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Dr. B. N. Thorat,
Assistant Professor,
Dept. of Animal Husbandry & Dairy Science,
College of Agriculture,
Dongarshelki Tanda, Udgir
Maharashtra, India

Dr. B. M. Thombre,
Head, Dept. of Animal Husbandry & Dairy Science,
College of Agriculture,
Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani.
Maharashtra, India.

Dr. C. A. Nimbalkar,
Associate Professor,
Dept. of Statistics,
College of Agriculture,
Mahatma Phule Krishi Vidyapeeth, Rahuri
Maharashtra, India

Correspondence
Dr. B. N. Thorat,
Assistant Professor,
Dept. of Animal Husbandry & Dairy Science,
College of Agriculture,
Dongarshelki Tanda, Udgir
Maharashtra, India

Studies on heritability, genetic and phenotypic correlation among some production traits of holdeo (HF x deoni) crossbred cattle

Dr. B. N. Thorat, Dr. B. M. Thombre and Dr. C. A. Nimbalkar

Abstract
India has a pride possession of a large livestock wealth, both in terms of number as well as diversity. The activity of livestock production is largely confined to the rural sector. In the present study systematic record in respect to LMY, 300 DMY, PMY, DAPMY and LP was taken from the pedigree sheets and daily milk yield records maintained at CCBP farm. The records of 411 Holstein Friesian x Deoni crossbred over a period of 38 years were utilized for study. Heritability and genetic correlation was done by parental half-sib correlation method. In Holdeo cows medium to high heritability (h^2) in respect of LMY, 300DMY, PMY, DAPMY and LP. The genetic correlations of 300 DMY, PMY and LP with LMY were positive and significant ($P < 0.01$). PMY and DAPMY with 300 DMY were positive and significant ($P < 0.01$). Whereas, LP was non-significant. DAPMY with PMY was negative and significant ($P < 0.01$). While, LP was non-significant. LP with DAPY was negative and significant ($P < 0.01$). The phenotypic correlations of 300 days milk yield with LMY was positive and significant ($P < 0.01$). However, PMY and LP were positive and non-significant and DAPMY was negative and non-significant. PMY and 300 DMY was positive and non-significant. Whereas, DAPMY and LP with 300 DMY were negative and non-significant. DAPMY with PMY and LP were positive and non-significant. LP with DAPMY was negative and non-significant.

Keywords: DAPMY, 300DMY, genetic and phenotypic correlation, heritability, holdeo, LMY, LP and PMY

Introduction

Crossbreeding of Indian cattle with improved European breeds of dairy cattle has been adopted as method of replacing the genotypes and augmenting the milk production. Crossbreeding as a mating method is used in different countries for years. Crossbred animal performance is combination of additive and non additive genetic factors. The crossbred cows have shown their superiority over local cows in productivity and reproductive efficiency in our country. Effects are being made on different farms to develop new breeds which could be efficient producer under our agro climatic conditions. The production efficiency traits considering both the production aspects of the animal are important parameter for ensuring profitability of dairy animal over longer period. The impact of crossbreeding was improved milk production, per capita availability of milk, growth rate and reproductive efficiency. Crossbreeding programme in India has made significant impact on milk production in the country (Kharat *et al.*, 2008) [19].

Materials and Methods

Estimation of heritability

Additive genetic variance was an important component of total phenotypic variance. It was understand by the ratio σ^2 A / σ^2 P. Where σ^2 A was all the additive and σ^2 P total phenotypic variance. The ratio arrived at was the heritability (h^2). Estimation of the h^2 of LMY, 300 DMY, PMY, DAPY and LP was done by parental half-sib correlation method. The sires having 5 or more female progenies were only considered for the estimation of heritability of production traits. The formula used for estimation of h^2 was given by Becker (1975).

$h^2 = 4$ R

$$R = \frac{A - B}{A + (\lambda - 1)\,B}$$

Where,

A = between sire components

Genetic correlation

The genetic correlation coefficients among production traits were computed by paternal half-sib analysis of covariance method as describe by Narain *et al.* (1979) [28].

Phenotypic correlation

Phenotypic correlation coefficients among various traits were computed according to the procedure suggested by Snedecor and Cochron (1967) [42]. The statistical, significance of correlations were tested by using t-test.

Result and Discussion

1. Lactation Milk Yield

a) Heritability

The heritability of lactation milk yield in Holdeo cows were presented in Table 1. The heritability of lactation milk yield was found to be 0.25 ± 0.17. Similar estimates were reported by Basu and Ghai (1980) [5], Raheja (1994) [37] and Komatwar *et al.* (2009) [20] in Holstein Friesian x Sahiwal crossbred, Thalkari (1984) [45] and Thombre (1996) [46] in Holstein Friesian x Deoni halfbred, Singh *et al.* (1993) [40] and Tiwari *et al.* (1995) [48] in Jersey x Sahiwal, Deshmukh *et al.* (2003) [13] and Faco *et al.* (2008) [15] in Holstein Friesian x Gir crossbred, Misra and Joshi (2004) [25] in Karan Fries, Bajetha and Singh (2011) [2] for crossbred cattle, Usman *et al.* (2012) [50] in Holstein Friesian, Patond (2013) [34] in Gir triple cross cows and Bhutkar (2014) [10] in Holstein Friesian x Deoni crossbred and in Deoni cows and Thombre *et al.* (2015) [47] in Deoni cows.

Table 1: Estimates of heritability, genetic and phenotypic correlation of milk production traits in Holdeo

Traits	LMY	300 DMY	PMY	DAPY	LP
LMY	0.25 ± 0.17	0.760**	0.509**	0.100	0.339**
300 DMY	0.467**	0.14 ± 0.06	0.468**	0.454**	0.067
PMY	0.142	0.140	0.27 ± 0.17	-0.334**	0.108
DAPY	-0.050	-0.042	0.003	0.12 ± 0.05	-0.437**
LP	0.098	-0.046	0.011	-0.022	0.50 ± 0.18

Figures at diagonal are heritability estimates of that trait; Figures above diagonal are genetic correlations and below are phenotypic correlations * = $P < 0.05$; ** = $P < 0.01$

b) Genetic correlation

The genetic correlations of lactation milk yield with other traits was presented in Table 1. In Holdeo cows genetic correlations of 300 days milk yield (0.760), peak milk yield (0.509) and LP (0.339) with lactation milk yield were positive and significant ($P < 0.01$). These results were supported by Panda and Sadhu (1983) reported in crossbreds of Hariana cattle with HF and Jersey, Rahumathulla *et al.* (1993) [38] in Jersey x Red Shindhi cows, Gawari (1999) [16] in triple cross cows, Tomar *et al.* (1999) [49] in crossbred cattle, Dhumal *et al.* (2000) [14] and Lakshmi *et al.* (2009) [24] in Holstein Friesian x Sahiwal crossbred, Tekerli *et al.* (2000) [43] in Friesian cattle, Vinoo *et al.* (2005) [51] in Ongole cattle, Kumar and Singh (2006) [21] in Karan Fries cows, Bhopale (2008) [8] and Bhutkar (2014) [10] in Holstein Friesian x Deoni crossbred, Portillo and Pollott (2008) [36] in HF cows, Nikam (2010) [29] in Phule Triveni synthetic cows, Bajetha and Singh (2011) [2] in crossbred cattle, Patond (2013) [34] in Gir triple cross cows, Ambhore (2015) [1] and Tambe (2016) [44] in HF x Gir halfbred. While, DAPMY was positively and non-significantly (0.10) correlated with LMY. These results were supported by Ambhore (2015) [1] in Holstein Friesian x Deoni crossbred.

c) Phenotypic correlation

In Holdeo cows the phenotypic correlations of some production traits with lactation milk yield were given in Table 1. The phenotypic correlations of 300 days milk yield (0.467) with lactation milk yield was positive and significant ($P < 0.01$). However, the phenotypic correlations of peak milk yield (0.142) and lactation period (0.098) with lactation milk yield were positive and non-significant and days to attain peak milk yield (-0.050) with lactation milk yield was negative and non-significant. Similar positive and significant phenotypic correlations of 305 days milk yield in Jersey x Red Sindhi crossbred, 305 days milk yield, lactation length and peak milk yield in crossbred dairy cows, peak yield in HF cows, 300 DMY in Phule Triveni synthetic cows, 300 days milk yield, peak milk yield and days to attain peak milk yield in Gir triple cross cows and 300 days milk yield, peak milk yield and lactation period in HF x Gir halfbred with lactation milk yield were reported by Rahumathulla *et al.* (1993) [38], Tomar *et al.* (1999) [49], Portillo and Pollott (2008) [36], Nikam (2010) [29], Patond (2013) [34] and Tambe (2016) [44].

2. 300 Days Milk Yield

a) Heritability

The heritability of 300 DMY in Holdeo cows were presented in Table 1. The heritability of 300 DMY was found to be 0.14 ± 0.06. These results were close to Bhoite (1996) [7] reported in FJG and BFG triple cross cows, Sivakumar (1998) [41], Misra and Joshi (2004) [25], Kumar and Singh (2006) [21] and Banu *et al.* (2009) [4] in Karan Fries crossbred, Bakir *et al.* (2004) in Brown Swiss cattle, Mukherjee (2005) [26] in Frieswal cows, Faco *et al.* (2008) [15] in HF x Gir crossbred and Lakshmi *et al.* (2009) [24] in HF x Sahiwal cattle.

b) Genetic correlation

The genetic correlations of 300 DMY with other traits were presented in Table 1. In Holdeo cows genetic correlations of peak milk yield (0.468) and days to attain peak milk yield (0.454) with 300 DMY were positive and significant ($P < 0.01$). While, lactation period (0.067) was non-significantly correlated with 300 DMY. Similar genetic correlation between peak yield and 300 DMY was observed by Gawari (1999) [16] in triple cross cows, Tomar *et al.* (1999) [49] in crossbred cows, Patond (2013) [34] in Gir triple cross cows and Tambe (2016) [44] in HF x Gir halfbred.

c) Phenotypic correlation

In Holdeo cows the phenotypic correlations of some production traits with 300 DMY were given in Table 1. The phenotypic correlation between peak milk yield (0.140) and 300 DMY was positive and non-significant. However, the phenotypic correlations of days to attain peak milk yield (-0.042) and lactation period (-0.046) with 300 DMY were negative and non-significant. Tomar *et al.* (1999) [49] in crossbred cows reported similar phenotypic correlation between lactation period and 305 DMY.

3. Peak Milk Yield

a) Heritability

The heritability of peak milk yield in Holdeo cows were presented in Table 1. The heritability of peak milk yield was found to be 0.27 ± 0.17. Closer heritability values noticed by Bhutia and Pande (1988) [9] observed in Holstein Friesian x

Sahiwal, Deshmukh *et al.* (1995) [12] in Jersey x Sahiwal, Deshmukh *et al.* (1995) [12] in Jersey cattle, Deshmukh *et al.* (1995) [12] and Singh *et al.* (2001) [39] in Sahiwal cattle, Nanavati and Qureshi (1996) [27] in Gir cattle, Patil (1997) [32] in Jersey, Patond (2013) [34] in Gir triple cross cows, Bhutkar (2014) [10] in Deoni cows and in Holstein Friesian x Deoni crossbred cattle, Jagdale (2015) [18] in Deoni cattle.

b) Genetic correlation

The genetic correlations of DAPY and LP with PMY were presented in Table 1. In Holdeo cows genetic correlation of days to attain peak milk yield (-0.334) with peak milk yield was negative and significant ($P < 0.01$). While, lactation period (0.108) was non-significantly correlated with PMY. These results supported by Gawari (1999) [16], Portillo and Pollott (2008) [36] and Kumar *et al.*(2012) [22] reported negative and significant genetic correlation between days to attain peak milk yield and peak milk yield in triple cross cross cattle, HF cows and Sahiwal cattle, respectively and Bhutkar (2014) [10] in Holstein Friesian x Deoni crossbred cows. However, genetic correlations of days to attain peak milk yield with peak milk yield was positive and significant reported by Kumar *et al.* (1992) [23] observed in Hariana cattle, Patond (2013) [34] in Gir triple cross cows, Jagdale (2015) [18] in Deoni cattle and Pawar (2015) [35] in Holstein Friesian x Deoni halfbred. While, genetic correlations of days to attain peak milk yield with peak milk yield was negative and non-significant reported by Ambhore (2015) [1] observed in Holstein Friesian x Deoni halfbred and Tambe (2016) [44] in HF x Gir halfbred.

c) Phenotypic correlation

In Holdeo cows the phenotypic correlations of DAPY and LP with PMY were given in Table 1. The phenotypic correlations of days to attain peak milk yield with peak milk yield (0.003) and lactation period (0.011) were positive and non-significant. These result was supported by Tambe (2016) [44] observed in HF x Girhalfbred.

4. Days to Attain Peak Milk Yield

a) Heritability

The heritability of days to attain peak milk yield in Holdeo cows were presented in Table 1. The heritability of days to attain peak milk yield was found to be 0.12 ± 0.05. Similar values of heritability for DAPY reported by Gawari (1999) [16] observed in triple cross cattle, Patel *et al.* (2010) [31] in Holstein Friesian cattle and Patond (2013) [34] in Gir triple cross cows. Low heritability of DAPY indicated that most of the variations in this trait could be attributed to environmental and managerial causes. So the improvement of this trait is linking with improving system of herd feeding and management.

b) Genetic correlation

In Holdeo cows the genetic correlation of LP with DAPY was presented in Table 1. In Holdeo cows genetic correlation of LP with DAPY was negative and significant ($P < 0.01$). Similar results reported by Patond (2009) [33] observed in Jersey cows and Bhutkar (2014) [10] in Holstein Friesian x Deoni crossbred.

c) Phenotypic correlation

In Holdeo cows the phenotypic correlation of LP with DAPY was given in Table 1. The phenotypic correlation of lactation period with days to attain peak milk yield (-0.022) was negative and non-significant. These result supported by Dange (1996) [11] reported in JFG cows.

5. Lactation Period

a) Heritability

The heritability of lactation period in Holdeo cows were presented in Table 1. The heritability of lactation period was found to be 0.50 ± 0.18. Similar values of heritability reported by Ghanaer *et al*. (2008) [17] observed in Sahiwal and Jagdale (2015) [18] in Deoni cattle.

Conclusions

In Holdeo cows medium to high heritability (h^2) in respect of lactation milk yield, 300 days milk yield, peak milk yield, days to attain peak milk yield and lactation period have indicated the beneficial effect of Holstein Friesian inheritance in elevating the status of the traits under study and appropriate guidance for planning the selection of crossbred in early productive life. The positive and highly significant genetic correlations between 300 days milk yield, peak milk yield, lactation period and lactation milk yield clarified that these traits were likely to be controlled by the same number of genes. Thus, lactation milk yield, 300 days milk yield, peak milk yield and lactation period in Holstein Friesian x Deoni crossbred could be improved simultaneously through selective breeding. Higher heritability of LP attributed to the increase in values of additive genetic variance and reduction in values of permanent environmental components. Thus higher heritability of LP indicated that the correlation between genotype and phenotype of individual was high and therefore, selection on the basis of individual's own phenotype should be effective.

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