Genetic and phenotypic trends for milk yield in Holstein populations in Mexico

H. O. Toledo1, F. J. Ruíz2, C. G. Vazquez1, J. M. Berruecos1, M. A. Elo3
1Universidad Nacional Autónoma de México, Ciudad de México, DF, México
2INIFAP, Querétaro, Querétaro, México
3University of Florida, Gainesville, FL, USA

SUMMARY
The objectives were to evaluate genetic and phenotypic trends from 2007 to 2011 for milk yield in three Holstein populations representing 24% of the milk production in Mexico. Data consisted of first lactation milk yields adjusted to 305 d, adult equivalent and weighted means. Records were obtained from the National Breeding Program of Mexico (NBDP), the Holstein Association of Mexico (HAM) = 43,668, the National Dairy Information (NDBI, n = 120,217), and the Breeding NDBI (NDBI, n = 163,853) which included records from HAM and NDBI. Best Linear Unbiased Predictions of breeding values (BV) were computed with ASREML using a mixed model to account for fixed and random effects and animal residual. Random effects were animal and residual. Weighted and unweighted yearly means of BV were computed for HAM, NBDP, and NDBI. Weights were numbers of daughters per sire per year. Weighted yearly means of BV in NDBI were also computed by country of origin (USA, Canada, Mexico, Others). Lastly, yearly means of cow BV and phenotypic variances (PV) were obtained for HAM, NBDI, and NDBI. The mean BV and PV of cows for milk yield in the HAM, NBDP, and NDBI populations increased between 2007 (BV = 1044 ± 5.7 kg; PV = 227.5 ± 25.9 kg) and 2011 (BV = 2423 ± 3.3 kg; PV = 486 ± 13.0 kg). Differences between yearly means indicated that cow BV from HAM tended to be lower than that of NBDP (122 ± 0.8 kg in 2009 to 472 ± 2.0 kg in 2011). Holstein sires from the US tended to have substantially higher yearly mean BV for milk yield (2724 ± 2.0 kg in 2009 to 3852 ± 2.0 kg in 2010) than Holstein sires from Mexico. Breeders from HAM tended to use Holstein BV for milk yield more frequently than HAM breeders. Genetically better domestic Holstein BV for milk yield allowed dairy breeders in Mexico to consistently increase cow genetic and phenotypic means from 2007 to 2011.

INTRODUCTION
Genetic evaluations and research of Holstein cattle in Mexico are few and have only included animals registered in the Holstein Association of Mexico (HAM). Thus, genetic progress in Holstein bulls outside the association is unknown. However, these bulls are major contributors to the national Holstein population. In fact, the National Bank of Dairy Information (NDBI) which is part of the National Breeding Program of Mexico (NDBP), currently includes records from HAM and HAM. One important goal is to evaluate differences in breeding values of the parents of Holstein bulls and their use in the population over time. The NDBP dairy cattle genome is unique in the world in terms of genetic and phenotypic trends of cows and bulls for the past 5 years. Thus, the objectives of this study were: a) to analyze genetic and phenotypic trends for milk production in the first lactation of the cows of the NDBP (i.e., NDBP, HAM, HAM) to evaluate the genetic trends of weighted and unweighted but EBV means for NDBP, HAM, and HAM; to c) assess the genetic means of the EBV means weighted by the number of daughters in NDBI according to their country of origin.

MATERIALS AND METHODS

Animals and Data
The NDBP dataset included records from HAM and NDBI. The NDBI contained a total of 163,853 records of cows that were daughters of 1,094 sires. The HAM dataset included 43,668 sires, while the NDBI dataset had 120,217 cow progeny of 1,528 sires. All datasets contained 350-d milk yield (MY) records first lactation cows obtained from 2007 to 2011. Records from cows under 18 months of age at first calving, MY records with less than 1,500 kg (lactation considered abnormal), and records from animals with less than 90 days in milk were eliminated to ensure at least three weighings. Edited datasets and pedigree files were created using a program in C# and the Statistical Analysis System (SAS).

Climate, nutrition and management. The data came from 22 states of Mexico: Aguascalientes, Campeche, Chiapas, Durango, Guanajuato, Hidalgo, Jalisco, Michoacan, Morelos, Nayarit, Oaxaca, Puebla, Querétaro, San Luis Potosí, Sinaloa, Tamaulipas, Zacatecas. There were five different climate types in these states. Two states were dry desert, six were dry steppe, four were warm and humid, two were semi-humid warm and eight were temperate semi-humid. The dry desert climate had temperatures between 0 °C and 40 °C and rainfall lower than 400 mm per year in the summer. The dry steppe climate had temperatures between 18 °C and 28 °C and rainfall below 750 mm in the summer. The warm humid and semi-humid climate temperatures between 16 °C and 38 °C and rainfall from 750 to 1500 mm [in the semi-humid occurs only in summer]. The semi-humid semi-humid climate had temperatures from 12 °C to 18 °C and rainfall of 800-1500 mm in summer. This climate was defined by corral the factors herd-year-season of calving. Seasons of calving were: Summer 3 from December to May, and Season 2 from June to November. Scores were given for different environments across herds and regions. Feeding was based on forage cut and carry, use of silo, hay and concentrates with mineral supplementation, and in some local products, and industrial byproducts. The main forages were corn (Zea mays), oats (Avena sativa), alfalfa (Medicago sativa), forage sorghum (Sorghum vulgare), alfalfa (elosum cv). White clover (Trifolium repens), Kikuyu grass (Pennisetum clandestinum) pastures from the region.

RESULTS AND DISCUSSION
Descriptive statistics of PV and BV of cows, and the BV of sires for milk yield during the first lactation for the entire population (NDBP) and for the two subpopulations (HAM and NDBI) are shown in Table 1.

Table 1. Descriptive statistics of Breeding Value (BV) and Phenotypic Value (PV) for the National Breeding Program of Mexico (NDBP), the Holstein Association of Mexico (HAM), and the National Bank of Dairy Information (NDBI).

<table>
<thead>
<tr>
<th></th>
<th>HAM</th>
<th>NDBI</th>
<th>NDBP</th>
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<tbody>
<tr>
<td>Mean</td>
<td>957.72</td>
<td>750.82</td>
<td>750.40</td>
</tr>
<tr>
<td>SD</td>
<td>596.02</td>
<td>596.47</td>
<td>596.27</td>
</tr>
<tr>
<td>Min</td>
<td>200</td>
<td>257</td>
<td>257</td>
</tr>
<tr>
<td>Max</td>
<td>2006</td>
<td>2006</td>
<td>2006</td>
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</tbody>
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Genetic trends. Yearly mean BV for milk yield at first calving for cows in NDBP, HAM and NDBI are presented in Figure 1. Yearly BV means for NDBI showed a similar pattern to those of NDBP and HAM. They increased between 2007 and 2010 for all populations, but they declined in 2011. Yearly BV means for NDBI were similar to those for NBDP for the 2 years after 2010. BV means for NBDIP was lower than BV means for NBDP except in 2011 when they had similar mean BV values. Mean BV for NBPD were similar to those for NBDP largely due to the few sires with high BV from HAM which were not included in NBDP. Yearly weighted and unweighted sires and cow BV means for milk yield are shown in Figure 2 for HAM, Figure 3 for NBDP, Figure 4 for NBDI. Yearly weighted sires means and Figure 6 presents yearly mean weights for the 3 populations. Lastly, Figure 7 contains weighted sire BV means in Figure 1, except that cow PV means were equal to their own BV means.

Figure 1. Genetic trends for milk production at 305 days of cows per year of calving, for cows and cows (weighted and unweighted means), for the National Breeding Program of Mexico (NDBP), Holstein Association of Mexico (HAM) and the National Bank of Dairy Information (NDBI).

Figure 2. Genetic trends for milk production at 305 days of cows per year of calving, for cows and cows (weighted and unweighted means), for the National Breeding Program of Mexico (NDBP), Holstein Association of Mexico (HAM) and the National Bank of Dairy Information (NDBI).

Figure 3. Genetic trends for milk production at 305 days of cows per year of calving, for cows and cows (weighted and unweighted means) of the Holstein Association of Mexico (HAM).

Figure 4. Genetic trends for milk production at 305 days of cows per year of calving, for cows and cows (weighted and unweighted means) of the National Breeding Program of Mexico (NDBP).

Final Remarks
Farmers consistently used sires with higher breeding values between the years of the study. The frequent use of sires with higher breeding values allowed the increase of genetic and phenotypic values of dairy cows in Mexico. It is important for NBDP farmers to be included in national genetic evaluations programs. These programs are essential to continue to increase milk production and meet the growing demands for dairy products in Mexico. Foreign sires had BV greater than Mexican sires and were more frequently used by farmers during the years of the study. Farmers continue to import significant amounts of semen from the USA and other countries, genetic trends for milk production in Mexico will continue to be influenced by both immigration of genetic material and internal selection of sires and cows.

REFERENCES


