. The farm is a seasonal producer with calving from late July until mid October. All cows are dried off by the end of May, the exact date depending largely on pasture availability.

The DCRU was split into two similar units. The organic unit covers an area of 20.4Ha and the conventional 21.3Ha, carrying typically 46 organic cows (2.27cows/Ha) and 51 conventional (2.39cows/Ha), respectively. In 2003, the organic unit achieved its full AgriQuality (New Zealand) organic certification. From August 2006, all organic dairy suppliers to Fonterra NZ Ltd were required to meet the standards set by the USDA National Organics Program. Each of the two units is managed individually according to "best practice" for its particular type of management system and environmental conditions. Thus, no attempt is made to replicate on one farm what is done on the other. The project has been described in detail by Kelly *et al.* (2006).

Mastitis control for the conventional herd is based on the Seasonal Approach to Managing Mastitis (SAMM) Plan, a nationwide scheme administered by the National Mastitis Advisory Committee. Control in the organic herd is based on the same principles excluding (since 2005) the use of antibiotics. An iodine-based teat spray is used on both herds post milking. Treatment of clinical (CM) and sub-clinical mastitis (SCM) in the organic herd generally relies on homeopathy along with supportive therapy. Financial penalties apply to bulk milk submitted with a somatic cell count (SCC) exceeding 400,000 cells per mL. The predominant major mastitis pathogen in

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New Zealand is *Streptococcus uberis* followed by *Staphylococcus aureus*. The most commonly isolated minor pathogen is Coagulase Negative *Staphylococcus* (CNS) (McDougall, 1998). Incidence of CM and prevalence of SCM are important prerequisites to estimating the cost of mastitis to the dairy industry (Petrovski *et al.*, 2006). This study presents the incidence of CM, prevalence of SCM, and describes the bulk milk somatic cell count (BMSCC) from both herds involved in the system comparison.

Materials and methods

In November 2003, a sampling regime began whereby milk from each cow in both herds was submitted for bacterial culture. Sampling occurred 4 times per season; at calving, 14 days after calving, at mid lactation and at drying off. Culture and classification of organisms was initially carried out by a post-graduate student (Silva *et al.*, 2005) and subsequently by New Zealand Veterinary Pathology Ltd (NZVP). Additional data was gathered from monthly individual somatic cell counts (ISCC) carried out by the Livestock Improvement Corporation as part of routine herd testing and daily BMSCC provided by Fonterra. Episodes of CM were recorded by DCRU staff.

Results

Clinical mastitis

Of the total 402 cow-lactational seasons included in the study, 61 (15.2%) had at least one episode of mastitis. The incidence of CM varied significantly between herds, from 14.2 cases/100 cow-lactational seasons in the organic herd to 16.9 cases/100 cow-lactational seasons ($p < 0.001$) in the conventional. In 34 of the cases (27.2%), more than one quarter was affected at the same time. There were 19 (33.3%) cases with multiple quarters in the organic herd and 15 (22.1%) cases with multiple quarters in the conventional herd.

Each affected organic cow averaged 1.5 quarters diagnosed with CM per episode and for each front quarter, 2.2 rear quarters were affected. Each conventional cow with CM averaged 1.4 quarters per episode and for each front quarter there were 1.8 rear quarters affected.

Subclinical mastitis

Milk samples were collected from a total of 5004 quarters – 2365 from the organic and 2639 from the conventional herd. 69.9% of organic quarter samples did not grow causative organisms. The most frequently isolated organisms were *S. aureus* (41.8% of all isolates), CNS (29.8%), and *S. uberis* (11.1%). 74.2% of conventional quarter samples did not grow causative organisms. The most frequently isolated organism were CNS (39.5% of the isolates), *S. aureus* (26.6%) and *S. uberis* (12.3%). A total of 1392 (27.8%) quarters were affected by subclinical mastitis, based on culture results, in 1251 tests of 391 cow-lactation seasons. For each front quarter there were 1.2 rear quarters affected by SCM with 1.3 and 1.1 rear quarters affected in the organic and conventional herds, respectively. The differences in the incidence of isolation of *S. aureus* or *S. uberis* between herds and quarters were significant, whilst differences of *S. uberis* isolation between different quarters were non-significant throughout the study period. Differences between the two systems for *S. uberis* isolation were also generally non-significant whereas differences for *S. aureus* during the first three seasons were generally highly significant (Figure 1).

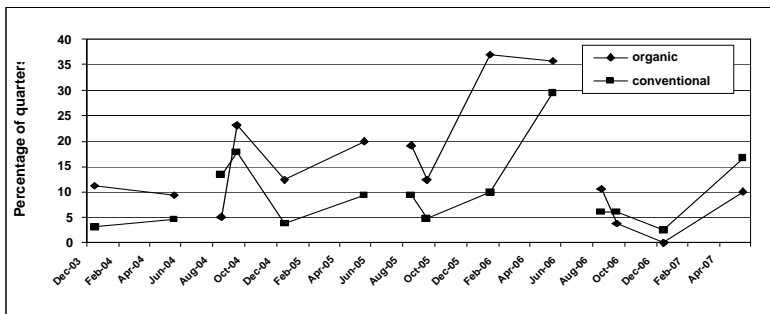


Figure 1: Proportion of *S. aureus* isolates among herds over 4 seasons

BMSCC data are presented in Figure 2. While the conventional herd demonstrated typical U-shaped curves each season, the organic herd demonstrated irregularities in the curve shape and generally higher values. Most of the daily collections had significantly different BMSCC.

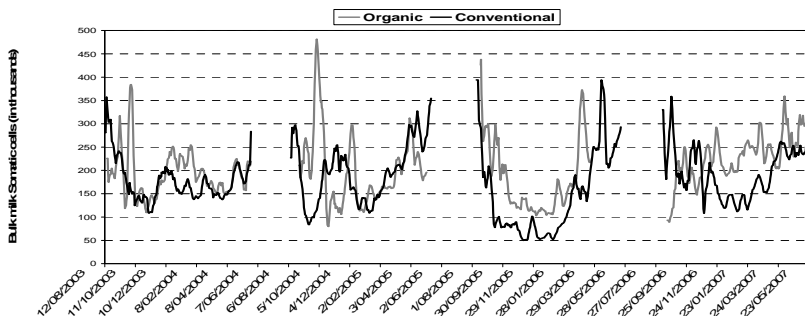


Figure 2. 10-day rolling average of BMSCC unadjusted for milk volume

A large proportion of the somatic cells appearing in the bulk tank originate from a relatively small proportion of cows (Table 1).

Tab. 1: Percentage of cows with ISCC >400,000 cells/mL two or more times per season

Season	2003/2004	2004/2005	2005/2006	2006/2007
Organic	17	24	17	23
Conventional	20	17	8	15

Discussion

Both herds have exhibited a number of unusual trends throughout the course of the study. The incidence of clinical mastitis is relatively high as is the prevalence of

S. aureus isolated at culture. Although the herds are milked into two separate bulk tanks, the same milking machine is used, the conventional cows being milked immediately after the organic. Thus there is potential for the spread of *S. aureus* from the organic to the conventional herd.

The structural limitations of the soil type mean careful management is required during wet periods and it was initially considered that its poor drainage characteristics may enhance the survival of environmental pathogens. The numbers of *S. uberis* recoverable from the environment of pasture-based systems are related to moisture levels and inversely related to ambient temperature and solar radiation (Lopez-Benavidez *et al.*, 2005). A number of initiatives were undertaken to keep contamination of teats to a minimum during critical times of the year and these appear to have been largely successful. Moreover, throughout the project, the bulk of quarters from which *S. uberis* was recovered at calving were negative at the 14 day test.

Management of BMSCC has tended to focus on the relatively small proportion of chronic SCM cases, identified by ISCC and monitored on a daily basis using the California Mastitis Test. Changes in management procedures targeting the incidence of *S. aureus* in the organic herd were instigated at the start of the 2006/07 season, including oral dosing with apple cider vinegar, an intensive homeopathy programme and improved teat spraying. Although there has been a decline in the incidence of *S. aureus* and CNS recovered from milk samples and in the incidence of CM in the organic herd, BMSCC has remained relatively high.

Conclusions

Control of *S. aureus* is likely to be the most important factor in managing mastitis in a pastoral-based organic herd, while environmental pathogens are easier to control with adequate management of the cow's surroundings. The difficulty in eliminating *S. aureus* once well established in the udder means BMSCC may remain relatively high despite minimal spread of infection between cows.

Acknowledgements

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