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MILK PRODUCTION POTENTIAL OF PURE BRED HOLSTEIN FRIESIAN AND JERSEY COWS IN SUBTROPICAL ENVIRONMENT OF PAKISTAN

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ABSTRACT

The data on 575 records of 270 Holstein Friesian and 818 records of 326 Jersey cows maintained in Punjab, Pakistan were analyzed. The cows were grouped into imported Holstein Friesian, imported Jersey, Farm born Holstein Friesian and farm born Jersey cows. Lactation milk yield of farm born Holstein Friesian and Jersey cows was significantly ($P<0.05$) lower than that of imported Holstein Friesian and Jersey cows. Breed group, season of calving and lactation number had significant ($P<0.05$) effect on lactation milk yield. The highest lactation milk yield was observed in imported and farm born Holstein Friesian cows calved during autumn, while in imported Jersey cows maximum lactation milk yield was observed in cows calved during spring season. The maximum lactation milk yield was observed in the third lactation in imported Holstein Friesian, imported Jersey and farm born Holstein Friesian cows, while in farm born Jersey cows maximum lactation milk yield was observed in the fifth lactation. The milk yield in all breed groups increased with increase in lactation length and service period.

Key words: Holstein Friesian, Jersey, Milk yield, Subtorpics, Pakistan.

INTRODUCTION

The poor production of local dairy animals may be attributed to the sub optimal performance of indigenous dairy animals as a result of unplanned breeding and inadequate feeding, management and disease control measures. Improving environmental conditions and management practices, coupled with improved genetic potential of dairy animals would be more effective approach for high milk production. The pre-requisite for effective management is accurate quantitative knowledge of factors affecting productive performance of animals (Bagnato and Oltenacu, 1994).

The Government of the Punjab, Pakistan imported a herd of purebred Holstein Friesian and Jersey cattle in 1985 from USA and maintained at the Livestock Experiment Station of Research Institute for Physiology of Animal Reproduction, Bhunikey, Pattoki, District Kasur, the area having sub tropical climatic conditions (Anonymous, 1988) so that these may be bred in the country and produce bulls of high genetic potential through selective breeding.

Besides their genotype, the performance of dairy animals is also affected by many environmental factors. These environmental factors may suppress the animal's true genetic ability and create a bias in the selection of animals. The present study was planned to compare productive performance of imported and farm-born Holstein Friesian and Jersey cows under subtropical environmental conditions.

MATERIALS AND METHODS

The data on 575 records of 270 Holstein Friesian (66 imported and 204 farm born) and 818 records of 326 Jersey cows (90 imported and 236 farm born) maintained at the Livestock Experiment Station, Research Institute for Physiology of Animal Reproduction (RIPAR), Bhunikey, Pattoki, District Kasur, Punjab, Pakistan during the period from 1986 to 2001 were analyzed. During entry of data, weekly milk yield records from October, 1997 to February 1998 were found missing. The animals were divided into four groups viz. Imported Holstein Friesian, Imported Jersey, Farm born Holstein Friesian and Farm born Jersey cows named as breed groups. Farm born animals were the progeny of imported cows that were raised in Pakistan. The year was divided into four seasons viz. winter (December to February), spring (March to May), summer (June to August) and autumn (September to November) after Bashir *et al.* (2007).

Total milk produced during a given lactation which terminated normally was considered as lactation milk yield. Lactation milk yields which had incomplete weekly milk records or having records less than 8 weeks (60 days) were deleted. First lactation records of imported Holstein Friesian and imported Jersey cows were not available because these cows were imported while pregnant for second lactation. During data editing, the lactation records of the fifth and above lactations were pooled. The data set comprising 1393 valid lactation milk records, lactation lengths and 927 service periods were analyzed, using the following general linear model:

Y_{ijkl} = $\mu+BG_i+SOC_j+LN_k+(BG*SOC)_{ij}+(BG*LN)_{ik}+\varepsilon_{ijkl}$

Where,

Y_{ijkl} = Individual observation of any trait
μ = Population mean
BG_i = Breed group (i = 1, 2, 3 and 4)
SOC_j = Season of calving (j = 1, 2, 3 and 4)
LN_k = Lactation number (k = 1, 2, 3, 4 and 5)
$(BG*SOC)_{ij}$ = Interaction of BG and SOC.
$(BG*LN)_{ik}$ = Interaction of BG and LN.
ε_{ijkl} = Random error associated with individual observation.

Effects of lactation length and service period on lactation milk yield were also estimated. For this purpose, the lactation length was grouped into seven classes. Class one comprised of cows having lactation length up to 150 days and subsequent classes were formed with 50 day class interval, while seventh class comprised cows having lactation length more than 400 days. Service period was grouped into seven classes. Class one comprised cows having service period up to 60 days and subsequent classes were formed with 30 day class interval, while seventh class comprised cows having service period more than 210 days. The general model used for these analyses was as under:

Y_{ijk} = $BG_i+Class_j+(BG*Class)_{ij}+\varepsilon_{ijk}$

Where,

Y_{ijk} = Individual observation of any trait
μ = Population mean
BG_i = Breed group (i = 1, 2, 3 and 4)
$Class_j$ = Class (j = 1, 2, 3 … 7)
$(BG*Class)_{ij}$ = Interaction of BG and class.
ε_{ijk} = Random error associated with individual observation.

Data on different parameters having unequal disproportionate sub class frequencies were analyzed by using General Linear Model (SPSS ®, 1999). Data entry and manipulation was done by using Microsoft Excel®. The comparison of the means among significant fixed effects on productive traits were done using Duncan's Multiple Range test, as modified by Kramer (1957).

RESULTS

The overall least squares mean milk yield of Holstein Friesian and Jersey cows in the present study was 3019.81 ± 93.57 and 2229.46 ± 62.02 kg, respectively. Imported Holstein Friesian and Jersey cows showed significantly ($P<0.05$) higher milk yield than the farm born Holstein Friesian and Jersey cows (Table 1).

Imported Holstein Friesian cows that calved during autumn showed higher lactation yield than those which calved during winter, spring and summer seasons ($P<0.05$). The difference in milk yield among winter, spring and summer calvers was non significant. Among farm born Holstein Friesian cows, spring calvers showed lower milk yield than other seasons ($P<0.05$). No significant difference was seen in cows calved during winter, summer and autumn seasons. Imported Jersey cows calved during spring significantly differed in milk yield with cows which calved during other seasons. The difference in milk yield during winter and summer was non significant. Among farm born Jersey cows, a non significant difference in milk yield existed in all seasons of calving (Table 2).

Lactation milk yield of imported Holstein Friesian and Jersey cows was higher ($P<0.05$) in second and third than fourth and fifth lactation. Milk yield also differed between fourth and fifth lactation, while it did not differ between second and third lactation. Among farm born Holstein Friesian cows, milk yield was highest in the third lactation and a non significant difference existed between first, second and fifth lactations. Farm born Jersey cows showed a non significant difference in milk yield among all lactations (Table 3).

Lactation length classes were also significant source of variation ($P<0.05$) for milk yield. Among imported Holstein Friesian cows, maximum milk yield was observed in cows with lactation length of >400 days. All lactation length classes had significant difference, except lactation length of 351-400 and >400 days. In other breed groups, all lactation length classes differed significantly except fourth (251-300 days) and fifth (301-350 days) lactation length classes among farm born Jersey cows which differed non significantly from each other (Table 4).

Lactation milk yield significantly ($P<0.05$) differed among different service period classes. In imported and farm born Holstein Friesian cows, maximum milk yield was observed in the sixth service period class (180-210 days). Imported Jersey cows showed a non significant difference in milk yield among all service period classes. Among farm born Jersey cows, maximum milk yield was observed in sixth service period class (181-210 days). All other service period classes showed a non significant difference in milk yield from one another (Table 5).

Table 1: Least square means of lactation milk yield (kg) for different breed groups

Breeds	Imported	Farm born	Overall
Holstein Friesian	3363.41 ± 100.75^{a} (165)	2881.64 ± 88.41^{b} (410)	3019.81 ± 93.57 (575)
Jersey	3047.51 ± 68.23^{a} (322)	1698.39 ± 57.99^{b} (496)	2229.46 ± 62.02 (818)

Figures given in parenthesis indicate number of observations
Means in a row with different superscripts are significantly ($P<0.05$) different.

Table 2: Least squares means of lactation milk yield (kg) in different breed groups in different seasons of calving

Breed group	Winter	Spring	Summer	Autumn
IH	3233.41 ± 150.53^{b}	2907.42 ± 228.92^{b}	3030.70 ± 258.06^{b}	4282.08 ± 207.28^{a}
FBH	3024.93 ± 128.40^{a}	2520.38 ± 201.07^{b}	2893.86 ± 123.39^{a}	3087.37 ± 105.11^{a}
IJ	2933.16 ± 121.12^{b}	3352.55 ± 164.59^{a}	2794.01 ± 157.17^{b}	3110.29 ± 119.78^{ab}
FBJ	1722.69 ± 98.15^{a}	1719.09 ± 126.97^{a}	1519.19 ± 103.81^{a}	1832.57 ± 105.82^{a}

Means in a row with different superscripts are significantly ($P<0.05$) different.
IH = Imported Holstein Friesian, FBH = Farm born Holstein Friesian, IJ = Imported Jersey, FBJ = Farm born Jersey.

Table 3: Least squares means of lactation milk yield in different breed groups during different lactations

Breed group	L1	L2	L3	L4	L5
IH	-	3725.76 ± 188.69^{a}	3873.62 ± 201.69^{a}	3193.74 ± 231.34^{b}	2660.50 ± 193.09^{c}
FBH	2809.88 ± 90.16^{ab}	2808.71 ± 115.78^{ab}	3177.02 ± 143.77^{a}	2697.46 ± 202.57^{b}	2915.11 ± 287.66^{ab}
IJ	-	3306.37 ± 150.27^{a}	3615.13 ± 144.58^{a}	2916.34 ± 146.34^{b}	2352.17 ± 115.74^{c}
FBJ	1558.16 ± 91.77^{a}	1548.46 ± 102.72^{a}	1735.25 ± 119.93^{a}	1772.18 ± 160.06^{a}	1877.87 ± 153.56^{a}

Means in a row with different superscripts are significantly ($P<0.05$) different., L1- L5 Lactatin numbers,
IH = Imported Holstein Friesian, FBH = Farm born Holstein Friesian, IJ = Imported Jersey, FBJ = Farm born Jersey.

Table 4: Effect of different lactation length classes on lactation milk yield in different breed groups

BG	Lactation length (days)						
	Upto 150	151-200	201-250	251-300	301-350	351-400	>400
IH	1419.14 ± 136.30^{f}	1985.24 ± 144.24^{e}	2772.76 ± 141.44^{d}	3674.45 ± 153.77^{c}	4724.75 ± 118.57^{b}	5517.73 ± 165.46	5683.37 ± 254.99^{a}
FBH	644.00 ± 125.55^{g}	1532.13 ± 117.00^{f}	2510.54 ± 92.34^{e}	3040.99 ± 69.08^{d}	3561.11 ± 70.05^{c}	3852.38 ± 111.29	4920.14 ± 157.38^{a}
IJ	724.82 ± 174.92^{g}	1439.69 ± 141.44^{f}	2008.54 ± 106.34^{e}	2941.51 ± 81.14^{d}	3541.77 ± 72.85^{c}	4023.33 ± 115.49	4494.41 ± 174.92^{a}
FBJ	561.02 ± 82.73^{f}	1078.95 ± 79.64^{e}	1587.61 ± 66.11^{d}	2127.21 ± 64.77^{c}	2343.12 ± 84.99^{c}	2701.58 ± 174.92	3129.50 ± 294.44^{a}

Means in a row with different superscripts are significantly ($P<0.05$) different.
BG = Breed group, IH = Imported Holstein Friesian, FBH = Farm born Holstein Friesian, IJ = Imported Jersey, FBJ = Farm born Jersey.

Table 5: Effect of different service period classes on lactation milk yield in different breed groups

BG	Service period (days)						
	Upto 60	61-90	91-120	121-150	151-180	181-210	>210
IH	-	3372.33 ± 269.56^{d}	3472.66 ± 301.38^{d}	4066.10 ± 330.14	4399.60 ± 466.89^{b}	5571.75 ± 522.00	3658.08 ± 208.80^{cd}
FBH	2503.16 ± 301.38	2474.41 ± 179.04^{c}	3162.73 ± 155.63^{ab}	3327.44 ± 174.00^{a}	2642.841 ± 239.51^{b}	3353.84 ± 289.55	3077.63 ± 88.87^{ab}
IJ	2923.77 ± 222.58	2992.92 ± 169.36^{a}	2940.70 ± 213.10^{a}	2732.85 ± 233.44^{a}	2672.30 ± 330.14^{a}	2728.30 ± 289.55	3100.82 ± 131.53^{a}
FBJ	1417.00 ± 138.28	1690.70 ± 126.60^{ab}	1721.54 ± 138.28^{ab}	1771.00 ± 161.09^{a}	1630.07 ± 204.74^{ab}	2013.43 ± 261.00	1957.10 ± 105.46^{ab}

Means in a row with different superscripts are significantly ($P<0.05$) different.
BG = Breed group, IH = Imported Holstein Friesian, FBH = Farm born Holstein Friesian, IJ = Imported Jersey, FBJ = Farm born Jersey.

DISCUSSION

Imported Holstein Friesian and imported Jersey cows showed higher milk yield than farm born cows. The animals of temperate regions maintained under tropical conditions cannot behave similarly in both the environments (Javed *et al.,* 2002). The herd under study was imported from temperate zone (United States of America) and kept in the subtropical environment of central Punjab, Pakistan, where ambient temperature often rises around 45°C in summer months. The import of temperate breeds to tropical environments is often trouble making. According to Payne and Hodges (1997), if improved management was not given, the pure-bred cattle imported from temperate regions often failed to survive. The more tragic dimension to this practice arose when such cattle were introduced in harsh environmental conditions. Vaccaro (1979) concluded that the performance of temperate dairy cattle in the tropical areas of Latin America was disastrous. Purebred temperate cows suffered unacceptably high losses, which indicated that the animals of temperate zone did not adapt well to the harsh environments of the tropics. Seasonal variation in animal performance in the tropics is expected to be primarily a manifestation of variation in feed quality and quantity (Javed *et al*., 2000).

The present results suggested that milk yield was sensitive to seasonal variations. Generally, the cows which calved in autumn produced more milk, apparently due to low environmental temperatures and availability of good quality fodder. The cows that calved during spring season might have confronted with hot season and scarcity of fodder period (summer) after calving as they approached peak lactation. The cows calving in summer season were the poor producers as these cows faced hot season and scarcity of fodder period immediately after calving. Thermal stress may also explain seasonal variation in performance in the region where the present herd was being maintained where dry months (summer season) are invariably the hottest months. Thus, a combination of nutritional inadequacy and thermal stress may well explain the seasonal variation in the productive performance of cows under study. This is even more likely as ambient temperature around 45^{o}C or higher is not uncommon in this region. The results of the present study indicate that calving in spring and summer months were undesirable. Efforts should be diverted to the conservation of feed and fodder for scarcity periods in addition to provision of shade for reducing the thermal stress. Moreover, breeding should be managed in such a way that most calvings occur in autumn or winter seasons. This may eliminate seasonal and nutritional stress on Holstein Friesian and Jersey cows.

The present study revealed that comparatively high milk yield was obtained in the second and third lactations except in Farm born Jerssey cows where difference was non significant in all lactations. The lactation maturity in the cows may also vary with the rate of development and increased functioning of the active secretory tissue of the udder, which could be greatly influenced by feeding and management practices. According to Schmidt *et al*. (1988), first lactation cows freshening at 24 months of age produce approximately 75% of the milk produced by mature cows. Average figures for 3-years old cows indicate that they produce approximately 85% of the milk produced by a mature cow; the figures for 4 and 5 year old cow are 92 and 98%, respectively. Cows of most breeds are considered mature at 6-years of age. When cows are 8 to 9 years of age, a slight reduction in the amount of milk produced occurs and the reduction continues till their death. However, some variation existed among breeds.

Although milk yield increased with lactation length, yet it did not seem advantageous to have lactation length exceeding one year. The increase in service period also resulted in increased lactation milk yield which may be attributed to the prolonged lactation persistency due to absence of pregnancy stress up to 210 days in imported and 150 days in farm born Holstein cows.

Conclusions

A significant difference in production performance was observed among breed groups. Lactation milk yield was higher in imported than in farm born cows. Season of calving was an important source of variation for milk yield. Cows calved during autumn and winter showed good performance.

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