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Effects of season and herd milk volume on somatic cell counts of Florida dairy farms

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ABSTRACT

Dairy farms in Florida produce less milk and milk with higher somatic cell counts (SCC) in the hot and humid summer. This has consequences for the interpretation of average milk quality. The objectives were to describe the associations of bulk tank SCC (BTSCC) with time of the year and the milk volume per farm. Monthly BTSCC and milk volume records from 84% (in 2012; n = 1,308) and 77% (in 2013; n = 1,200) of the 130 dairy farms in Florida were used. Data were analyzed separately per year. We calculated arithmetic averages of the BTSCC for each farm (ASCCf), each month (ASCCm), and each year (ASCCy). We used the milk volume to calculate a milk-weighted average for each farm (WSCCf), each month (WSCCm), and each year (WSCCy). Period 1 (P1) was defined as February, March, and April, and period 2 (P2) was defined as August, September, and October. These periods generally had the lowest and highest BTSCC throughout the year, respectively. Seasonality was expressed by the P2/P1 ratios of BTSCC and milk volume in both periods. In 2012 and 2013, 72 and 74% of the monthly milk volume observations were <400,000 cells/mL. A clear seasonal pattern with lower milk volume and higher ASCCm during P2 was observed for most farms. The averages of the P2/P1 ratio of milk volume were 0.68 and 0.74 in 2012 and 2013. The averages of the P2/P1 ratio of SCC were 1.30 and 1.65 for 2012 and 2013, respectively. The WSCCy was 297,000 cells/mL in 2012 and 274,000 cells/mL in 2013. These values were 13 and 16% lower than the ASCCy in the respective years. In 2012, 82% of the farms shipped milk with a lower WSCCf than their ASCCf. In 2013, 97% of the farms shipped milk with a lower WSCCf than their ASCCf. The difference between a farm's WSCCf and its ASCCf tended to be greater in more-seasonal farms for BTSCC and milk volume. The WSCCm was lower than the ASCCm in every calendar month in both years. Collectively, these results show that the SCC of pooled milk from Florida was substantially lower than the arithmetic averages of monthly BTSCC values. Therefore, it should be made clear if the SCC is weighted by milk volume when "average" SCC results are reported. Programs to improve milk quality in Florida might be focused on conditions during August, September, and October because the BTSCC is then markedly increased on many farms.
Key words: Florida, seasonality, milk volume, somatic cell count

INTRODUCTION

Elevated SCC are an indication of intramammary infection. Elevated SCC adversely affect the quality of fluid milk (Ma et al., 2000) and reduce shelf life (Barbano et al., 2006). Increased SCC are associated with lower milk production by cows (Hand et al., 2012). Increasingly, milk prices are dependent on SCC. The SCC is also the main milk quality measure that is regulated throughout the world (van Schaik et al., 2002; Schukken et al., 2003). In the United States, the standard maximum SCC in grade A milk is 750,000 cells/mL (FDA, 2009), but states such as California and Idaho and also individual milk processors have reduced the acceptable SCC limit (USDA-APHIS, 2013). A maximum SCC of 400,000 cells/mL has progressively been adopted as the international export standard in many countries (More, 2009; USDA-AMS, 2011). The maximum acceptable SCC level in the European Union is based on a 3-mo rolling geometric average (More et al., 2013). In the United States, a maximum limit of 400,000 cells/mL has frequently been proposed by several dairy organizations (Norman et al., 2011). Hence, dairy farmers have several incentives to produce milk with lower SCC.

Programs to improve milk quality may depend on how the average SCC is calculated and whether milk volume is considered (Allore et al., 1997). Pighetti et al. (2014) reported an arithmetic average SCC of 388,000 cells/mL for Florida farms in 2012 using bulk tank SCC (**BTSCC**) data from all 130 farms inspected by the Florida Department of Agriculture and Consumer Services. This average SCC was independent of how much

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milk was produced by each farm and in which season. The DHIA reported SCC averages of 267,000 cells/mL (2012; 31 farms) and 229,000 cells/mL (2013; 23 farms) for the Florida dairy farms that participated in DHIA mastitis screening (Norman and Walton, 2014). Federal Milk Marketing Order 6 (**FO6**), which comprises geographically the state of Florida except the most western counties where few dairy farms are located, reported average SCC of 293,000 cells/mL and 264,000 cells/mL in 2012 and 2013, respectively (Atlanta Market Administrator, 2014). These annual FO6 SCC values are the arithmetic averages of the 12 monthly SCC values where each month's SCC is based on producer milk weight and payroll data provided by handlers (Atlanta Market Administrator, 2014).

In many regions, SCC has a seasonal pattern with increases during the summer and decreases during the winter months (Schukken et al., 1992; Olde Riekerink et al., 2007; Archer et al., 2013). Summer heat stress, more cows in later stages of lactation (Green et al., 2006), changes in diets, and mixing of groups (Harmon, 1994) may all be contributing factors. In the United States, the highest percentages of DHIA test-day SCC exceeding the official thresholds are in the summer months (Norman et al., 2013; Norman and Walton, 2014). In the FO6 data, the highest SCC were observed in August (332,000 and 324,000 cells/mL for 2012 and 2013, respectively; Atlanta Market Administrator, 2014). The lowest FO6 SCC value was observed in December 2012 (258,000 cells/mL; 68% of August) and March 2013 (211,000 cells/mL; 65% of August), respectively.

In Florida, milk production also has a seasonal pattern where typically the most milk is produced in March and the least amount of milk is produced in September (USDA-AMS, 2013; USDA-NASS, 2014). Compared with March, the volume of milk produced in September ranged from 69 to 72% for 2010 to 2013. The seasonal pattern in milk volume in Florida is primarily caused by differences in milk per cow because the number of cows throughout the year is fairly constant (USDA-NASS, 2014). Cows produce less milk during the summer because in Florida most of the calvings occur in the fall and winter (DeLorenzo et al., 1992; De Vries et al., 2005), which results in more cows in the lower producing stage of their lactation in the summer. In addition, summer heat stress reduces milk production directly (St-Pierre et al., 2003; West, 2003) and affects most herds in Florida.

Average SCC and the seasonality of SCC and milk production in Florida have recently been documented by several authors (Norman et al., 2013; Norman and Walton, 2014; Pighetti et al., 2014). The relationships between farm milk volume, seasonality of milk production, and BTSCC have not been documented for Florida, however. The pooled SCC of all milk produced in Florida during a year is likely lower than the arithmetic average of monthly BTSCC values reported for each farm. The reputation of the state's milk quality may depend on how the state average SCC is calculated and presented.

The objectives of the present study were to describe the association of BTSCC in Florida milk with time of the year and the volume of milk shipped per farm. One hypothesis was that dairy farms that shipped more milk had a lower BTSCC. A second hypothesis was that dairy farms that had a greater seasonality in milk volume also had a greater seasonality in BTSCC. Consequently, more-seasonal farms in their BTSCC and milk volume are likely to have greater differences between the arithmetic average BTSCC and the pooled BTSCC weighted by milk volume.

MATERIALS AND METHODS

Data Set

Monthly total volumes of milk shipped and monthly average BTSCC were provided for 122 and 106 of the 130 Florida dairy farms in 2012 and 2013 by the 2 largest milk buyers in Florida. Both milk buyers were cooperatives. Complete records for both BTSCC and milk volume for 12 consecutive months were available for 109 (84%) and 100 (77%) farms in 2012 and 2013, respectively. The remaining farms had between 1 and 11 records per year because these farms either went out of business or changed milk buyers during the year. We used only data from the farms with all 12 observations (both milk volume and average BTSCC), for a total of 2,508 complete records, to avoid potential biases.

The monthly BTSCC value for a farm was the arithmetic average of all SCC measurements taken by the milk buyers in the milk shipments in that month. In most cases, each milk shipment was a full truck with milk from a single farm. In other cases, a truck was only partially filled and the BTSCC measurements were made on variable amounts of milk shipped. The monthly BTSCC value for a farm was therefore not weighted by the volumes of milk that were shipped in that month. The BTSCC values that we received were presented in thousands cells per milliliter. Data on individual milk shipments were not available.

BTSCC Categories

Five different BTSCC thresholds were set to describe the changes in BTSCC frequencies throughout the year. The first limit of 200,000 cells/mL is sometimes