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Genetic studies on performance traits of Jersey crossbred cows in sub-temperate region

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ABSTRACT

The evaluation of production performance traits of Jersey crossbred cows is essential for their genetic improvement in sub-temperate region. The present investigation was conducted on 619 records of 265 Jersey crossbred cows maintained at an organized institutional dairy farm in North-West Himalayan state of Himachal Pradesh for 29 years (1981–2009). The production traits considered in the present study were 305day lactation milk yield, peak yield, lactation milk yield, lactation length, average milk yield/day of lactation length, average milk yield per day of calving interval. Heritability, genetic and phenotypic correlation coefficients were estimated for these traits. Periods showed significant effect while season had nonsignificant effect on these production traits. Parity had highly significant effect on all the traits except lactation length. These production traits showed significantly higher values in winter except peak yield. These traits did not show a consistent trend across different periods, which are due to change in managemental conditions. In third lactation these traits showed better performance. The heritability estimates of these traits were very low except of peak yield. The genetic associations among these traits were positive and high except association of lactation length with other traits which were negative and low. The phenotypic associations were observed low to high across these traits.

Key words: Himachal Pradesh, Jersey crossbred, Production traits, Sub-temperate

Jersey crossbred (Jersey × Red Sindhi) cows are well adopted in the sub-temperate environment of Himachal Pradesh. Its evaluation in terms of the production performance traits along with impact of certain non-genetic factors such as seasons, periods and parities, is essential to formulate breeding and selection strategies. It becomes essential to know the estimate of heritability, genetic and phenotypic associations among production performance traits of Jersey crossbred cows. Improving environmental conditions and management practices, coupled with the improved genetic potential of the Jersey crossbred cows would be a more effective approach for high milk production. Hence, an attempt was made to evaluate production performance traits of Jersey crossbred cows and to determine the inheritance of and genetic and phenotypic correlations among these traits under subtropical environmental conditions of Himachal Pradesh.

MATERIALS AND METHODS

The data pertains to 619 lactation milk records of first 3 lactations of 265 Jersey crossbred cows (Jersey × Red Sindhi) maintained at organized institutional dairy farm in North-west Himalayan state of Himachal Pradesh. Least squares technique (Harvey 1979) was used to study the influence of season, period of calving and parity. Season was classified as summer (April-June), rainy season (July-September), autumn (October-November) and winter (December-March); period of calving as period-1 (1981–1984), period-2 (1985–1988), period-3 (1989–1992), period-4 (1993–1996), period-5 (1997–2000), period-6 (2001–2004), period-7 (2005– 2008) and period-8 (2009); and parity was classified as first, second and third lactation. Total milk produced during a given lactation which terminated normally was considered as lactation milk yield. Lactation milk yields less than 500 kg and records less than 100 days lactation length were not considered and the following model was used to analyze the effects of non-genetic factors on production traits of Jersey.

$$Y_{ijkl} = m + S_i + P_j + Pr_k + e_{ijkl}$$

where, Y_{ijk} l^{th} record of k^{th} parity in the i^{th} season and j^{th} period and from k^{th} parity; μ, overall mean; S_i, effect of i^{th} season; P_j, effect of j^{th} period; Pr_k, effect of k^{th} parity; e_{ijkl}, random error, assumed to be NID (0, $\sigma^2 e$).

The economically important production traits considered for the present study were 305day milk yield (MY_{305}) in

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kg, lactation milk yield (LMY) in kg, lactation length (LL) in days, peak yield (PY) in kg, average milk yield per day calving interval (AMY/CI) in kg and average milk yield per day of lactation length (AMY/LL) in kg. The statistical analysis of the data was made following the least squares analysis of variance technique (Harvey 1975) considering seasons and parity as fixed effects and period of calving as random effects. Duncan's multiple range test (DMRT) modified by Kramer (1957) was used to make pair- wise comparison among the means.

Prior to estimation of genetic parameters, the data were adjusted for different significant non-genetic factors (season/period of calving and parity effects). Paternal half sib correlation (intra-sire correlation among daughters) method as described by Becker (1975) was used to estimate the heritability estimates and genetic and phenotypic correlations of different traits. The standard error of genetic correlation was estimated by using the formula given by Robertson (1959). Phenotypic correlations among various traits were calculated from variance-covariance analysis. The standard error of phenotypic correlation was computed using the formula given by Snedecor and Cochran (1968).

RESULTS AND DISCUSSION

The overall least squares means observed in the present study were 2104.14 ± 38.79 kg for MY_{305}, 2354.41 ± 49.62 kg for LMY, 11.25 ± 0.19 kg PY, 340.99 ± 5.91 days LL and 7.14 ± 0.12 kg AMY/LL and 5.65±0.09 kg AMY/CI (Table 1).

The overall least squares mean of LMY of 2,354.41 kg as observed in the present study is higher than that reported by and Upase and Narayankhedkar (1996) in different crossbreds of Jersey and LL of 340.99 days is comparable to that of 350 days as in 50% Jersey × Red Sindhi animals. However, many workers observed a variable trend of LL in different crossbred animals. The overall least squares means for lactation milk yield, lactation length and dry period of Sahiwal and Sahiwal × Jersey crossbred cows were 1122.74±80.74 kg and 1391.38±171.51 kg; 279.72 ± 6.55 days and 288.49±9.19 days; 247.14±33.69 days and 249.72±21.36 days, respectively (Hadge *et al.* 2012).

The average PY of 11.25 kg observed in the present study is comparable with that of 11.36 kg observed by Vaidya (2002) in Jersey and Holstein Friesian crosses. The overall last squares mean for AMY/LL of 7.14 kg obtained in the present study is higher than that of 5.31 kg and 5.94 kg observed by Vaidya (2002) in Jersey and Holstein Friesian crosses.

The AMY/CI of 5.63 kg obtained in the present study is higher than that of 4.80 kg reported by Nagare and Patel (1997) in Jersey × Gir and 4.15, 4.70 and 5.23 kg by Srimannarayana and Rao (1995) in Jersey × Ongole crossbreds.

The effect of season of calving was found statistically nonsignificant on all the production traits under study in Jersey crossbred animals under the present investigation. Similar findings were reported by Thakur (1997) in Jersey crosses with indigenous breeds and by Verma (2010) in Jersey × Red Sindhi crossbred animals. However, Vaidya (2002) reported nonsignificant impact of season of calving on all production traits except on LL in pooled over lactations in organized herds of Jersey and Friesian crossbred cattle of Konkan region. He reported that LL in summer calving cows was significantly longer (341.74 days) than that of 322.36 days cows calving in winter and rainy season (323.74 days). The influence of season of calving was reported significantly on LMY and LL and

Table 1. Least-squares means for various non-genetic factors affecting production traits of Jersey crossbred cows

Effect	N	MY_{305} (kg)	LMY (kg)	PY (kg)	LL (days)	AMY/LL (kg)	AMY/CI (kg)
m	603	2104.14±38.79	2354.41±49.62	11.25±0.19	340.99± 5.91	7.14±0.12	5.63 ± 0.11
Seasons		NS	NS	NS	NS	NS	NS
Summer	142	2121.51±53.23	2331.02±69.25	11.59±0.26	334.33 ± 8.25	7.12±0.16	5.74 ± 0.15
Rainy	152	2041.66±51.34	2337.98±69.80	11.14±0.27	349.42 ± 8.32	6.99 ± 0.16	5.44 ±0.15
Autumn	116	2083.64±58.17	2284.51±77.15	11.08±0.29	333.29 ± 9.19	7.15 ± 0.18	5.50 ± 0.16
Winter	193	2169.76±47.78	2464.14 ±63.45	11.18±0.24	346.91 ± 7.56	7.28 ± 0.15	5.84 ± 0.13
Period		*	*	*	*	*	*
1981–1984 (P_1)	17	2094.50±121.20^{a}	2365.97±170.81^{a}	12.86±0.65^{a}	349.47± 20.36^{a}	7.05 ± 0.40^{a}	5.92 ± 0.36^{a}
1985–1998 (P_2)	152	2354.81±41.81^{b}	2564.74±57.40^{b}	13.53±0.21^{a}	333.94 ±6.84^{a}	7.76 ± 0.14^{a}	6.15± 0.12^{a}
1989–1992 (P_3)	97	2416.44±52.33^{b}	2610.46±70.02^{b}	12.93±0.27^{a}	335.38±8.35^{b}	7.87 ± 0.17^{b}	6.13±0.15^{a}
1993–1996 (P_4)	93	2048.16±52.99^{a}	2324.46±71.90^{b}	10.35±0.28^{b}	343.09±8.57^{b}	7.07 ± 0.17^{b}	5.30 ±0.15^{b}
1997–2000 (P_5)	73	1801.01±58.32^{ab}	1974.33±80.01^{ab}	9.49± 0.31^{b}	338.38± 9.53^{a}	5.95±0.19^{abc}	4.58± 0.17^{bc}
2001–2004 (P_6)	72	1887.24±53.09^{a}	2364.18±81.26^{bc}	9.92± 0.31^{b}	380.63± 9.69^{c}	6.57±0.19^{abc}	5.25±0.17^{b}
2005–2008 (P_7)	94	2165.43±49.95^{abc}	2528.66±71.38^{bc}	11.62±0.27^{bc}	359.38± 8.51^{c}	7.41±0.17^{abc}	5.94±0.15^{a}
2009 (P_8)	5	2065.54±255.25^{a}	2102.51±09.44^{bcd}	9.32±1.18^{b}	287.63±36.88^{b}	7.41±0.73 ^{abc}	5.78± 0.66^{a}
Parity		**	**	**	NS	**	**
First lactation	242	1880.21±47.10^{a}	2071.43± 61.14^{a}	9.42 ± 0.23^{a}	338.38 ± 7.29	6.17 ± 0.14^{a}	4.85±0.13^{a}
Second lactation	190	2157.50±49.79^{b}	2397.28±64.29^{b}	11.84±0.25^{b}	337.15 ± 7.66	7.18 ± 0.15^{b}	5.83±0.14^{b}
Third lactation	171	2274.71±49.08^{bc}	2594.52± 67.23^{c}	12.49±0.26^{b}	347.43 ± 8.01	8.05 ± 0.16^{c}	6.20±0.14^{c}

* Significant (P<0.05); **highly significant (P<0.01); NS, nonsignificant and means with same superscript do not differ significantly.

Table 2. Heritability, genetic and phenotypic correlations among performance traits of Jersey crossbred cows

Traits	MY_{305}	LMY	PY	LL	AMY/LL	AMY/CI
MY_{305}	0.12 ± 0.09	0.51**± 0.07	0.50 ± 0.38	–0.08 ± 0.08	0.90** ± 0.04	0.72** ± 0.06
LMY	0.48 ± 0.29	0.20 ± 0.10	0.33**± 0.08	–0.08 ± 0.08	0.32** ± 0.07	0.59** ± 0.06
PY	0.50 ± 0.38	–0.13 ± 0.48	0.61 ± 0.20	–0.03 ± 0.07	0.35** ± 0.07	0.32** ± 0.07
LL	–0.71* ± 0.23	–0.65* ± 0.27	–0.11± 0.53	0.12 ± 0.07	–0.25** ± 0.07	0.14 ± 0.07
AMY/LL	–0.31 ± 0.39	0.57* ± 0.26	0.45 ± 0.36	–0.31 ± 0.39	0.12 ± 0.079	0.54** ± 0.06
AMY/CI	–0.94*± 0.07	0.66* ± 0.30	–0.05 ± 0.63	–0.94* ± 0.07	NE	0.06 ± 0.06

Above diagonal, phenotypic correlations, below diagonal =genetic correlations with SE; Heritability, diagonal bold elements and NE, not estimated.

nonsignificant on DP by Das *et al.* (2001) in Jersey and Jersey × Red Sindhi cows.

The period effects were significant on all the production traits under the present study indicating managemental variations from period to period. Though, no systematic trend was evident over the periods, yet the general performance was toward decline during the later periods. The average estimates for AMY/LL, AMY/CI and also PY reflected a trend similar to that of the other production traits like MY_{305}, LMY, for crossbred cows calving in different periods i.e. significant rise from period 1981–1984 to 1989–1992 and a significant decline thereafter with improvement in period 2005–08. These findings on effect of period of calving on production traits were in agreement with Vaidya (2002) except for LL whereas, Verma (2010) reported non-significant influence of period of calving on the same production traits in Jersey×Red Sindhi crosses.

The least squares means of most of the production traits significantly varied from one to other lactation except for LL which reflected nonsignificant increasing trend unlike other production traits in crossbred cows. The least squares means for most of the production traits in first lactation were significantly lower than those in third parity except for LL, for which the parity wise variations were found nonsignificant. Similar findings for effect of parity were reported by Vaidya (2002) in Jersey and Friesian crossbred cows, whereas significant effect of lactation order on MY_{305} was observed (Verma 2010) in Jersey × Red Sindhi crosses.

Heritability estimates: The heritability for production traits heritability was observed as 0.12±0.09, 0.20±0.10, 0.61±0.20, 0.12±0.08, 0.12±0.08 and 0.06±0.06 for MY_{305}, LMY, PY, LL, AMY/LL and AMY/CI respectively. The heritability estimate of PY was high (0.61) in pooled over lactations of Jersey crossbred cows under the present study whereas Vaidya (2002) reported moderate heritability estimates ranging from 0.22 (PY) to 0.39 (LMY) and low (0.11 for LL) heritability (Deshpande *et al*. 1992) in Jersey crossbred cows.

Genetic and phenotypic correlation estimates: The genetic associations among production traits in Jersey crossbred cows are presented in Table 2. Genetic association of PY with production traits such as MY_{305}, LMY, AMY/LL and AMY/CI was observed ranging from 0.15 to 0.46. The genetic correlation coefficients of LL with production traits were positive ranging from 0.17 to 0.92 and it being high (0.83±0.14) and significant with LMY. The phenotypic associations among production traits were found to be significantly positive between LMY× AMY/LL (0.57±0.26) and LMY×AMY/CI (0.66 ± 0.30) in Jersey crossbred cattle. Verma (2010) reported very high (0.90 and 0.75) genetic association and phenotypic association (0.65 and 0.43) of PY with 305day milk yield and LMY in Jersey × Red Sindhi crossbred cows.

From the present study, it may be concluded that the production performance of Jersey crossbred were better during winter due to the better adaptability of them to the concerned environmental conditions except PY. In third lactation, all these traits showed better performance. Period showed significant effect on these traits, but were not in a definite trend under different periods. The low to moderate heritability estimates indicated that these characters are controlled by the factors other than additive gene action, which further emphasized that the individual selection is of less significance. To improve these production traits, it requires the information from other relatives and improvement in managemental practices. From the present investigation, it may be suggested that Jersey crossbred cows have the potential to improve in the sub-temperate agro-climatic condition of Himachal Pradesh.

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