Comparison Of National Genetic Evaluations For Jersey Cattle Used In Mexico And Other Countries

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Introduction

National genetic evaluations of Jersey cattle have been performed in Mexico since 2004. Some breeding animals, semen and embryos considered in the Mexican evaluation came from Canada and the United States, and they have also genetic evaluations in those countries. Studies in dairy cattle have shown that not all imported genetic resources maintain their genetic superiority in the importing country (Cienfuegos-Rivas *et al*. (1999); Montaldo *et al*. (2009)). Mexican breeders have become concerned that rank of the animals evaluated in other countries could be different to the predicted transmitted abilities (PTA) in Mexico. This have practical implications, since it is required to determine whether the shown superiority of animals based on PTA reported in other countries is transferable to Mexican conditions. Therefore, the objective was to compare genetic evaluations for milk, fat and protein yields of Jersey cattle used in Mexico, and those obtained in Canada and the US.

Material and methods

National genetic evaluations for milk, fat and protein yields adjusted to 305 d and mature equivalent of Jersey cattle in Mexico (2008), Canada (August 2008) and the US (April 2009) were used. All genetic evaluations were expressed as PTA (kg). Official genetic evaluation from Mexico included 5,122 lactation records (1988 to 2008) from 3,017 cows, and a pedigree file of 18,422 animals. The PTA were calculated by using a single-trait repeatability animal model. Official PTA of Canadian animals were obtained from the Web site of the Canadian Dairy Network (2008), which reported the use of single-trait test day animal model. Official PTA of US animals were obtained from the web site of the Animal Improvement Programs Laboratory of USDA (USDA-ARS (2009)), which reported the use of multi-breed single-trait repeatability animal model.

The data for breeding animals, semen or embryos with evaluations in Mexico-Canada and Mexico-US were edited to include only animals with a minimum reliability of 0.20. Final number of animals with evaluations in Mexico and Canada were 307 males and 237 females; whereas evaluations in Mexico and the US were 116 males and 865 females. Product-moment correlations between PTA in paired countries were adjusted (r_{PTA}) according to the following formula (Calo *et al*. (1973)): $r_{PTA} = r_{\text{product-moment PTA Mexico-Canada or Mexico-US}} / \sqrt{(\text{average reliability in Mexico})(\text{average reliability in Canada or US})}$. In addition, averages of PTA and reliabilities were estimated for all traits studied.

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Results and discussion

Adjusted correlations between PTA of animals with evaluations in Mexico and the other two countries ranged between 0.75 and 0.84 (Table 1). These values were close to the genetic correlation value (0.8) suggested by Robertson (1959) to consider a genotype-environment interaction (GEI) biologically important, indicating at least some re-ranking of animals.

Table 1: Estimates of adjusted correlations between predicted transmitted abilities (r_{PTA}) of Jersey animals with genetic evaluations in Mexico-Canada and Mexico-US, for lactation yields

r_{PTA}*	N	Milk yield	Fat yield	Protein yield
Mexico-Canada	544	0.83	0.75	0.81
Mexico-US	981	0.78	0.78	0.84

* $r_{PTA} = r_{\text{product-moment PTA Mexico-Canada or Mexico-US}}$ / √(average reliability in Mexico) (average reliability in Canada or US).

Several studies about the presence of GEI for Holstein milk yield between Mexico and Canada, and Mexico and the US have been carried out; however, they have arrived to opposite conclusions. Using correlations between PTA of the same sires used in Mexico and the US, some authors found values close to unity (Powell and Dickinson (1977); Powell and Wiggans (1991); Powell and Sieber (1992)); whereas others less than 0.78 (Valencia *et al.* (1999); Montaldo *et al.* (2009)). Dividing data by production levels within countries, genetic correlations for the high levels in Mexico-Canada and Mexico-US were 0.81 and 0.79; and between low levels were 0.78 and 0.70 (Montaldo *et al.* (2009)). Similarly, estimates of Cienfuegos-Rivas *et al.* (1999) between combinations of low and high production levels in Mexico and the US were less than 0.73, and for high levels in both countries was 0.93.

Considering the present and those previous studies, the results of determining a possible GEI for milk yield between Mexico and other countries will depend on the specific case, and the risk to transfer evaluated genetic resources will increase for more contrasting conditions. Even within Mexico, a similar pattern has been observed (Valencia *et al.* (2008)) when several regions were compared for milk production in Holstein cattle (genetic correlations from 0.38 to 0.93). Studies about GEI between Mexico and other countries for fat and protein yields were not found; however, it is expected a similar situation that for milk yield. Genetic correlations between Holstein genotypes in contrasting countries were lower than 0.35 (Charagu and Peterson (1998)), whereas for less contrasting environments were higher than 0.93 (Carabaño *et al.* (1990)).

In general, sires have more impact in genetic improvement than females. To illustrate the relationships between PTA obtained in Mexico and in the other countries, in Figure 1 the PTA for milk yield of common sires Mexico-Canada (A, n = 116) and Mexico-US (B, n = 307) are shown. The relationship of sires from Canada (r_{PTA} = 0.89) was closer than from the US (r_{PTA} = 0.71), suggesting more important re-ranking of sires evaluated in the US. Similar trend was observed for fat and protein yield, where sires from Canada had r_{PTA} of 0.90 and 1.00, whereas sires from the US were 0.68 and 0.74.

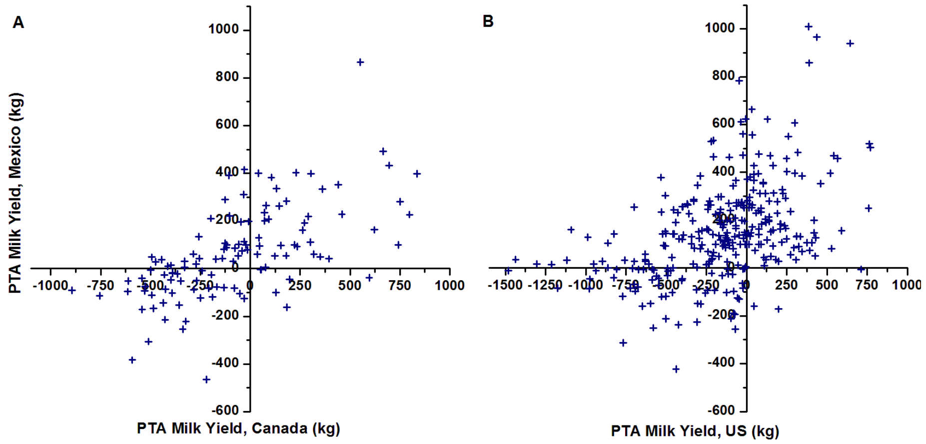

Figure 1: Relationships between predicted transmitted abilities (PTA) for milk yield of Jersey sires with genetic evaluations in Mexico (A, axis Y) - Canada (A, axis X) and Mexico (B, axis Y) - US (B, axis X)

In both paired situations (Figure 1), sires with positive PTA for Mexico and both countries (quadrants II) were the highest proportions (45.6 and 32.8% for Canada and the US), followed by sires with negative PTA for Mexico and both countries (quadrants IV), which had 20.2 and 33.6% for Canada and the US. This indicates that around 2/3 of the sires have lower risk to cause GEI when used in Mexico. Also, the sires with negatives PTA in paired countries indicate that those animals should not be used on Mexico, if the selection objective is for milk yield. Most of the remaining sires had positive PTA in Mexico and negative in the other countries (33.2 and 28.4% for Canada and the US, quadrants I). The pattern of distribution for sires milk PTA was similar to the observed for fat and protein yields.

Averages of PTA of animals with evaluations in Mexico and the other countries are shown in Table 2. The differences in number of animals by sex used in Mexico suggest that the importing country depends mainly on imported genes of females from Canada and males from the US. The animals evaluated in Canada or the US had negative PTA averages, indicating that breeders of Mexico have been buying genetic resources inferior to the average genetic bases of the exporting countries. Also, these results suggest that Mexican breeders are selecting mainly for other traits. The same animals that had negative PTA averages evaluated in exporting countries had positive values when they were evaluated in Mexico (with exception of protein yield for Mexico-Canada). This finding suggests that genetic bases of populations from Canada and the US are probably higher than from Mexican population. As expected, reliabilities obtained in exporting countries were higher (94 and 66% for males and females) than in the importing country (from 42 to 54% for males and from 30 to 39% for females). These results are mainly explained by the smaller database of evaluation in Mexico than the used in Canada and the US. For definitive conclusions about genotype by country interaction, more information about Mexican population is required.

Table 2: Averages of predicted transmitted abilities (PTA, kg) of Jersey animals with genetic evaluations in Mexico-Canada and Mexico-US, for milk (MY), fat (FY) and protein (PY) yields

Countries/Sex	N	MY_M^*	FY_M^*	PY_M^*	MY_{C-U}^{**}	FY_{C-U}^{**}	PY_{C-U}^{**}
Mexico-Canada							
Males	116	66.5	1.3	-0.02	-67.9	-2.5	-2.2
Females	865	16.0	0.1	-0.50	-228.2	-8.3	-7.8
Mexico-US							
Males	307	152.5	3.7	3.0	-148.6	-5.0	-5.6
Females	237	97.7	2.5	2.0	-251.7	-7.4	-8.8

* Averages of PTA in Mexico.

** Averages of PTA in Canada or US.

Conclusions

Ranking of Jersey cattle with national genetic evaluations in Canada and the United States is different to the ranking of the same animals evaluated in Mexico, for milk, fat and protein yields. Re-ranking of sires from the United States is higher than from Canada. Averages of predicted transmitted abilities of genetic resources used in Mexico that come from Canada and the United States are negative in their country of origin for lactation yield traits, and Mexican breeders probably are not buying based on those values. Some animals from the exporting countries must not be used in the importing country (negatives in both countries), if selection objectives are lactation yield traits. Reliabilities of genetic evaluations in the Mexican population should be increased to have definitive conclusions.

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