Evaluations of Holstein Bulls and Cows in Ecuador

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ABSTRACT

Adjustment factors for age and month of calving were developed from Holstein lactation records in Ecuador. Age factors were similar to those in the United States, but calendar month effects were small, apparently because of uniform feeding and management as the result of a similar climate throughout the year. Genetic evaluations were computed with the USDA animal model system but without identification for dams. Thus, resulting evaluations were essentially from a sire model. Highest bull evaluations were associated with semen imported from the United States. Highest cow evaluations were for daughters of United States bulls. Use of United States bulls has tended to increase in recent years. Correlation between animal model evaluations from United States data and those from Ecuadorean data for 107 bulls in common was much less than expected (.42 vs. .72), perhaps because of assortative mating, genotype-environment interaction, or a combination of the two.
(**Key words**: genetic evaluation, Ecuador, animal model)

INTRODUCTION

Studies of interaction between genotype and environment for yield of dairy cattle (1) have generally concluded that such effects are small. Ranking for bulls evaluated in Mexico was similar to that expected from US evaluations with accuracy considered (7). Although such studies often compare bull evaluations in different countries, herd management in different countries may not be much more different than herd management within a country. Herd management in the Mexican testing program was similar to that for US herds. In justifying efforts to maintain indigenous breeds or strains, Maijala (1) pointed out that failure to find interactions may be largely from failure to examine performance in environments that were significantly diverse. Peterson (5) reported a significant interaction for Canadian sires used both in Canada and in New Zealand. The management system in New Zealand relies primarily on grazing.

Dairying in Ecuador is largely in the high altitudes of the Andes, as much as 2 km above sea level. Concentrates are expensive, and nearly all dairy cattle feed is pasture (Mora, personal communication) in contrast to the US where moderate to heavy grain feeding is typical.

The production testing program in Ecuador is patterned largely after the DHI program in the US. Supervisors visit farms monthly to gather data, and reports and action lists from the central computer facility are returned to clients on forms that use those from the US as a model. Two of the major differences are that the program is run by Asociacion Holstein Friesian del Ecuador, the Ecuadorean breed association for Holsteins, rather than by a separate testing organization and that only about half of milk is tested for fat content. Although this lack of testing for fat may seem unusual, this situation parallels that in the US for protein percentage a few years ago.

Ecuador does not have a genetic evaluation program for dairy cattle. However, semen and bulls from the US have been imported into

Received December 28, 1989.
Accepted May 29, 1990.
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TABLE 1. Numbers of cows by birth year of cow and origin of sire identification and ratio of US- to Ecuadorean-sired cows.

Cow birth year	Number of cows with US sires	Number of cows with Ecuadorean sires	US-sired cows: Ecuadorean-sired cows
≤1974	43	166	.26:1
1975	95	216	.44:1
1976	170	401	.42:1
1977	220	575	.38:1
1978	268	732	.37:1
1979	489	604	.81:1
1980	648	628	1.03:1
1981	576	688	.84:1
1982	497	682	.73:1
1983	554	542	1.02:1
1984[1]	183	218	.84:1
≥1985[1]	5	2	2.50:1
All years	3748	5454	.69:1

[1]Incomplete data.

Ecuador. The primary purpose of this study was to develop genetic evaluations for Holstein bulls and cows in Ecuador and to examine possible differences in ranking of bulls evaluated in the US and Ecuador. A secondary purpose was to provide evaluations to assist in current selection decisions and thereby promote genetic progress in Ecuador.

MATERIALS AND METHODS

Data from Holstein cows in testing programs in Ecuador were received through a cooperative agreement between USDA and Utah State University, which had access to data from the Ecuadorean testing program through a program sponsored by the US Agency for International Development. Distribution of cow birth dates is in Table 1. Pedigree data from Ecuador were available only for bulls, and this information was supplemented by data from the USDA pedigree file for males. Lactation records did not include dam identification. About half of the 28,406 lactation records contained fat data.

Lactation records were not included if calving date was less than 10 mo after the previous calving date. Milk yield was required to have been between 3.6 and 40.8 kg/d and fat percentage (if available) to have been between 1.7 and 6.0. These edits removed about 4% of lactation records. Because few cows are culled in Ecuador if they are giving any appreciable amount of milk, lactation records shorter than 220 d were rare and were not provided by cooperators in Ecuador. Of the records received, 72% were for lactations of 305 d; 84% were for lactations of at least 280 d. Because of this, lack of last sample-day data, and no records in progress, lactation records were not projected. Almost no cows are turned dry prior to 305 d to provide an ample dry period. Mean lactation length for cows with US sires was about .5 d longer than for cows with Ecuadorean sires (296.2 vs. 295.6 d). These means show that few lactations were appreciably less than 305 d.

Age and month of calving factors were calculated from 26,533 lactation records of 12,403 cows. The model was the same as used by Norman et al. (2) and included fixed effects of calendar month, age group, age within age group, interaction of age group and calendar month, and herd-year and random effects of cow within herd-year and residual. Ratio of 1:1 for residual-to-cow variance corresponded to a repeatability of .50. The 23 minor age classes within groups were the same as in (2), but 4 major age groups instead of 6 were used.

Genetic evaluations were calculated with the USDA animal model system (9). However, because dams of females were not known, resulting evaluations were essentially the same as those from a sire model. Cows were required to have a first lactation record, and only lactation records from the first herd were accepted. Data were more numerous for cows born after 1978 with increased representation of US sires (Table 1). Many of the bulls referred to as Ecuadorean were purchased in the US and registered in Ecuador. Male pedigree data provided by Holstein Friesian del Ecuador contributed to relationships in the animal model evaluations.

RESULTS AND DISCUSSION

Example age and month of calving factors for Ecuador are in Table 2. Because of the limited number of records with fat data, only results for milk yield are reported. Base age (maximum yield) was 80 mo, which is similar to 79 mo for milk yield in the US (3). Similar feeding and management throughout the year because of a more uniform environment may be the reason for Ecuadorean factors that were

TABLE 2. Example factors for adjustment of lactation milk yield for age and month of calving in Ecuador.

Age (mo)	January	March	May	July	September	November
24	1.29	1.29	1.29	1.31	1.29	1.31
36	1.19	1.18	1.20	1.20	1.20	1.20
48	1.09	1.10	1.09	1.11	1.08	1.09
60	1.04	1.04	1.04	1.05	1.03	1.05
72	1.02	1.01	1.01	1.02	1.02	1.00
80[1]	1.00	1.00	1.00	1.00	1.01	.98
84	1.01	1.01	1.01	1.01	1.01	.99

[1]Base age.

similar across months for a given age. National Holstein factors for the US vary by .07 at 24 mo of age (3). Lactation data were adjusted by Ecuadorean factors for use in calculating evaluations.

Superiority of US genetics is clear as shown by mean PTA in Table 3 and Figures 1 and 2. Of the top 100 cows for PTA milk in Ecuador, 76 were sired with semen that had been imported from the US. In comparing the two groups of sires, it must be remembered that US sires were selected for use in Ecuador, whereas many of the Ecuadorean sires, even those used through AI, were used with little or no knowledge of their genetic merit when breeding decisions were made.

The positive impact of US genetics is demonstrated further in Table 4. For simplicity, all non-US identification numbers were considered to be from Ecuadorean animals, although in rare cases that may not have been true. Genetic merit was higher with increased US background. Bulls imported from the US (Ecuadorean bull number but US parents) had the highest average reliability. These bulls averaged 84 daughters in their evaluations compared with 26 for all other bulls. Mean PTA for imported bulls were 121 kg lower than that for bulls used through imported semen and only 5 kg higher than for Ecuadorean bulls from US sires and Ecuadorean dams. The expense of importing US bulls does not seem to be warranted. Importing semen from top US bulls to use on top Ecuadorean cows would seem to be more economical.

Ecuadorean evaluations were released for 215 bulls that had at least 10 daughters or, if reliability was 40% or more, at least 5 daughters. Measure of US merit was PTA from USDA preliminary animal model evaluations using data available for January 1989 Modified Contemporary Comparison (MCC) evaluations (8). Correlation of PTA from the US preliminary animal model evaluations with PD from MCC evaluations was .99 for the 107 bulls that also were evaluated in Ecuador.

Correlation of bulls' PTA in Ecuador and the US was .42 compared with an expected value (square root of product of average reliabilities) of .72. The discrepancy may result from a true genotype-environment interaction or from limitations of the data. An interaction is possible because of the difference in feeding practices between the countries: high concentrate feeding in the US compared with little or none in Ecuador. Genetic ability to convert pasture into milk may be a trait different from ability to use a high grain diet, a hypothesis supported by the interaction reported by Peterson (5). Because identification was not available for dams of cows, the model did not account for merit of bulls' mates. Although merit of mates is of little importance in the US (4), it is more likely to have an impact in Ecuador where all bulls considered in the interaction investigation were used through imported semen. If such bulls are used selectively with regard to yield (some with positive assortative mating and some with negative assortative mating), correlation with the US evaluation would be lowered. Nearly half (46%) of herds with at least 20 cows in the data had 25 to 75% US sires. Therefore, there was opportunity for differential mating between US and Ecuadorean bulls in addition to assortative mating among US bulls.

Correlation between differences in evaluations (US minus Ecuadorean) with US PTA was .87, which suggests that evaluations for high ranking US bulls may have been restricted

TABLE 3. Mean PTA milk for cows and their sires by birth year of cow and country of sire identification.

Cow birth year	US Cow PTA	US Sire PTA	Ecuador Cow PTA	Ecuador Sire PTA
	(kg)			
1975	−30	−2	−57	−82
1976	−20	−33	−36	−77
1977	−13	−4	−71	−92
1978	+37	+38	−30	−83
1979	+17	+23	−43	−99
1980	+40	+56	−41	−80
1981	+46	+57	−25	−70
1982	+43	+47	−14	−72
1983	+107	+88	+33	−50
1984[1]	+137	+125	+52	−38
All years	+45	+48	−26	−77

[1]Incomplete data.

because of environment. The SD for PTA in Ecuador was only half (159 kg) that for US PTA (319 kg). The reduction may result from both lower reliability (54 vs. 96%) and lower yield. Average standardized milk yield in Ecuador was only 4468 kg compared with over 8000 kg in the US for the same period (6).

Failure of US PTA to reflect ranking of Ecuadorean PTA as accurately as expected from the reliabilities of evaluations occurred mainly for bulls not at the extremes. Mean US and Ecuadorean PTA for deciles of bulls based on US PTA are in Table 5. Bulls in the top and bottom deciles were the high and low ranking bulls in Ecuador. However, the relationship was not close for the other 80% of bulls. The lower SD of PTA in Ecuador may have contributed to that lack of agreement. Some failure to follow an expected positive relationship between two sets of PTA may be explained by the small number of bulls in each decile. However, a closer overall relationship was expected. Mean

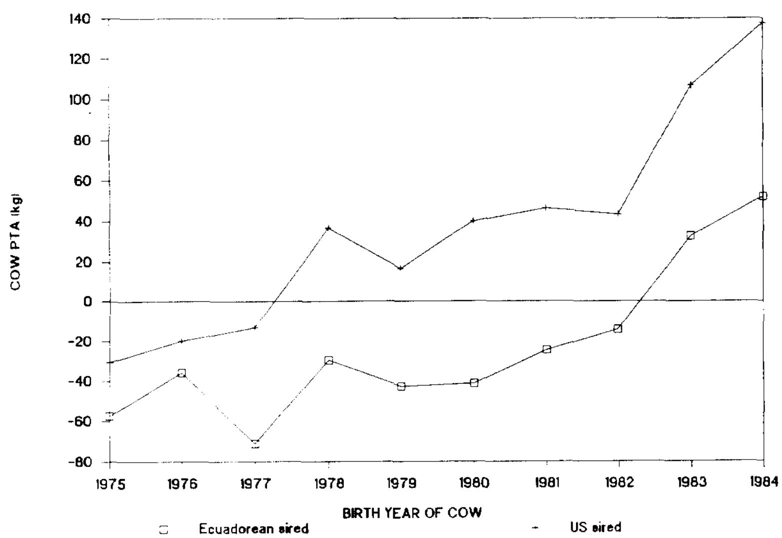

Figure 1. Mean PTA milk of cows by birth year of cow and country of sire identification.

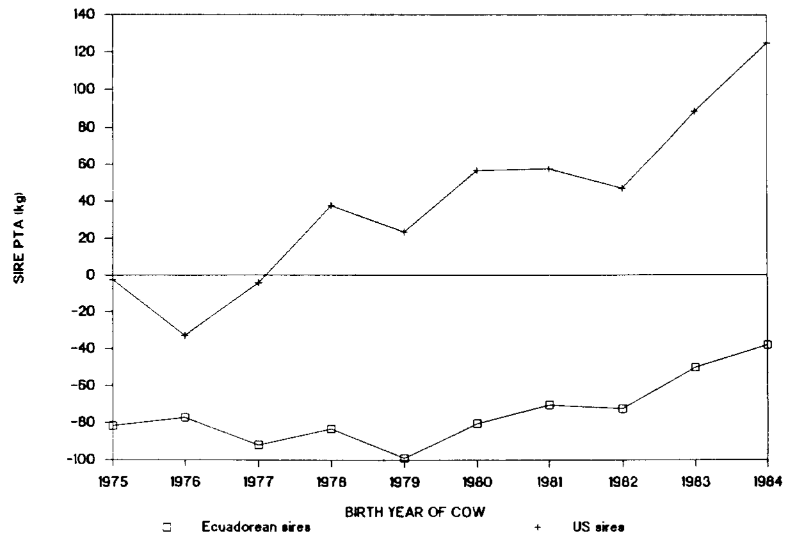

Figure 2. Mean PTA milk of sires by birth year of cow and country of sire identification.

TABLE 4. Mean bull PTA milk and reliability according to country of identification of bull and parents.

Country of identification			Number of bulls	PTA milk	Reliability
Bull	Sire	Dam			
				(kg)	(%)
US	US	US	110	+65	54
Ecuador	US	US	31	−56	65
Ecuador	US	Ecuador	40	−61	42
Ecuador	Ecuador	Ecuador	34	−134	41

TABLE 5. Mean US and Ecuadorean PTA and Ecuadorean rankings for 107 bulls based on US rankings.

Decile based on US PTA	Number of bulls	PTA		Mean rank in Ecuador among the 107 bulls
		United States	Ecuador	
		(kg)		
Top	10	+380	+288	21
2	11	+231	+46	58
3	11	+59	+74	52
4	10	−55	+153	37
5	11	−136	+83	50
6	11	−219	+38	56
7	10	−307	+27	59
8	11	−392	+30	67
9	11	−464	+58	57
Bottom	11	−704	−48	79

PTA in Ecuador was positive for US bulls for all but the lowest decile.

CONCLUSIONS

Seasonal effects on yield were relatively small in Ecuador compared with those in the US. Genetic evaluations were highest for US bulls and their daughters. However, evaluations of 107 bulls with evaluations in both the US and Ecuador were not as highly correlated as expected from reliabilities of the pairs of evaluations. Whether this indicates a true genotype-environment interaction or is the result of failure to account for assortative mating with imported semen or both is unclear. To determine which is true, evaluations need to be computed with merit of mates considered. This adjustment to evaluations requires data that include identification of dams of daughters; although these data were not available for this study, they are anticipated in future data sets that will allow more definitive conclusions.

ACKNOWLEDGMENTS

This project was part of a cooperative agreement between ARS-USDA and Utah State University. Cooperation of the Asociacion Holstein Friesian del Ecuador and particularly Fernando Mora is appreciated greatly.

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