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ORIGINAL PAPER

Record keeping, genetic selection, educational experience and farm management effects on average milk yield per cow, milk fat percentage, bacterial score and bulk tank somatic cell count of dairy farms in the Central region of Thailand

J. A. Rhone · S. Koonawootrittriron · M. A. Elzo

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Abstract A study was conducted to estimate the record keeping, genetic selection, educational, and farm management effects on average milk yield per cow (AYC), milk fat percentage, bacterial score, and bulk tank somatic cell count (BTSCC) of dairy farms in the central region of Thailand. Farms were located in the provinces of Saraburi and Nakhon Ratchisima and were members of the Muaklek dairy cooperative. Records from individual animals were unavailable. Thus, farm records of milk yield, milk fat percentage, bacterial score, and BTCCC were collected from July 1, 2003 through June 30, 2006. Additional record keeping, genetic selection, education, and farm management information was collected through a questionnaire in May of 2006. Data from the Muaklek dairy cooperative and the questionnaire were then merged by a farm identification number. A single trait mixed model was used to analyze AYC, milk fat percentage, and BTSCC, while a log linear model was used to analyze bacterial score. Results showed that farms that kept records on individual animals had higher ($P<0.05$) milk fat percentages and lower bacterial scores than farms that did not. Farms that used genetic information (EBV) and phenotypes when selecting sires were higher ($P<0.05$) for milk fat percentage than farms that used only phenotypes and personal opinion. Farms milking cows with a single unit milking machine and by hand, had higher ($P<0.05$) bacterial scores and BTSCC than farms using only a single or multi unit machine. Overall farms that kept individual animal records, used EBV when selecting sires, used a single method for collecting milk, and used family labor achieved higher performance from their herds than farms that did not.

Keywords Milk yield · Bacterial score · Bulk tank somatic cell count · Education · Record keeping

Abbreviations

AYC	average milk yield per cow
BTSCC	bulk tank somatic cell count
EBV	estimated breeding value
LBS	natural logarithm of bacterial score
LBTSCC	natural logarithm of bulk tank somatic cell count

J. A. Rhone (✉) · M. A. Elzo
Department of Animal Sciences, University of Florida, Gainesville, FL 32611, USA
e-mail: jrhone_1@msn.com

S. Koonawootrittriron
Department of Animal Science, Kasetsart University, Bangkok 10900, Thailand

Introduction

In dairy farms across the globe farmers are striving to increase profits by improving traits of economic importance such as milk, fat, and protein yield, somatic cell count, reproduction and productive life (VanRaden and Multi-State Project S-1008 2006). All these traits are affected in some measure by genetic and environmental factors. Genetic evaluation and selection of animals as well as the level of nutrition, management, and health conditions will influence individual animal and herd performance as well as profitability of dairy farms. Through genetic progress and the establishment and use of EBV, farmers have been able to select for traits in their animals and make improved progress in the health and production of their herds. However in fairly new and developing dairy industries, such as in Thailand, the use of EBV for genetic selection and other dairy farm management practices such as record keeping are still not utilized by many farmers (Rhone et al. 2007c).

The Dairy Farming Promotion Organization (DPO), in collaboration with Kasetsart University, has been publishing annual sire summaries with genetic evaluations for dairy cattle in Thailand since 1996 (DPO 2005). Through these efforts and training from dairy cooperatives and other dairy organizations, some segments of the Thai dairy industry have adopted the use of EBV to select sires and are also keeping records on individual animals (Rhone et al. 2007c). This is important because farms that keep records on herd and individual animal performance were shown to have higher rolling herd milk yields than farms that do not (Losinger and Heinrichs 1996).

In previous research in Thailand, clean and hygienic floors of milk spaces, troughs, and drainage systems were factors related to high quality milk of farms (Yhoung-Aree 1999). Thus, keeping records is of great importance if farmers are to identify and manage mastitis and reproduction of cows in their herds (Ten Hag 2001). This is relevant in that traits such as milk yield, bulk tank somatic cell count, and bacterial score, have shown to either increase or decrease revenues and overall profits of farms in Thailand (Rhone et al. 2007b). However, improved management practices will only be adopted by farmers through an effective educational training program. The use of a participatory, farm demonstration, and farmer to farmer interaction training has shown to be an effective method of training farmers for improving dairy farm management techniques in Thailand (Wanapat et al. 2000). Once research provides precise solutions to obstacles of dairy farms, dairy cooperatives and organizations should continue to work together in order to properly train dairy farmers in improved techniques and technologies.

The objective of this study was to determine record keeping practices, genetic selection, educational experience, and farm management effects on average milk yield per cow, milk fat percentage, bacterial score, and bulk tank somatic cell count of farms in the central region of Thailand.

Materials and methods

Farms

A total of 50 farms were included in the study. Farms were located in central Thailand, between 15° 00′ North latitude and 100° 00′ East longitude, in the provinces of Saraburi and Nakhon Ratchisima. Within these provinces farms were in the districts of Muaklek (n=42) and Pak Chong (n=8). All farms were members of the Muaklek dairy cooperative. Farms milked their cows twice a day and used single or multi unit milking machines. Most cattle in Thailand are 75% Holstein or greater cattle, although there are farms that raise purebred Holstein and crossbred Holstein cattle (MOAC 2005). Breeds such as Sahiwal, Red Danish, Brahman, and Thai native are sometimes used by farmers for crossing with Holstein cattle. The climate of Thailand is tropical and can be categorized into the three climatic seasons of winter (November to February), summer (March to June), and rainy (July to October). During the rainy season farms feed 30–40 kg of planted or native grass roughage, while rice stalk is more frequently fed during the summer (dry) season (Suzuki 1998). Concentrates are typically fed to milking cows in the amounts of 12 to 15 kg per day. Additional information on farm nutrition, feeding, milking practices, and climate in Thailand can be found in Rhone et al. (2007a).

Data collection and records

There were two sources of data for this study: 1) data collected from the Muaklek dairy cooperative and 2) data collected from a survey administered by faculty of Kasetsart University. Records from the Muaklek dairy cooperative were collected from July 1, 2003 through June 30, 2006 and taken from farms that sold milk to the Muaklek dairy cooperative during the time of the study (Rhone et al. 2007a). Survey data was taken from a questionnaire written by faculty at the University of Florida and Kasetsart University and distributed at two dairy seminars held by the Muaklek dairy cooperative in April of 2006 (Rhone et al. 2007c). Data from the Muaklek dairy cooperative and the questionnaire were merged by farm identification number to form one data file. This study used a total of 22,180 daily farm milk yield (kg), 1,433 milk fat (%) and bacterial score (score), and 302 BTSCC (cells/cm^3) records.

Records from the data set also included month and year of collection date, breed of cows used by farm, type of production system, fertility of cows in the herd, method of sire selection, type of labor used for dairy production, record keeping, source of dairy information, milking method, method of sending milk to collection center, and the distance in kilometers from farm to the cooperative milk collection center. Breed of cows within a farm were defined as farms having 2/3 or more cows within a breed group, were classified in that breed group. Variables used in this study and their description are shown in Table 1.

Farms were classified by size into groups: 1=small (less than 10 cows milked per day), 2=medium (between 10 and 19 cows milked per day), and 3=large (20 or more cows milked per day). A contemporary group variable was created to account for variation across combinations of farm sizes (small, medium, and large) and districts (Muaklek and Pak Chong). The resulting 4 contemporary groups were: 1) small size farms in Muaklek, 2) medium size farms in Muaklek, 3) medium size farms in Pak Chong, 4) and large size farms in Muaklek.

Milk yield was analyzed as average milk yield per cow (AYC) and was defined as farm milk yield divided by the number of cows milked per day (Rhone et al. 2007a). Bacterial scores were assigned using a methylene blue reduction test (Rhone et al. 2007a). Scores assigned to milk samples ranged from 1 to 4 based on the number of hours needed for the sample

Table 1 List of variables, number of variable categories (n), and description of variables used in statistical models

Variable	n	Description
Breed of cows in herd	4	Purebred Holstein
		≥75% Holstein
		50–75% Holstein
		Other or unknown breed
Production system	2	Confinement
		Confinement and pasture
Fertility (cows in herd)	2	1–2 AI services per conception
		≥3 AI services per conception
Method of selecting sires	2	Phenotype and personal view
		Phenotype and genotype (EBV)
Farm labor	3	Husband or husband and wife
		Wife or wife and children
		Hired labor and husband or wife
Record keeping	2	No records
		Kept records
Source of information used for dairy production	2	Books, magazine, newsletter, or seminar
		Training from cooperative/business
Milking method	3	Single unit milking machine
		Multi-unit milking machine
		Single unit and by hand
Method of sending milk to cooperative	3	Send yourself
		Ask someone to send
		Other method
Distance to cooperative	∞	Distance from farm to milk collection center (km)

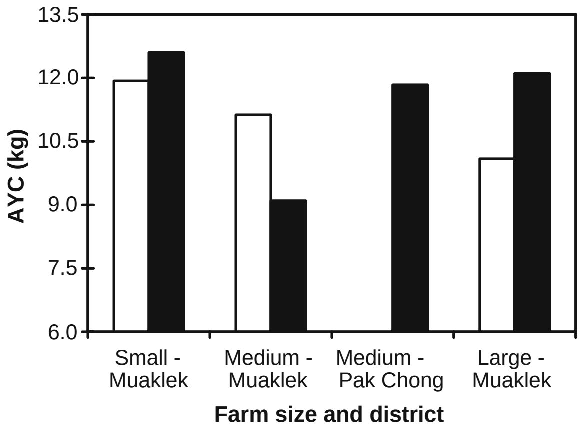

Fig. 1 Least square means of average milk yield per cow (AYC; kg) by type of production system (white column= confinement; black column=confinement and pasture) – farm size – farm district of dairy farms

to change color or the dye to disappear; 1 having the slowest rate and least amount of bacteria and 4 the fastest rate and greatest number of bacteria. Scores were defined as: 1=more than 6 hours, 2=between 4 to 6 hours, 3=between 3 to 4 hours, 4=less than three hours (MDCL 2005).

Statistical analysis

Average milk yield per cow, milk fat, and BTSCC were analyzed using the mixed model procedure of SAS (SAS 2004). The mixed linear model for AYC included the fixed effects of month nested with year of collection date, contemporary group by production system subclass, breed, fertility, sire selection, record keeping, farm labor, information used for dairy production and the random effects of farm and residual. The model for milk fat percentage contained the same fixed and random effects as the AYC model, but additionally included the sire selection by record keeping subclass.

The BTSCC data were not normally distributed. Thus, data were transformed using natural logarithms after which it was approximately normally distributed. Likewise, bacterial scores data followed a Poisson distribution, thus the bacterial score trait was analyzed using a generalized linear model with the GENMOD procedure of SAS (SAS 2004). To normalize the data, bacterial score was transformed with a log link function. The mixed linear LBTSCC model included the fixed effects of month nested within year of collection date, contemporary group, breed by production system subclass, milk sending method, farm labor by milking method subclass, source of information for dairy production, record keeping, a covariate accounting for distance from farm to the milk collection center, and the random effects of farm and residual. The log linear model for log of bacterial score (LBS) included the same explanatory variables as the LBTSCC model, but included the record keeping by source of dairy information subclass and no random effects. Additionally,

Table 2 Least square means (LSM) and standard errors (SE) of average milk yield per cow (kg) by fertility, method of selecting sires (sire selection), record keeping, breed, and source of information on dairy production of dairy farms

Effect	LSM	SE	P-value
Fertility			
1 to 2 AI services per conception	12.99	2.42	<0.01
2 or more AI services per conception	9.52	2.18	<0.01
Sire selection			
Phenotype and personal view	10.50	2.57	<0.01
Phenotype and genotype (EBV)	12.00	2.30	<0.01
Record keeping			
No records	9.77	2.37	<0.01
Kept records	12.73	2.29	<0.01
Breed			
Purebred Holstein	10.15	3.94	0.01
75% or greater Holstein	12.56	2.50	<0.01
50–75% Holstein	13.55	3.58	0.01
Other or unknown breeds	8.75	3.99	0.04
Source of information on dairy production			
Book, magazine, newsletter, or seminar	13.19	3.12	<0.01
Training from dairy cooperative/business	9.31	1.82	<0.01

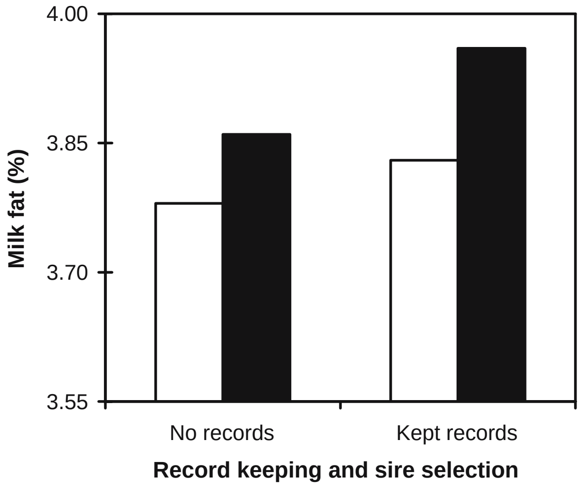

Fig. 2 Milk fat percentage of dairy farms by individual animal record keeping practices and type of information used to select sires (white column=phenotype and personal view; black column=phenotype and genetic (EBV))

the farm labor and milking method variables were considered as separate fixed effects in the LBS model.

Random farm effects were assumed to have mean zero and a common variance σ_f^2. Residual effects were assumed to have mean zero and common variance σ_e^2. Variances for random effects were estimated using restricted maximum likelihood. Significance of the variance due to farms within farm sizes (σ_f^2) was determined using a z-score ratio. Tests for main effects were compared using an F test at an α=0.05 level. Least square means for fixed effects, and differences between subclasses within fixed effects were compared using a *t*-test in all models except for bacterial score, which used a chi-square test, at an α=0.05 level.

Results

Average milk yield per cow and milk fat percentage

The contemporary group by production system subclass and month nested within year of collection date were important factors effecting AYC ($P<0.01$), while all other effects were not ($P\geq0.14$). Small size farms in Muaklek had higher ($P<0.05$; 11.92±3.14 kg) for AYC than medium and large size Muaklek farms (11.13±3.16 kg and 10.08±3.14 kg) in confinement production systems (Fig. 1). Using a combination of confinement and pasture system, small size farms in Muaklek also were higher ($P<0.05$; 12.60±2.03 kg) for AYC than medium size farms in Muaklek (9.10±2.05 kg). There was no difference ($P=0.70$) for AYC between medium size

Table 3 Least square means, standard errors and p-values of farm milk fat percentages by production system—farm size – farm district, breed, mineral supplementation, labor, and source of information on dairy production of farms (all effects had a *P* value of $P<0.01$)

Effect	LSM	SE
Confinement system		
Small size farm – Muaklek district	3.98	0.06
Medium size farm – Muaklek district	3.83	0.03
Large size farm – Muaklek district	3.90	0.04
Confinement and pasture system		
Small size farm – Muaklek district	3.88	0.03
Medium size farm – Muaklek district	3.80	0.04
Medium size farm – Pak Chong district	3.73	0.08
Large size farm – Muaklek district	3.89	0.03
Breed		
Purebred Holstein	3.84	0.04
75% or greater Holstein	3.82	0.03
50–75% Holstein	3.89	0.06
Other or unknown breeds	3.88	0.03
Labor		
Husband and/or wife	3.84	0.02
Wife or wife and children	3.80	0.03
Hired labor and husband or wife	3.94	0.07
Source of information on dairy production		
Book, magazine, newsletter, or seminar	3.82	0.04
Training from dairy cooperative/business	3.90	0.02

farms in Muaklek and Pak Chong. Although not significantly different, farms that kept records and used phenotypic and genetic (EBV) information when selecting sires were numerically higher for AYC than those that did not (Table 2). Farms that used 1 to 2 AI services per pregnancy, approached being significantly higher (P=0.14) than those farms that used 3 or more services per pregnancy. Farms that raised 50% to 75% Holstein crossbred cows had the highest AYC of 13.30±3.72 kg, but were not different (P=0.67) from other breed categories.

Except for the effects of breed and labor, all other effects were important sources of variation on milk fat percentage (P<0.05). Farms that kept records and used phenotypic information and EBV when selecting sires had higher milk fat percentage values (P<0.01; 3.96±0.02%) than farms that did not keep records and used phenotypic and genetic information/personal views when selecting sires (Fig. 2). Small and large size farms in Muaklek were higher for milk fat percentage than medium size farms (P<0.05). There was no difference (P=0.38) for milk fat percentage between medium size farms in Muaklek and Pak Chong. Farms that used training from their cooperative or a business as their source for updating dairy information had higher milk fat percentage values (P<0.05) than those that used a book, magazine, newsletter, or seminar. Farms that used other (or unknown) breed of cows had the highest milk fat percentage values but were not different from other breed categories (Table 3).

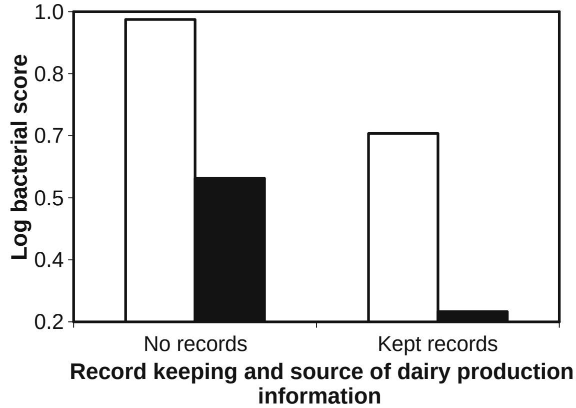

Fig. 3 Least square means of log of bacterial score by record keeping practices and source of information used for updating knowledge on dairy production (white column=book, magazine, newsletter, or seminar; black column=training from dairy cooperative/company)

Bacterial score and bulk tank somatic cell count

All effects in the LBS model were important ($P\leq$ 0.05) sources of variation affecting LBS. Small and medium size farms in Muaklek were lower for LBS (P<0.01) than large farm in Muaklek and medium

Table 4 Least square means and standard errors (SE) of log of bacterial score by contemporary group, method of sending milk, milking method, and type of labor used of dairy farms (all effects had P values of P<0.01)

Effect	LSM	SE
Contemporary group (farm size – district)		
Small – Muaklek	0.423	0.09
Medium – Muaklek	0.387	0.08
Medium – Pak Chong	0.967	0.17
Large – Muaklek	0.580	0.09
Method of sending milk to cooperative		
Send yourself	0.647	0.04
Ask someone	0.528	0.04
Other	0.593	0.10
Milking method		
Single unit machine	0.458	0.05
Multi unit machine	0.603	0.08
Single unit and by hand	0.706	0.07
Labor		
Husband or husband and wife	0.650	0.06
Wife or wife and children	0.428	0.07
Hired labor and husband or wife	0.689	0.08

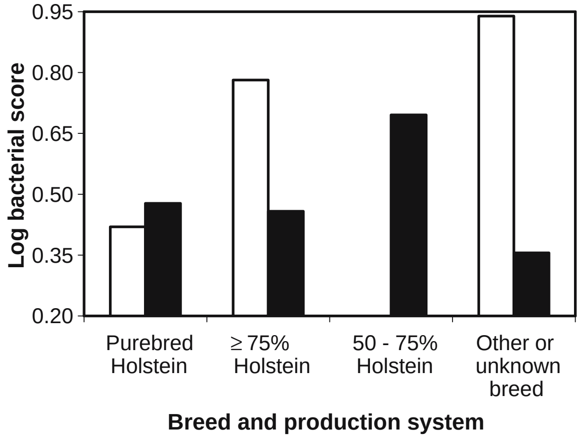

Fig. 4 Least square means for log of bacterial score by breed and production system (white column=confinement; black column=confinement and pasture) of dairy farms

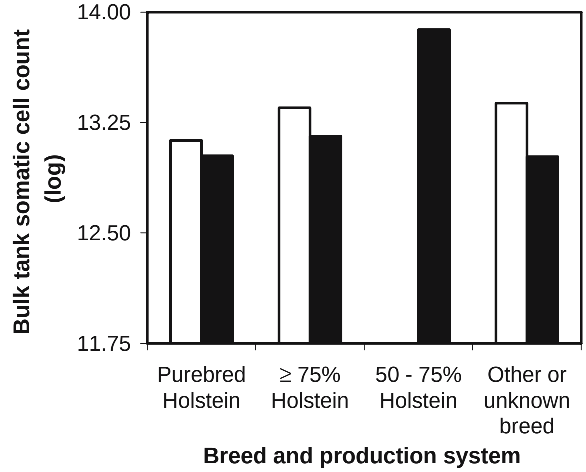

Fig. 5 Least square means of the natural logarithm of bulk tank somatic cell count by breed and production system (white column=confinement; black column=confinement and pasture) of dairy farms

farm in Pak Chong (Table 4). Farms that sent milk by themselves had lower LBS values ($P<0.01$) than those that had someone send it for them. Additionally farms that used either single or multi-unit milking machine when milking cows had lower LBS ($P<0.01$) than those that used a combination of a single unit and by hand. Farms that used labor of wife or wife and children were lower for LBS ($P<0.01$) than all other types of labor. Results for record keeping by source of dairy information showed that farms that kept records and used training from a cooperative/business had lower LBS values ($P<0.01$) than all other farms (Fig. 3). There was no difference ($P=0.63$) in farms using purebred Holstein cows for confinement and confinement and pasture systems, while cows of 75% or more Holstein and other (or unknown) breeds where higher for LBS ($P<0.01$) in confinement systems than a confinement and pasture system (Fig. 4).

Contemporary group, method of sending milk, labor by milking method subclass, and the covariate accounting for distance from farm to milk collection center were all important ($P<0.05$) sources of variation affecting LBTSCC, while all other effects were not. Small size farms in Muaklek were lower for LBTSCC

Table 5 Least square means and standard errors (SE) of log of bulk tank somatic cell count by contemporary group, method of sending milk, source of information on dairy production, and record keeping practices of dairy farms (all effects had P values of $P<0.01$)

Effect	LSM	SE
Contemporary group		
Small size farm – Muaklek	13.14	0.28
Medium size farm – Muaklek	13.47	0.34
Large size farm – Muaklek	13.83	0.38
Medium size farm – Pak Chong	12.67	0.44
Method of sending milk to cooperative		
Send yourself	12.61	0.15
Ask someone	13.40	0.16
Other	13.82	0.58
Source of information used to update dairy production		
Book, magazine, newsletter, or seminar	13.40	0.25
Training from cooperative/business	13.15	0.16
Record keeping practices		
No records	13.37	0.30
Kept records	13.19	0.16

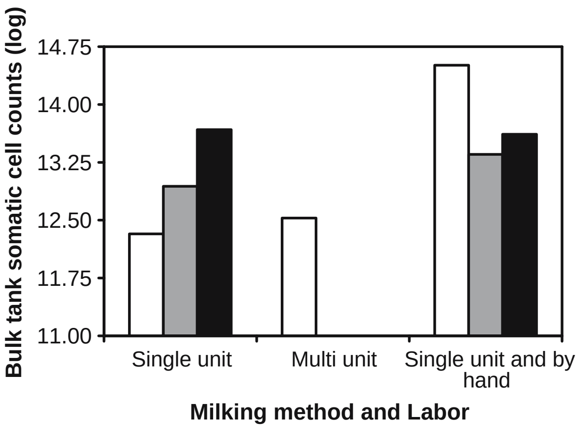

Fig. 6 Least square means of log of bulk tank somatic cell count by milking method and type of labor (white column= husband or husband and wife; grey column=wife or wife and children; black column=hired labor and wife or husband) of dairy farms

(13.14±0.28) than medium (*P*=0.06; 13.47±0.34) and large size (*P*<0.01; 13.83±0.38) farms in Muaklek (Table 5). There was no difference between medium size farm in Pak Chong and Muaklek for LBTSCC. Farms that sent their milk to milk collection centers themselves had lower (*P*<0.05) LBTSCC farms that asked someone else or used other method(s) of sending milk to collection centers. Farms that raised Purebred Holstein, 75% Holstein, other or unknown breed of cows in a confinement and pasture production system were lower for LBTSCC (*P*≤0.08) than herds that used crossbred cattle with 50% to 75% Holstein (Fig. 5). There was no difference (*P*≥0.50) for breed of cows used in a confinement production system. Results for milking method by labor subclass showed farms using husband or husband and wife labor using a single or multi unit milking machine had lower LBTSCC (*P*<0.01) than if they used a combination of a single unit machine and milked by hand (Fig. 6). Additionally, farms using hired labor with a husband or wife using a single unit machine had higher (*P*<0.01; 13.67±0.35) LBTSCC than farms with a husband or husband of wife type of labor (12.32±0.12).

Discussion

Average milk yield per cow and milk fat percentage

Small size farms in Muaklek having higher AYC than medium and large size farms in Muaklek is consistent with results found in Rhone et al. (2007a). Unfortunately, it is still uncertain why cows from these smaller farms are having higher average milk yields. Knowing that these farms are mainly family run, coupled with the fact that they probably either grow their own forage or use a cut and carry system, and possibly supplying higher quality forage to their animals could be reasons for the higher milk yields. Additionally, in this study we lack information on percent of diet that came from grazing vs. being stall fed (for confinement-pasture system), and the specific content, amount, and nutrient levels of the forage (or concentrate) that were grazed or fed. This may be why medium size farms in Muaklek had lower AYC than large size farms in Muaklek using a confinement and pasture system. Content and nutritional quality of diet is also a factor that affected differences seen in milk fat percentage between confinement and confinement-pasture system. Since the Muaklek dairy cooperative does not give premiums for milk fat percentage (deduction if <3.5%) results shown here of the milk fat percentage may not be of great importance to farmers in the Muaklek cooperative.

Although there were no differences between breed groups for AYC here, Kitpipit et al. (2003) reported that cows in Thailand with greater than 75% Holstein had higher yields than those with less than 75%. In a larger study, also in Thailand, Koonawootrittriron et al. (2001) found that 3/4 Holstein 1/4 Red Sindhi cows had significantly higher 305 d milk yields than both Purebred Holsteins and 1/2 Holstein 1/2 Red Sindhi cows. Perhaps the lack of individual animal records coupled with limited information on the feeding and nutrition of animals, prevented breed effects for AYC and milk fat percentage to be appropriately explained here. Additional research is needed in order to obtain more definite and precise evaluation of breed of cow effects on dairy production traits in Thai farms.

One of the major findings in this study is the increased performance in higher milk fat percentage and AYC of those farms that kept records on individual animal performance. Record keeping leading to higher milk fat percentage values and numerically higher milk yields is consistent with Losinger and Heinrichs (1996) that found farms keeping records on individual animals had higher herd milk yield averages than those that did not. The use of EBV when selecting sires was also an important factor leading to higher milk fat percentage (*P*<0.05) and numerically higher AYC levels. Knowing that milk yield and milk fat percentage are moderately heritable traits, through selection and use of EBV, farmers have the ability to increase level of performance of these traits in their animals (Bourdon 1997). Interestingly, the results of this study also showed that those farms that used training from their dairy cooperative or a business had higher milk fat percentage values than those that used other methods. Thus, it is critical for dairy cooperatives and other organizations of influence over dairy farms in Thailand to continue to educate and train farmers in the importance and use of record keeping and EBV when selecting sires. Lastly, results of this study show the importance of reproduction on milk yield which are similar to Alejandrino et al. (1999) that found cows which required 3 or more services per conception were much lower in productivity than those with less number of services per conception.

Bacterial score and bulk tank somatic cell count

In a previous study in Thailand, Yhoung-Aree (1999) found that the factors of family farms where children were a main source of farm labor, using more than one method of milking cows (i.e., single unit vs. single unit and by hand), and having a longer time period between finishing milking and milk arriving to the collection center all showed to increase total bacterial counts in raw milk. The results shown by Yhoung-Aree (1999) are very similar to results of this study where farms that used a single method for milking (single unit or multi unit) were lower ($P<0.05$) for LBS and LBTSCC than farms that used a single unit and milked by hand. Most likely, farms that are milking by hand and using a single unit machine are transferring bacteria from cow to cow or from some other source of contamination to the udder of a cow, thus increasing overall bacterial count. Although most farms in this study sent their raw milk to milk collection centers themselves (Rhone et al. 2007c), in some situations farmers lack the resources to send the milk themselves. Results here show that farmers that use other methods to send milk have higher ($P<0.05$) LBS and LBTSCC values than those that send milk themselves. Thus, careful attention should be paid to the length of time from finishing milking to milk arriving at the milk collection center, and the condition the raw milk is in during this time. Dairy cooperatives should work with farmers to reduce bacteria and improve milk quality, in order to bring higher revenues to both sides.

The labor findings in this study suggest that farms should use family labor, in particular if the wife is a major part of dairy labor versus using hired labor. Furthermore, women on dairy's in Asia have shown to be responsible for 40% of the entire dairy management and spend 52% of their time on farm related work, thus dairy cooperatives should provide appropriate training to wives and women working on these dairy farms (Moran 2005). If dairy organizations are not training woman, organizations are potentially not reaching the primary worker that is responsible for milking animals and controlling hygiene and other factors that affect milk quality in dairies.

There is not a great deal of literature in Thailand on breed effects on LBS and LBTSCC, thus reasons for farms milking 50% to 75% Holstein cows in a combination confinement and pasture system with high LBS and LBTSCC values are somewhat unknown. Since there is no individual animal records and identification in this study, it is difficult to draw precise conclusions if any particular breed type in this study tends to have lower bacterial scores and less mastitis than other breed(s). Further research including individual animal records will be needed in order to come up with definite conclusions.

Lastly, results for record keeping here show its importance for proper management of dairy farms. Farms that kept records produced higher quantity and quality of milk as well as higher milk fat percentages than farms that failed to keep records. Recording information on individual animals allows farmers to identify sick cows and/or cows with mastitis so that spread of bacteria from is limited. Since farms in the Muaklek dairy cooperative receive deductions for high bacterial scores and BTSCC (Rhone et al. 2007b), the need to train farmers in record keeping practices by cooperatives is imperative for improving the quality of milk and increasing profits for farmers and cooperatives. Overall major findings of this study show that farmers that use training from their cooperative or a business to keep updated on dairy information, use genetic information (EBV) when selecting sires, keep records on individual animals, have higher milk fat, AYC values, and lower bacterial scores and BTSCC than farms that do not. The need for continued training efforts of farmers (men and women) in the areas of proper use of EBV, record keeping, use of one milking method and sending milk to milk collection centers will prove to be economically beneficial for not only the farmer, but the cooperative as well.

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