Rev. Brasil. Genet. 16, 4, 949-956 (1993)
(Brazil. J. Genetics)

FACTORS AFFECTING PERFORMANCE OF HOLSTEIN AND JERSEY BY SAHIWAL CROSSBRED DAIRY CATTLE IN PAKISTAN*

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ABSTRACT

Performance of 138 crossbred dairy cows at the Livestock Production Research Institute, Pakistan was evaluated. Animals were offpring of crosses of Sahiwal females with Holstein or Jersey males. Total milk yield of Sahiwal dams mated to Holstein sires was 229 kg higher (17%) than yield of dams mated to Jersey sires. Adjustment of daughter performance for yield and length of record of dam did not alter differences in performance appreciably between the two breed groups although the adjustments were statistically significant. Adjusted for performance of dams and other environmental factors, lactation milk production was higher for Holstein crossbreds than for Jerseys (total yields, 2864 and 2539 kg; 305 day yields, 2710 and 2395 kg), based on 233 Holstein and 96 Jersey lactations. Means for other responses for the two groups were birth weight, 24.6 and 19.6 kg; age at puberty, 410 and 390 days; weight at puberty, 256 and 217 kg; weight at 15 months, 282 and 250 kg; age at first parturition, 755 and 781 days; weight at first parturition, 374 and 345 kg. All breed estimates differed. Effects of month of parturition were detected for total and 305 day milk yield, with a range of about 850 kg. Month of birth effects were detected for ages at puberty and first parturition, and for weight at 15 months, but not for other responses. Except for estimates of zero for age and weight at puberty and weight at 15 months, values within breed of heritabilities were similar, or slightly lower than those found in temperate dairy areas. Research continues to evaluate performance of subsequent crosses.

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* Florida Agricultural Experiment Station Journal Series Number R-02918.

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INTRODUCTION

Crossbreeding, as a system to develop new breeds or as a part of an upgrading program, is a widely used method of improving milk yield and profitability of native stock in many developing dairy production areas of the world. Certainly no single system can be best for all environmental and management systems now existent; a frequent limiting factor, however, is lack of management expertise, rather than shortages of feed or unfriendly environment. Potential of Sahiwal for milk and beef in Africa was reviewed exhaustively by Trail and Gregory (1981). They evaluated performance of Sahiwal as a part of multibreed (up to eight) composite breeds, and indicated that such composites were promising for various ecological zones and production systems in Africa. Crossbreeding research from 1911 to date in the U.S. was reviewed by Touchberry (1992). Theoretical aspects, including mathematical models for statistical analysis, were presented by Swan and Kinghorn (1992); they also discussed use of crossbreeding and multiple ovulation and embryo transfer (MOET). These latter two publications list 97 references concerning crossbreeding. Branton *et al.* (1966) evaluated Zebu (Red Sindhi) and European (Holstein and Jersey) crossbred performance in Southeastern United States. Their research and review suggested that such crossbreds had little potential under environmental and economic conditions of the U.S. Crossbreds were unacceptably poor, compared to European animals, in productive measures: they showed superior physiological adaptability, however, in resistance to heat stress and parasites.

High producing dairy cows of European origin, such as Holstein and Jersey, often do poorly or even fail to survive in tropical and subtropical areas (McDowell, 1972; Williamson and Payne, 1978), particularly if they are imported as adult animals. Yet native cattle often stay alive, reproduce, and produce meat, milk and labor under the same conditions; as milk producers, however, they are relatively unproductive. Breeders logically have used native cattle as a basis for crossbreeding and upgrading programs; Sahiwal and Jersey crossbreds, known as Australian Milking Zebu (Williamson and Payne, 1978) already have demonstrated promise for tropical use. Objectives of the present study were to compare milk yield and overall performance of first generation crossbred offspring of Sahiwal females mated to either Holstein or Jersey males.

MATERIAL AND METHODS

The Sahiwal herd at the Livestock Experiment Station, Bahadurnagar, Pakistan was crossbred with imported frozen semen of Holsteins and Jerseys mainly from the USA, Australia, West Germany and New Zealand. Pregnant Sahiwal cows carrying F_1 crossbred calves were separated and placed under special management about eight weeks prior to parturition. Details of the feeding and management program, from birth through first parturition, and beyond, are presented by Chaudhry and Shah (1989).

At parturition, milking animals were fed concentrates according to production, 1 kg concentrate per 3 kg milk, plus 2 kg of concentrate. Milking was twice daily. Green forage was provided throughout *ad libitum*, berseem and oats during winter and sorghum, corn and cowpeas during summer. Data were screened as follows. Gestations < 240 or > 315 days and calving intervals of < 270 or > 750 days were deleted. Cows were hand milked in absence of calf; yields were recorded daily. If cows dried off spontaneously even before 305 days, they were recorded as having milked 305 days.

Data were analyzed by the method of least squares analysis of variance (Harvey, 1990). Model used was Model 5. The mathematical model for milk yield included age at parturition (cubic), length of record (quadratic), daughter within sire, sire within breed, breed (Holstein or Jersey by Sahiwal crossbred), milk yield and length of record of dam (quadratic), and month and year of parturition. Weight at parturition was not included in the model since it was not recorded in 181 of the parturitions.

RESULTS AND DISCUSSION

Average (simple) lactation performance of the base population of Sahiwal cows used for crossbreeding is shown in Table I. Mean yields are typical for many tropical and subtropical developing areas of the world (Wilcox *et al.*, 1990). Average lactation length of all records was 318 days. It is apparent that matings were not totally at random in that Holstein males were mated to phenotypically superior Sahiwal females. Superiority was 231 kg milk and 32 days in lactation. Milk yield and days in milk of dam were statistically significant and therefore were included in the mathematical model for comparing the crossbred groups.

Least squares means for eight measures of performance are shown in Table II. The performance of Holstein crossbreds was greater than that of Jersey crossbreds for all variables except age at first parturition. Under subtropical Florida management conditions, pure Jerseys tended to freshen for the first time nine days younger than

Table I - Average first lactation performance of dams of Holstein and Jersey crossbreds.

Breed	No.	Milk yield (kg)	Length of lactation (days)
Holstein	91	1578	282
Jersey	36	1347	250
Overall[1]	127	1513	273

[1]Performance of base Sahiwal population.

Table II - Least squares means for Holstein and Jersey by Sahiwal crossbred cows.[a]

Trait	Observations (no.)	Breed group		Difference[b] (%)
		Holstein	Jersey	
Total milk yield	311	2864	2539	12
305d milk yield	311	2710	2395	12
Birth weight	130	24.6	19.6	23
Age at puberty	130	410	390	5
Weight at puberty	129	256	217	16
Weight, 15 mo	130	282	250	12
Age, first parturition	130	755	781	-3
Weight, first parturition	129	374	345	8

[a]Weights are in kg; ages are in days. Breeds differed for all traits, $P < .01$.

Mathematical model includes length of record (quadratic), breed group, sire in breed, daughter in sire, month and year of parturition, and length of record and milk yield of dam. Computer program was Model 5 of Harvey (1990).

[b](Holstein-Jersey)(100)/(1/2)(Holstein + Jersey)

Holsteins (Silva *et al.*, 1986) in a study covering over 50 years of data in seven herds. Simerl *et al.* (1991), however, found that pure Holsteins freshened 20 days earlier than Jerseys; these animals were in a single Florida herd and were managed and housed together.

Superior milk yield of Holstein crossbreds (329 kg total or 315 kg in 305 days) does not necessarily mean that they were more profitable, since numerous factors affect overall profitability. Stott and DeLorenzo (1988) showed that value of total milk was US$ 416 more per lactation for Holstein than Jerseys under Florida environmental and economic conditions; increased feed, mastitis and reproductive costs lowered this to US$ 120 profit per lactation; however, costs of rearing and salvage values were not considered.

Comparison of Hariana by Holstein or Jersey crossbreds by Baht (1980) showed that Holstein milk yields were higher (30% for total, 27% for 300 days), but age at first parturition was older (8%). Holstein crossbreds also had longer service periods (6%) and calving intervals (5%) than did Jerseys. Age at first parturition in many tropical areas frequently is greater than in temperate areas. Benevides (1984) found 1332 days for 884 Zebu by Red Poll crossbreds in Brazil.

Month of parturition or birth was found to be related to subsequent performance as shown in Table III. Such effects were not significant for body weights at birth, puberty

Table III - Least squares means by month of parturition or birth for productive and reproductive traits[a].

Month	Total milk yield** (kg)	305d milk yield** (kg)	Birth weight (kg)	Age at puberty** (days)	Weight at puberty (kg)	Weight 15 mo** (kg)	Age, first parturition** (days)	Weight, first parturition** (kg)
Jan	2574	2371	22.1	476	250	246	810	374
Feb	2428	2243	23.1	445	231	349	807	355
Mar	2484	2210	23.9	449	244	250	809	373
Apr	2812	2547	25.9	332	270	321	711	397
May	2843	2763	---	---	---	---	---	---
Jun	2801	2661	23.3	297	229	305	698	385
Jul	2364	3213	25.4	330	242	297	733	361
Aug	2776	2693	21.8	380	234	733	772	350
Sept	2787	2760	---	---	---	---	---	---
Oct	2953	2897	23.6	420	256	281	708	356
Nov	3126	3077	22.6	456	252	260	770	354
Dec	3155	3106	22.9	466	263	259	791	368

[a]Months were month of parturition for milk yields; month of birth for other traits. For mathematical model see text and footnote in Table II.

**P < .01 for month effects; P > .15 for other traits.

or first parturition. Milk yields were highest for animals freshening in November and December at over 3000 kg. Animals born in June reached puberty at 297 days, and freshened at 698 days, earliest of all months. Animals born in April and June were heaviest at 15 months of age and at parturition.

Heritabilities (Table IV) of milk yield within breed group were slightly lower than most estimates from temperate and subtropical and tropical areas (Wilcox *et al.*, 1990) but standard errors were large. Estimates for birth weight and for age at first parturition agreed with the preponderance of previous research. Surprisingly, estimates for age and weight at puberty and weight at 15 months were zero. Body weights are quite highly heritable traits in dairy cattle, usually .3 to .6 (Wilcox, 1992).

In summary, first generation (F_1) offspring by Holstein sires and Sahiwal dams were heavier at birth, puberty, 15 months and parturition than were Jersey crossbreds, as expected. They reached puberty 20 days later than Jersey crossbreds, and produced 12% more milk, although they freshened 26 days earlier. Except for body weights after birth, heritabilities of the traits studied were about the same as found in pure breeds in temperate climates. Economic studies are needed before recommendations can be made as to the use of Holsteins and Jerseys for crossing with Sahiwal in tropical and subtropical areas.

Table IV - Pooled within breed group heritability estimates.

Trait	Number of observations	Heritability[a]
Total milk yield	316	.16
305d milk yield	316	.12
Birth weight	130	.26
Age, 1st parturition	130	.19
Weight, 1st parturition	129	.03

[a] Range in standard errors, .15 to .21; heritability estimates for age and weight at puberty and weight at 15 mo were 0. Estimates were pooled within breed groups. For mathematical model see text and footnote in Table II.

ACKNOWLEDGMENTS

Assistance of the University of Florida Center for Tropical Agriculture, H.L. Popenoe, Director, and ARC Animal Breeding Research Organization, Edinburgh, Scotland, R.B. Land, Director (deceased), and St. C.S. Taylor, Research Leader (retired), is gratefully acknowledged.

RESUMO

Foi avaliado o desempenho de 138 vacas leiteiras mestiças do "Livestock Production Research Institute", Paquistão. Os animais eram descendentes de cruzamentos de fêmeas Sahiwal com machos Holstein ou Jersei. A produção total de leite das filhas de vacas Sahiwal com o reprodutor Holstein foi 229 kg (17%) maior que a produção das vacas filhas de cruzamentos com reprodutor Jersey. Ajustes do desempenho da filha para produção e duração do registro da cria não alterou diferenças no desempenho desejável entre os dois grupos cruzados embora os ajustes fossem estatisticamente significantes. Ajustado para desempenho de crias e outros fatores ambientais a produção de leite na lactação foi maior para cruzamentos com Holstein do que com Jerseys (produção total, 2864 e 2539 kg; 305 dias, 2710 e 2395 kg), baseado em 223 lactações Holstein e 96 Jersey. As médias para outras respostas para os dois grupos foram peso ao nascer, 24,6 e 19,6 kg; idade à puberdade, 410 e 390 dias; peso à puberdade, 256 e 217 kg; peso aos 15 meses, 282 e 250 kg; idade ao primeiro parto, 755 e 781 dias; peso ao primeiro parto, 374 e 345 kg. Todas as estimativas para as linhagens diferiram. Efeitos do mês do parto foram detectados para total de 305 dias de produção de leite, com uma variação de cerca de 850 kg. Efeitos do mês do nascimento foram detectados para idades à puberdade e primeiro parto, e para pesos aos 15 meses, mas não para outras respostas. Exceto para estimativas zero para idade e pesos à puberdade e aos 15 meses, valores de herdabilidades dentro de raças foram similares, ou ligeiramente menores que aqueles encontrados em rebanhos de áreas temperadas. Pesquisas continuam a avaliar o desempenho de cruzamentos subseqüentes.

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(Received January 27, 1993)