Abstract W187

Impact of sire by region interaction on first-lactation traits of dairy cows raised under tropical conditions in Thailand

Pimchanok Yodklaew*, Skorn Koonawootrittriron*, Mauricio A. Elzo† and Thanathip Suwanasopee*

***Department of Animal Science, Kasetsart University, Bangkok 10900, Thailand**

†Department of Animal Sciences, University of Florida, Gainesville, FL 32611-0910, USA

SUMMARY

Initial yield (**IY**), peak yield (**PY**), days to peak yield (**DP**) and persistency (**PS**) are traits associated with milk yield (**MY**) in dairy cattle. Daughters of the same sire could have different lactation curve traits (**IY**, **PY**, **DP**, and **PS**) and **MY** in different regions. ***Thus, the objective of this study was to investigate the impact of sire-by-region interaction on first-lactation traits in three regions of Thailand.*** The dataset contained 27,276 monthly test-day records from 2,431 first-lactation cows raised in 294 farms located in Central, Northeastern and Southern Thailand. Wood's gamma function was used to estimate **IY**, **PY**, **DP**, **PS**, and **MY** for individual cows using their monthly test-day records. A fixed linear model was used to avoid sire-by-region interactions due to unequal numbers of daughters per region. The fixed linear model included herd-year-season, calving age, Holstein fraction, and interaction between sire and region as fixed effects, and residual as a random effect. Sires were ranked in each region using their least squares means and correlations between sire rankings across regions were computed. Herd-year-season affected (P < 0.001) all lactation traits and calving age only influenced **PY** (P = 0.02). Holstein fraction had no effect on any trait and sire-by-region interaction had an effect only on **PY** and **MY** (P < 0.001). ***Correlations between sire rankings in the Central and Northeastern regions, Central and Southern regions, and Northeastern and Southern regions were low or close to zero for PY (-0.01 to 0.05) and MY (0.03 to 0.29). These results suggested that sires would affect their daughter's first-lactation PY and MY differently if they were located in different regions of Thailand. Thus, sires would need to be selected based on their genetic superiority in each region to optimize genetic improvement for milk production in this Thai population.***

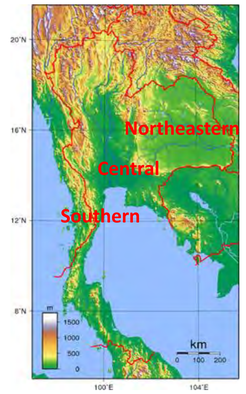
INTRODUCTION

Dairy production in Thailand has been developing rapidly since the Thai government began promoting consumption of fresh milk and milk products to the Thai people in 1962. Commercial dairy farms and cooperatives have been spreading out from Central Thailand to other regions of the country. These regions have different in terms of weather, geography, natural resources, agricultural activity and culture. However, regardless of region, Thai dairy farmers prefer to have dairy cows that can produce a large volume of high quality milk. Lactation characteristics of individual cows including initial yield (**IY**), peak yield (**PY**), days to peak yield (**DP**) and persistency (**PS**), all of which are associated with 305-d milk yield (**MY**), have been considered for genetic selection and management improvement. Artificial insemination has been practiced using frozen semen across the country. Frozen semen of the same sires was used to mate cows in different regions making it feasible to study sire-by-region interaction. In particular, sire ranking based on performance of their daughters may differ across regions. Ignoring sire-by-region interaction may lead to biased genetic evaluations which would affect efficiency and response of selection. ***Thus, the objective of this research was to investigate the impact of sire-by-region interaction on first-lactation traits in the Central, Northeastern and Southern regions of Thailand.***

MATERIALS AND METHODS

Animals and Data. The dataset consisted of 27,276 monthly test-day records of 2,432 first-lactation cows raised in 294 farms located in Central, Northeastern and Southern Thailand from 1998 to 2012. Cows in this population had a Holstein fraction that ranged from 28.125 to 100%. Other breeds represented in various fractions in crossbred cows were Brahman, Brown Swiss, Jersey, Red Danish, Red Sindhi, Sahiwal, Simmental and Thai Native. Pedigree and performance data of these cows were gathered by staff from the Dairy Farming Promotion Organization of Thailand (DPO).

Climate, Nutrition and Management. The Central region (23.9 to 33.3°C; 74% RH) has abundant water, including several rivers and irrigation for agriculture. Most areas are lowlands and floodplains. Mountains are located in the eastern and western parts. The Northeastern region (22.7 to 32.6°C; 72% RH) has a short monsoon season and a long dry season. Soil is generally poor. The Southern region (24.0 to 32.9°C; 76% RH) has a long monsoon season and a short dry season. Land is flat, composed of deposited silt, sand and mud, and located between the Gulf of Thailand and the Andaman Sea.



Seasons in the 3 regions were classified as winter (November to February), summer (March to June), and rainy (July to October). Cows in all regions were kept in open barns and milked twice a day. The first milking was in the morning (beginning at around 5 am) and the second one in the afternoon (beginning at around 3 pm). Feeding was mainly based on concentrate (1 kg of concentrate per 2 kg of milk), and fresh grass (30 to 40 kg/d). Grasses included *Brachiaria mutica, Brachiaria ruziziensis, Penicum maximum*, and *Pennisetum purpureum*. Rice straw, crop residues and agricultural by products were provided as supplement when fresh grasses were insufficient, especially during dry seasons (winter and summer). Minerals were available as free choice. All cows were artificially inseminated. Semen of Holstein and crossbred Holstein bulls was generally chosen primarily based on price and semen availability.

Data Analysis. Lactation characteristics (**IY**, **PY**, **DP** and **PS**) and **MY** of individual cows were estimated by Wood' s gamma function using their monthly test-day records. A fixed linear model was used to avoid sire-by-region interactions due to unequal numbers of daughters per region (Ron Hillel, 1983). The fixed linear model considered calving herd-year-season, caving age, Holstein fraction of cow, and interaction between sire and region as fixed effects, and residual as a random effect. Preliminary data analysis indicated that 24 out of 447 sires were used in all three regions. Thus, these sires were ranked in each region using their least squares means (LSM) for each trait. Then, Spearman's rank correlations were computed for pairs of sire rankings across regions.

RESULTS AND DISCUSSION

Descriptive statistics showed that cows in this population had a mean value 9.09 (SD = 5.72) kg for **IY**, 18.21 (SD = 4.53) kg for **PY**, 55.51 (SD = 30.98) d for **DP**, 6.99 (SD = 1.01) for **PS**, and 4,417.71 (SD = 1,125.67) kg for **MY**. Calving age had had a mean of 30 mo of age with a minimum 17 mo and a maximum of 49 mo of age.

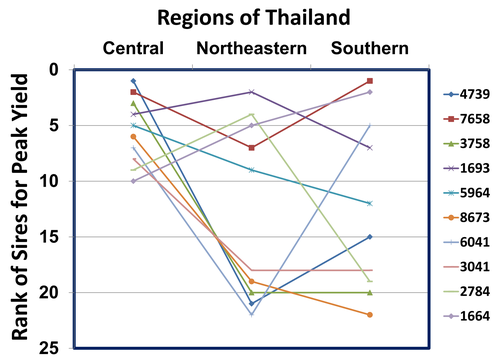
All first-lactation traits (**IY**, **PY**, **DP**, **PS**, and **MY**) were affected by herd-year-season (P < 0.001). Range of LSM was from -17.24 ± 8.41 to 26.01 ± 8.30 kg for **IY**, -13.05 ± 5.19 to 21.58 ± 4.29 kg for **PY**, -173.42 ± 46.60 to 106.00 ± 50.10 d for **DP**, -6.37 ± 1.50 to 7.40 ± 1.54 for **PS**, and -3,825.35 ± 1,224.33 to 5,499.49 ± 1,012.58 kg for **MY**. These wide ranges for all traits suggested the existence of sizable combined differences in climate, nutrition, and management captured by herd-year-season effects across these three regions in Thailand.

Calving age influenced only **PY** (P = 0.02). Older first-lactation cows had higher **PY** than cows that calved at younger ages (0.05 ± 0.02 kg/mo). This difference was probably related to the level of maturity of first lactation cows. Younger first-lactation cows were less mature and may have devoted a higher proportion of their nutritional resources to growth than to production compared to older cows.

Table 1 Factors affecting on lactation characteristics and milk yield

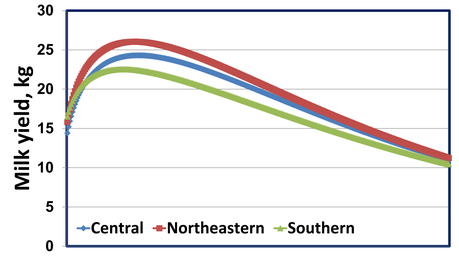
Factors	IY	PY	DP	PS	MY
HYS	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Cage	0.9097	0.0179	0.3772	0.1479	0.0975
Holstein %	0.6740	0.5326	0.8000	0.4120	0.7861
Sire × Region	0.4879	0.0007	0.6440	0.0996	< 0.0001

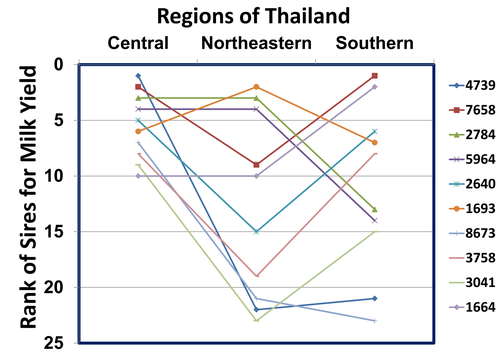
Holstein fraction of cow did not affected any trait. This happened in spite of the wide range of Holstein percentages (28.125 to 100%) present in cows within this population across the three regions. This may have happened because cows with high Holstein percentage may have been unable to fulfill their production potential under the management, nutrition, and hot and humid climatic conditions in this tropical region (Koonawootrittriron *et al.*, 2009). Consequently their performance was similar to that of cows with medium and low Holstein percentages.



Sire-by-region interaction affected only **PY** and **MY** (P < 0.001). Correlations between pairwise sire EBV rankings for the 24 sires in common in the Central, Northeastern, and Southern regions were low or close to zero for **PY** (-0.01 to 0.05) and **MY** (0.03 to 0.29). These low rank correlations were a strong indicator of sire-by-region interaction among these three Thai regions.

The ranking of the 24 sires in common for **PY** and **MY** was vastly different in Central, Northeastern and Southern regions. Of the top 10 sires for **PY** in the Central region only 5 remained in the top 10 in the Northeastern region, and 4 in the Southern region. Similarly, only 4 sires of the top 10 for **MY** in the Central region stayed in the top 10 in the Northeastern region, and 5 in the Southern region. Further, only 1 sire was in the top 10 sires for **PY** and **MY** in all regions. The re-ranking of sires suggested that sires would affect their daughter's first-lactation **PY** and **MY** differently depending on the region they were located. Differences would be due to the differential expression of the set of genes that daughters received from the their sire (Aasteveit and Aasteveit, 1993) when located in different regions of Thailand.





These two traits (**PY** and **MY)** were found to have a high genetic correlation in Central Thailand (Seangjun *et al.*, 2009). However, the re-ranking of sires for **PY** and **MY** based on LSM here suggested that sires would need to be selected based on their genetic superiority in each region to optimize genetic improvement for these traits. Thus, a follow-up study treating records in each region as different traits would be needed to estimate heritabilities within and genetic correlations across these three regions for all lactation traits. This next study would help reconfirm that sire-by-region interaction would need to be accounted for in models used for national genetic evaluations of dairy animals in Thailand.

FINAL REMARKS

- ***Older cows at first calving had higher PY than younger cows***
- ***Holstein fraction did not affect any of the lactation traits***
- ***Sire-by-region interaction affected only PY and MY***
- ***Results suggested that sires would need to be selected based on their genetic superiority within regions***

LITERATURE CITED

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