STUDY OF COMPARATIVE MILK PRODUCTION AND REPRODUCTION OF JERSEY CATTLE UNDER USA AND PAKISTAN CONDITIONS

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Summary

In 1985, fifty Jersey cows were imported to Pakistan from United States of America (USA). This paper compares milk production and reproduction performance of imported cows and their daughters under USA and Pakistan conditions. The imported cows which had yielded 5,858 kg, of milk (305 d lactation) in the USA produced only 3,192 kg, at NARC. The milk production of their daughters averaged 2,617 kg, being 22% lower than their mothers under the same environment at NARC. Year and season of calving had no significant effects on milk production. Average milk production of the first lactation was 10% lower than the mean of the second, third and fourth lactations, but, the differences between lactation means were non-significant. Mean calving interval in the USA was 385 days, whereas the same cows had a longer ($p < .01$) calving interval of 490 days at NARC. The calving interval of the daughters was longer (452 d; $p < .01$) than their mothers calving interval in the USA, and shorter ($p < .01$) than their mothers calving interval in Pakistan. The low age at first calving suggests that locally born Jersey cows were not reproductively disadvantaged by the local environment and nutrition, suggesting the adaptability of this breed in the new environment.
(Key Words: Reproduction, Lactation, Calving Interval, Environment, Jersey)

Introduction

Pakistan has 17.4 million native (Economic Survey of Pakistan, 1992-93) and 50,000 imported Friesian and Jersey cattle (Livestock Sector Study, 1987) compared to the USA dairy population of 10.1 million (National Agriculture Statistics Service, 1990). However, milk production in Pakistan is much lower than in the USA. The low productivity is due to poor per animal milk production by native cattle. Poor genetic potential for milk production is a result of overriding emphasis on past selection for draught animals in Asia (Meyn, 1991).

Adequate feeding of a small number of highly productive animals should be more economical than inadequate feeding of a large number of lowly productive animals. Therefore, efforts are being concentrated on increasing milk production by improving per animal productivity. Milk production can be improved significantly by introducing genes of improved cattle breeds into the native breeds through crossbreeding, and by direct importation of exotic breeds.

Many studies have been conducted on dairy crossbreeding in Pakistan. Little work has been done to evaluate the performance of exotic cattle under local conditions. The purpose of this study was to compare the productive and reproductive performance of Jersey cows in the USA and Pakistan. The daughters of the imported cows were also compared with their mothers for milk production and reproduction.

Materials and Methods

Animals and Management

The Pakistan Agricultural Research Council (PARC) improted a herd of 50 Jersey cows and 500 doses of Jersey semen from the USA in 1985. These animals were kept at National Agricultural Research Centre (NARC), Islamabad. At the Centre temperature varies from 0℃ to 45℃ in winter and summer, respectively. Humidity ranges between 45 to 90% during monsoon (July-September) season. Well ventilated sheds with head to head system are used for housing. The significant environmental difference from the place of origin, of the imported cows, is high temperature and humidity during summer days in Islamabad.

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The primary objective of the importation was to establish a nucleus herd of high genetic merit under local conditions. Later, superior bulls from the herd were to be used by artificial insemination or natural service for crossbreeding with native cattle to produce genetically improved animals for higher milk production.

The cows were purchased from various livestock farms in North and South Carolina States. The cows were managed as a group and were put on *ad lib.* green fodder. The green fodders offered around the year were mainly oats, corn, alfalfa, sugarcane tops and soybean crops. During lean period of winter silage (sorghum and maize) and wheat straw was fed with concentrates (@ 5 kg/animal). Cows were also grazed on natural grass and oats. Cows were machine-milked twice daily and concentrate containing cotton seed cake, crushed maize, wheat bran, molasses etc. was offered *ad lib.* at milking times. The concentrate contained 20% crude protein. Individual milk production was recorded twice in a month throughout lactation. Hence, total milk yield for each animal for the lactating days was calculated using fortnightly milk records. Lactation length was also recorded for each cow.

The imported cows had completed their first lactation in the USA and started their second lactation within 3 to 6 months of their importation (April to July, 1985). Lactation records for the imported cows and their daughters collected between 1985 and 1990 were used in the analyses. Individual milk production records of first lactation (305 d) for the imported cows were available. Milk production of 79 lactations of the imported cows and 75 lactations of their progeny (born in Pakistan from 1985-1988) were recorded at NARC. The cows were milked from 1985 to 1990; however, the progeny had lactations records between 1987 to 1990 only. Due to small number of animals, age-wise distribution of each group was not possible. Therefore, animals of all age groups were pooled in one group. Milk production records, completed at NARC, were regressed on their respective lactation length (days) and subsequently a 305-day milk yield was estimated for each cow. The estimated 305 day lactation records were used for the comparison of the Jersey groups.

Age at first calving and calving interval for the imported cows were recorded because date of birth and calving for the first lactation of these cows were available. Moreover, the cows were impregnated prior to their importation and calved in Pakistan which made it possible to calculate calving interval between first and second lactation. These calving intervals were compared with the subsequent calving intervals of the same cows and their daughters at NARC. The data were analyzed using statistical procedures described by Harvey (1987).

Due to the nature of data, several models were run for the analyses. Three sets of data; i performance of 50 Jersey cows in the USA; ii performance of 50 imported Jersey cows in Pakistan; and iii performance of 39 progeny born in Pakistan, were compared for milk production, age at first calving and calving interval. The statistical model used to describe cow traits was:

$Y_{ijkl} = \mu + G_i + L_j + C_k + S_l + E_{ijkl}$ where

μ = Overall mean

G_i = The effect of $_i$th Jersey group (i = 1-3)

L_j = The effect of $_j$th lactation number (j = 1-4)

C_k = The effect of $_k$th calving year (k = 1-5)

S_l = The effect of $_l$th season (l = 1-4)

E_{ijkl} = Random variation

Additional two-way interactions were tested and dropped from the final model after being found non significant ($p > .50$). For estimating seasonal and lactation number effects on milk production, the USA lactation records of 50 imported cows were deleted from the data to make these estimates meaningful. Similarly, for the year analysis, records obtained in 1985 were dropped from the analysis to avoid confounding effects because year 1985 had records of imported cows only.

Results and Discussion

Milk Production

Lactation length varied from 120 to 550 days. Average milk production (estimated 305-d lactation) of the imported cows was 3,192 kg at NARC which was 46% lower than their milk production in the USA (table 1). Milk production of the daughters of the imported cows averaged 2,617 kg, being 22% lower than their mothers' in the same environment. This was despite the fact that the daughters were produced either by

insemination of imported cows in the USA or with the imported semen from bulls of high genetic merit.

The 50% decline in milk production of the imported animals at NARC is quite understandable as the animals were in an entirely different environment outside the comfort temperature zone of their native conditions. Different feeding and management under the stress of hot and humid summer conditions, coupled with higher disease incidence reduced their milk production. However, despite environment, management and disease stress, the estimated 305-d lactation yield in our study was much higher than 305-d lactation yields of Jerseys (1,840 kg) in India (Arora and Sharma, 1982).

TABLE 1. LEAST SQUARE MEANS AND STANDARD ERRORS FOR 305 DAY LACTATION YIELD (kg) OF JERSEY COWS UNDER THE USA AND PAKISTAN ENVIRONMENTS

Item	Environment	No.	Mean	SE
Jersey	USA	50	5,858	141
Jersey	Pakistan	79	3,192	108
Progeny	Pakistan	75	2,617	107
Overall	—	204	3,889	70

The relative low milk production of locally born cows was somewhat unexpected. It is conceivable that the imported cows were selected animals and above the average of the genetic merit of the Jersey population. It is interesting to note that the progeny were bred for first calving about 100 days earlier than their mothers in the USA. With the result they might not have well grown up like their mothers. Therefore, relative low age at first calving might adversely affected the milk production of the progenies. Similarly, Madsen (1976) reported significantly lower milk production of locally born cattle than that of their imported mothers (3,785 vs 4,111 in India; and 2,305 vs 3,445 kg in Thailand, respectively). Menzi et al. (1982) also reported that milk production per lactation of Brown Swiss daughters born in India was on an average 220 kg lower than their imported mothers.

Season and Lactation Number

All lactation of the imported cows and their progeny completed in Pakistan were used to estimate the effects of season and lactation number. Average milk yield ranged from 2,795 kg for spring to 2,985 kg for autumn (table 2). The relative higher milk yield of cows calving in autumn can be attributed to lower temperature, favorable for Jerseys. Mean milk yield for the first lactation was 2,679 kg, being 10% lower than the mean of the second, third and fourth lactation (2,958 kg). However, the differences between lactation means were non-significant (table 2).

TABLE 2. LEAST SQUARE MEANS AND STANDARD ERRORS FOR 305 DAY LACTATION YIELD (kg) IN PAKISTAN OF JERSEY COWS CALVING IN DIFFERENT SEASONS AND FOR VARIOUS LACTATIONS

Seasons	No.	Mean	SE
Winter	29	2,875	192
Spring	46	2,795	182
Summer	43	2,899	176
Autumn	36	2,985	173
Lactation	**No.**	**Mean**	**SE**
1	38	2,679	201
2	70	3,020	138
3	24	2,926	221
4	22	2,928	236
Overall	154	2,889	92

N.B. Milk Production of all cows present during 1985 90.

Year Effects

As imported cows and their daughters (born in Pakistan) were not contemporary, the comparison between the Jersey groups could have been misleading in the presence of significant year effects. Therefore, an analysis was conducted to

estimate variation due to year. Lactation records of the imported cows for the year 1985 were deleted from the data for meaningful comparison. From 1986 to 1990, milk production averaged 2,675 kg ranging from 2,475 kg for 1987 to 2,928 kg for 1986 (table 3). However, differences among years were non-significant, which suggested that feeding and management practices remained similar for the period under study.

TABLE 3. LEAST SQUARE MEANS AND STANDARD ERRORS FOR 305 DAY LACTATION YIELD (kg) OF JERSEY COWS CALVING IN PAKISTAN IN VARIOUS YEARS

Calving year	No.	Mean	SE
1986	15	2,928	344
1987	28	2,475	216
1988	29	2,700	218
1989	20	2,534	265
1990	16	2,736	302
Overall	108	2,675	117

Age at First Calving

Age at first calving is the best indicator of age at puberty. A low age at first calving results in less maintenance cost, longer productive life and fewer replacements. Mean age at first calving in the USA for the imported cows was higher ($p<.01$) than the mean of their daughters (769 vs 661 days) at NARC (table 4). The relative low age at first calving in daughters of the imported cows was unexpected. While breed, climate and nutrition are major factors influencing age at puberty, the warm climate at NARC might have induced early puberty. In the USA, cattle breeding is organized and cows are inseminated for first calving at certain weight and age. In Pakistan, progeny of Jersey cows was not inseminated strictly on the basis of age or weight rather were bred when they exhibited heat. This has resulted into early breeding which is also obvious from their low milk production. However, this has not been observed for crossbred cattle, generated in Pakistan (by combination of Jersey and native breeds) which had a higher age at first calving (794 days) in a similar environment (Naqvi, 1989). Also Arora and Sharma, (1982) reported Jersey cows had a high age at first calving (836 d) in India, a tropical country like Pakistan. The low relative age at first calving of locally born Jersey cows suggests that the local environment and nutrition is relatively suitable to their reproduction.

Calving Interval

Calving interval is a very useful and practical measure of reproductive efficiency and a good indicator of milk production in a cow's productive life. Cows calving each year are considered ideal for high milk production, more offspring, and lower conception and dry cow maintenance expenses. It is estimated that a cow producing

TABLE 4. LEAST SQUARE MEANS AND STANDARD ERRORS OF JERSEY COWS FOR AGE AT FIRST CALVING (DAYS) UNDER THE USA AND PAKISTAN ENVIRONMENTS

Item	Environment	No.	Mean	SE
Jersey	USA	50	769	13
Progeny	Pakistan	39	661	14
Overall	–	89	715	9

TABLE 5. LEAST SQUARE MEANS AND STANDARD ERRORS OF JERSEY COWS FOR CALVING INTERVAL (DAYS) UNDER THE USA AND PAKISTAN ENVIRONMENTS

Item	Environment	No.	Mean	SE
Jersey	USA	50	385	15
Jersey	Pakistan	55	490	13
Progeny	Pakistan	51	452	15
Overall	–	156	442	8

5,909 kg milk with a 12-month calving interval makes at least as much profit as a cow producing 7,955 kg milk with a 16 month calving interval (Swanson, 1987). The mean calving interval of our Jersey cows in the USA was 385 days (table 5) whereas the same cows had a calving interval of 490 days at NARC ($p < .01$). The daughters of the imported cows also had a longer calving interval (452 d; $p < .01$) than their mothers under USA conditions. Similar results were observed in India where calving interval of imported Jersey cows averaged 443 days (Sadana and Basu, 1983).

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