July 1975

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Sire Comparisons for Holsteins in Mexico Versus the United States and Canada[1]

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ABSTRACT

Henderson's mixed model procedure was used to determine sire comparisons for Holstein sires from the United States, Canada, or local bred in 48 Mexican herds. For sires with five or more daughters, 74% of the sires in artificial insemination from the United States had plus values compared to 34% from Canada, 44% from the local stud, and 40% for local bred sires. Genetic correlations with Mexican sire comparisons were Northeast Artificial Insemination Sire Comparison with >20 daughters in Mexico .86, with 10 to 20 daughters .71, United States Department of Agriculture (USDA) proof >10 daughters .81, and Canada Northeast Artificial Insemination Sire Comparison with >10 daughters .61. Correlations with United States proofs indicate effects of sire by location were small. Cow origins were imports from Canada or the United States (imports), sired by imported semen or sires (.5 imports), and locally bred (locals). Differences between imports and .5 imports were small, but cows of United States origin exceeded Canadian by 300 to 500 kg in milk yield. Progeny of imported sires (.5 imports) were lower in milk yield than progeny from sires in artificial insemination. Locally produced cattle were poorer than imports or .5 imports by sires in the United States or Canada.

INTRODUCTION

Currently, the export of females of dairy breeds from the United States is about 35,000 per year (11). In 1973, 62% of the 33,987 exported went to countries in the subtropics or tropics. The annual export of semen from dairy bulls in the US is about 750,000 services. The majority of the semen also goes to the warm climate regions. About 90% of females and over 80% of the semen exported have been Holstein. Canada also is exporting females and semen to many of the same countries.

Those concerned with livestock development in the subtropical and tropical regions frequently have reservations about the introduction of cattle and semen from temperate regions. In Mexico, which had few cattle suitable for commercial dairying, the better genetic potential of breeds like Holstein has been recognized. Those willing to concede that importations might be wise have stressed that the exotic cattle should serve as a base from which strains could be selected for adaptation to local conditions. Towards achieving this goal, AI (artificial insemination) centers and progeny testing schemes on a limited scale have been set up in several countries. The lack of technically trained personnel and other resources hinders the conduct of an extensive progeny testing program.

Most studies in the US on interactions of sire by location or sire by herd (5, 6, 7, 10, 13) have concluded these interaction effects were not important. Lytton and Legates (6) and Thomas (10) reported correlations of .9 to 1.0 between the average breeding values of sires in the northern and southern regions of the US. Projections from these studies suggest that ranks for breeding values of sires would be similar in temperate and tropical areas.

The objective of this study was to determine the correlation of sire values for US and Canadian sires used in herds of Mexico and to evaluate the relative sire values of AI progeny tested sires, sires exported to Mexico, and sires selected from herds in Mexico. The comparative performances of imported cows, cows sired by imported bulls or semen, and local bred cows

Received July 31, 1975.

[1] This work was part of the Southern Regional Dairy Cattle Breeding Project, S-49 (Genetic Methods for Improving Dairy Cattle for the South).

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were also investigated. In addition, some sires used in Puerto Rico were evaluated.

MATERIALS AND METHODS

Source of Data

The Asociación de Criadores Holstein-Friesian de México sponsors a DHIA (Dairy Herd Improvement Association) program. Records are processed at the Regional Center, Provo, UT, and completed records are forwarded to USDA. The 48 herds in the study were located between 19° and 23° north latitudes at elevations ranging from near sea level to 800 m. The region varies from warm and humid to hot and dry (9). The herds consisted mainly of cattle registered with the Mexico Holstein-Friesian Association plus grade Holsteins and some crossbreds or other breeds. A number of the cows were imports from Canada or the US. Most of those locally bred were progeny of semen or sires imported from Canada or the US.

There were 27,556 records for calvings from 1969 to 1973, but only records with the following characteristics were included: cows coded as Holsteins, accurate sire identification, days in milk between 60 and 305, more than 600 kg milk yield, birth date, calving date, normal lactation termination code, and the first available record. After editing there were 7634 milk records used for determining sire comparison values (SC). These records were adjusted to a mature equivalent basis with factors for age-month of calving for New York. Fat tests were not recorded in Mexico.

There were only 12 of the 56 herds on DHIA in Puerto Rico which recorded sire identification. Most sires had few daughters; hence, the main study centered on Mexico.

Methods of Analysis

Sires were grouped according to country of origin, Canada, Mexico, or US. For estimates of genetic trend and to facilitate computation of sire comparisons, sires were sorted into groups of 50 by sequence of registration numbers within country of origin.

The model to represent a daughter record was:

$$Y_{ijkl} = \mu + hys_i + g_j + s_{jk} + e_{ijkl}$$

where

Y_{ijkl} = daughter's mature equivalent production;
μ = population mean;
hys_i = fixed effect of i^{th} herd, year, season group;
g_j = effect of the j^{th} sire group;
s_{jk} = effect of the k^{th} sire within the j^{th} group; and
e_{ijkl} = random error.

Estimates for sire groups (g_j) and sires (s_{jk}) were by Henderson's mixed model procedure (4). Sire comparison values were calculated by adding the estimates of group effect to the predicted sire values and adjusting to a mean of zero.

For those sires which had daughter records in the US or Canada, correlations were between the separate SC values computed from the two daughter groups for each source of daughter record; NEAISC (Northeast AI SC), December, 1974 (3); USDA, PD (Predicted Difference) 1974 (12); and Canadian proof, NEAISC procedure (unpublished). To estimate more accurately the true genetic correlation between these values, the phenotypic correlations were adjusted for differences in numbers of daughters. The formula was:

$$A = \sqrt{(\Sigma b_c)(\Sigma b_m)/b_c b_m} \text{ with}$$

$b_c = n/(n + 15)$, where n = number of records used in the US or Canadian proof (comparison group); and
$b_m = m/(m + 15)$, where m = number of records in the Mexican SC.

RESULTS AND DISCUSSION

Sires Selected from AI

The percentages in Table 1 show that less than 50% of the sires chosen were plus in predicted difference (PD) for milk and fat yield in the 1974 US and Canadian proofs (1, 12). Random samples of sires of similar age from these same sire summaries showed the average PD for Holsteins was −19 kg for milk and −1 kg for fat in the US and −44 kg of milk and +3 kg of fat in Canada.

The average milk yield for daughters was below breed average for more than 50% of the sires. However, the progeny of these sires tended to excel breed average in fat percent and

TABLE 1. Evaluation of AI sires from Canada and the US used in herds of Mexico and Puerto Rico.

Item	Mexico	Puerto Rico
No. sires with proofs	179	81
+ Predicted diff. for milk (%)	44	46
+ Predicted diff. for fat (%)	44	33
Daughter avg > breed avg (%)		
Milk yield	46	43
Fat %	61	64
Type classification	81	65

TABLE 2. Distribution of herd averages in milk yield for cows calving during 1973 in Mexico.

Milk (kg)	No. herds	% Herds	No. records
> 6000	7	15	640
5500 to 6000	7	15	788
5000 to 5500	9	19	556
4500 to 5000	12	25	588
4000 to 4500	10	21	560
< 4000	3	6	167
Total	48		3299

type score (Table 1). Apparently both Mexican and Puerto Rican dairymen give considerable emphasis to type score in the selection of AI sires. Although the daughter average for fat percent tended to exceed breed average, it is unlikely that fat percent was given much attention as both Mexico and Puerto Rico require a minimum fat test of 3.0% with little or no premium for higher content.

Herd Average Milk Yield

The stratification of herd averages in milk yield for cows calving in 1973 is in Table 2. The average for all actual records in 1973 was 4750 kg (sd ± 1200 kg). The annual rate of increase was around 60 kg since 1969 (9). The DHIA average for Puerto Rico in 1973 was 3800 kg or 950 kg less than for Mexico with about the same annual rate of increase since 1970. The average for Mexican herds indicates reasonably good feeding and management. Further description on the herd environments was published earlier (9).

Genetic Trend

To derive an estimate of genetic trend, all sires (AI, plus imports) with US, Canadian, or Mexican registration numbers were grouped by year of birth and proofs calculated according to NEAISC procedure. The solutions were adjusted to sum to zero. The sire values in Table 3 indicate a positive genetic trend for sires from the three countries.

Average SC values for cows calving yearly from 1969 to 1973 are in Fig. 1. Similar to Table 3, the designations US, Canada, or Mexico represent origin of the sires. There was a distinct positive trend with time for US and Canadian bred sires but not much change for sires born in Mexico.

Sire Comparisons

In Table 4 are the average SC values for all bulls with 5 or more daughters and those with 20 or more daughters in Mexican herds. The groups designated as AI US and AI Canada were

TABLE 3. Average sire comparison values (SC) in milk (kg) yield for sires grouped by year of birth and country of origin.

Birth period for sires	US		Canada		Mexico	
	No.	SC	No.	SC	No.	SC
< 1956	49	-87	44	-304		
1956 to 1958	50	-6	100	-154		
1959 to 1961	50	89	100	-135		
1962 to 1963	50	211	50	-59	19	-267
1964 to 1965	50	310	100	-56	25	-98
1966 to 1967	50	181	100	146	25	-91
> 1967	6	368	81	206	11	-9

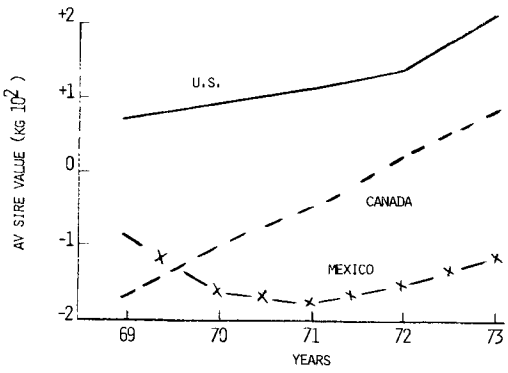

FIG. 1. Average sire comparison values for sires with daughters calving 1969 to 1973 in Mexican herds by country of origin.

identified as being from studs in one of the countries. The group classed as Private consisted of bulls imported from Canada or the US and bulls selected from herds in Mexico. The group identified as AI Mexico were sires in the local AI stud at Queretaro, Mexico. All nine AI bulls with proofs originated from Canada. The latter two groupings were made for a comparison of the quality of sires chosen from local herds or those selected by breeders for importation to those from AI.

The SC for milk averaged highest for US sires (Table 4) while the average values for the other three groups were considerably lower. For sires with five or more daughters, 74% of the 89 AI US sires were above average. In the AI Canada group, 34% were above average, in the Private group 40%, and in AI Mexico 44% were above average.

The sire comparisons indicated that herds which used AI US sires introduced greater genetic potential for milk yield than herds using the other three sources of sires.

Correlations of Sire Values

The SC from the Mexico data were correlated with values from available sire summaries (Table 5). In calculating the correlations, adjustments were made for number of daughters included in the two proofs. This procedure affected the correlations but did not remove all differences associated with number of daughters since the correlation improved as the number of daughters in Mexico increased. When there were 10 or more daughters, the correlations between Mexico and NEAISC or USDA proofs were high (.71 to .86), but the correlation was lower between Canadian and Mexican proofs (.61). The reasons for the differences in magnitude of relationship is not clear.

At the time this study was initiated, factors derived from Mexican data to adjust records for age-month of calving were not available. Factors for New York were used. Effects of month of calving appear at least twice the magnitude in Mexico as New York (9). Thus, the correlations may have been higher had other adjustment factors been used.

The sire selection differential also may have affected the correlations. That only 46% of the bulls selected from AI in Canada and the US

TABLE 4. Average sire comparison values (SC) in milk (kg) for sires with 5 or more and more than 20 daughters in Mexican herds.

Sire groupings	>5 Daughters			>20 Daughters		
	No. sires	Avg. no. daughters	SC milk	No. sires	Avg. no. daughters	SC milk
AI US[a]	89	15	167	18	40	217
AI Canada[b]	115	27	-79	41	60	-161
Private[c]	91	18	-75	25	38	-105
AI Mexico[d]	9	21	-12	2	60	-86

[a]Sires in AI studs of US.

[b]Sires in AI studs of Canada.

[c]Sires used in one or more herds in Mexico with origin as import or born in Mexico.

[d]Sires identified in the AI stud in Mexico (all of Canadian origin).

TABLE 5. Genetic correlations between proofs for sires used in Mexico or Puerto Rico and proofs in the US or Canada.

Sire summaries	No. daughters	No. sires	Correlation
		Mexico	
NEAISC	>20	28	.86
	>10	47	.71
	>5	100	.65
	All	233	.46
USDA	>10	29	.81
	All	170	.64
Canadian	>10	64	.61
		Puerto Rico	
USDA + Record of performance, Canada	>10	18	.66
	>5	44	.56
	All	62	.43

were +PD for milk (Table 1) suggests the distribution in quality of sires was moved toward the minus side.

The correlations between proofs in Puerto Rico and outside were lower than for Mexico in the five or more daughter grouping but similar for the all grouping (Table 5). The lower correlations with Puerto Rico proofs were attributed to not differentiating USDA and Canadian proofs in the correlations.

Correlations for sires with 10 or more daughters in each location indicate that effects of sire by location between temperate and tropical areas should be small. From the average SC for US AI sires (Table 4), it appears dairymen in Mexico could expect to increase milk yield most rapidly through the use of good quality sires from US AI studs. Certainly this procedure is recommended for at least the next 10 yr because of the limited resources presently available in Mexico to collect and work with sire sampling programs. The same goes for Puerto Rico as they too have a local AI stud but lack manpower and other resources effectively to manage a sire sampling program.

Cow Performance

A number of the herds in Mexico contained imported cows. In some cases, the imports were selected by pedigree and in other instances entire herds from the US or Canada had been moved to Mexico. However, a large portion of the imports was ordered in lots of 100 or more from commercial cattle dealers in Canada or the US. To estimate comparative performance attributable to origin of females, average sire values and lactation milk yields were computed. Cows with fewer than five paternal half sisters in Mexico were classed as imports (Table 6). Daughters of AI sires in Canada or the US with more than five paternal half sisters in Mexico were assumed to be offspring from imported semen and were classed as .5 imports. The .5 imports under Mexico (Private or AI) were progeny of imported sires. For those classed as Local, both sires and cows were at least one generation beyond imports.

For both US and Canadian sire progeny, the differences in average milk yield and average SC for imports and .5 imports were small (Table 6). Progeny of imported sires, .5 imports, Mexico AI, or Private were considerably lower in milk yield than imports or .5 imports by US and Canadian sires. The average SC for local sire was lowest, but average milk yields of their progeny were about the same as for the imported sires. These results indicate imported cattle or progeny of sires from temperate areas can be expected to perform as well or better than locally bred cattle unless selection is much more intensive for sires produced in Mexico.

Van Vleck (13) showed genetic variability could differ between environments. Thus, lower estimates of genetic variability could be associated with lower production. Although McDow-

TABLE 6. Weighted average sire comparison value and daughter average milk yield for cows classified as imports, .5 imports, or locals.

Origin of sire	Cow classification	No. cows	Avg sire value (kg)	Avg milk yield Mexico (kg)[a]
US	Import[b]	742	118	5451
Canada	Import[b]	1124	-30	4924
US	.5 Import[c]	2124	170	5194
Canada	.5 Import[c]	5053	13	4885
Mexico, Private	.5 Import[d]	1343	-9	4432
Mexico AI	.5 Import[d]	301	-30	4297
Mexico	Local[e]	1311	-148	4527

[a]Mature equivalent basis.

[b]Imported as bred heifers or cows.

[c]Cows sired by AI bulls in the US or Canada.

[d]Cows sired by bulls imported from the US or Canada.

[e]Both sires and cows at least one generation beyond importation.

ell (9) found the total variation in milk yield in Mexico was similar to that reported for the temperate areas, it is possible that the lower production for Holsteins in Mexico would influence the estimates of transmitting ability among sires. If this is an acceptable hypothesis, it should prove more feasible to select sires proved under better environmental conditions, like Canada and the US.

The results of this study show that AI organizations can promote the export of semen from good sires with greater confidence. There are reservations, however, that will need consideration. Fat tests were not available in Mexico, but Camoens (2) found the percentage of the total variance in fat percent associated with sire was zero in Puerto Rico. This aspect needs further study.

A number of breeders in Mexico seem convinced that progeny of sires above average in type classification give better net performance than progeny of sires with high SC for milk and average to below breed average in type because of better reproductive efficiency on the part of the progeny of the former. Some breeders also contend the incidence of "wooly coated" animals is higher among the progeny of imported semen or sires than for locally bred animals. Wooly coat influences performance of cattle in the tropics (8) and is often caused by malnutrition and internal parasites. Thus far, possible sire relationships have not been demonstrated.

The study also suggests Holstein females exported to tropical areas can be expected to perform as well as locally producing Holsteins. This hypothesis leads to the conclusion that some of the traditional concepts about the adaptation of Holsteins to tropical areas ought to be reexamined.

ACKNOWLEDGMENT

The authors wish to thank R. W. Everett, Extension Division, Department of Animal Science, for assistance in the analysis and L. R. Schaeffer, University of Guelph, for supplying the Canadian sire comparison values. Our appreciation also goes to E. Cabello F., Asociación de Criadores Holstein-Friesian de México, for help in sire identification, and to the Animal Physiology and Genetics Institute, US Department of Agriculture, Beltsville, MD, for making the records available.

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