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GENETIC AND NON-GENETIC FACTORS AFFECTING THE LACTATION MILK YIELD AND LACTATION LENGTH OF DAIRY CATTLE

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ABSTRACT

The present study was conducted on lactation milk yield and lactation length (LL) of Desi, Holstein Friesian crossbred (HFX) and Jersey crossbred (JX) cows were utilized for this study. The investigation was conducted on 104 randomly selected private dairy units consisting of 229 Desi, 85 HFX and 103 JX cows utilizing the procedures of "stratified random sampling with proportional allocation" in and around Madhepura (Bihar). The main aim of this investigation was to study the effects of genetic and various non-genetic factors on milk production efficiency traits. The least squares mean of LL (days) in Desi, HFX, and JX cows were obtained as 262.585± 1.473, 311.382 ± 2.496, and 300.682 ± 2.361, respectively. Apart from these, various constraints perceived by the dairy farmers were also studied to suggest a suitable package of dairy practices for economic milk production. The genetic groups included Desi, HFX, and JX cows, whereas the non-genetic factors consisted of the location of herd, herd size, herd constitution, season of calving, sequence of lactation, and farming system.

Key words : *Genetic, non-genetic factors, cattle, lactation length, lactation milk yield.*

Milk yield in dairy animals can be defined as average daily yield or total milk yield in a specified period such as standard lactation of 305 days or completed lactations. India is top milk producer (155.5 million tons) in the world, but the average daily milk production of our indigenous cattle is very poor (2.24 kg) as compared to crossbred and exotic cows (6.87 kg). Thus, intensive efforts are being made to increase milk production through scientific breeding, balanced feeding, health care, and better management of milch animals. In the present scenario, dairying has emerged as a constant source of income for millions of rural families around the year thus plays a significant role in the Indian agricultural economy. This dairy breed is well known for its higher milk production, greater endurance for hot climate under tropics and subtropics, resistance to the tropical diseases, low cost of maintenance with high feed conversion efficiency and for production of synthetics around the globe. This might be attributed to low genetic potential coupled with the various environmental factors primarily poor level of nutrition and improper management. Animal husbandry and dairy farming are vital sectors of the rural economy. These provide a significant proportion of self-employment opportunities in these sectors. Landless milk producers and marginal and small farmers engage themselves in dairying for gainful employment or supplementing their income.

The importance of dairying lies not only in the production of milk but it also brings about significant change in the socioeconomic structure of the rural economy. Since the profitability is the main objective of any enterprise, there must be an optimum level of milk production for maximizing the economic gain. The milk-producing efficiency of cows is dependent on various genetic and non-genetic factors. Although many studies have been conducted on milk production efficiency of cows in organized farms, the information on the cows maintained in unorganized dairy units (khatals) is scanty (Shrivastava and Singh, 2000; Kumar, 2005 and Kumar,2006).

Source of Data : The present research study was carried out on Desi and Holstein Friesian crossbred (HFX) and Jerseycrossbred (JX) cows maintained in private dairy units located in a radius of about 15 kms in and around Madhepura (Bihar).

MATERIALS AND METHODS

The study was carried out on 229 Desi, 85 HFX cows and 103 JX cows maintained in private dairy units located in a radius of about 15 km in and around Madhepura, Bihar, utilizing the producer of stratified random sampling with proportional allocation (Snedecor and Cochran, 1967). Means and standard error were obtained as per the formula is given by snedecor and Cochran (1967). Least squares analysis of variance (Harvey, 1966) was performed to study the effect of genetic and various nongenetic factors on peak yield and days to attain peak yield using the following mathematicalmodel.

Yijklmnop=μ+Gi+HLj+HSk+HCi+Lm+Sn=Zo+ eijklmnop

Where,

Yijklmnop=The value of p^{th} individual under i^{th} genetic group, j^{th} location of herd, k^{th} herd size, 1th herd constitution, m^{th} lactation order, nth season of calving, and o^{th} farming system.

μ=Overall general mean.

G_i=the effect of ith genetic group (i=1, 2, 3)

HL_j=the effect of location of herd (j=1, 2, 3, 4)

HS_k=the effect of herd size (k=1, 2, 3)

HC_l= the effect of herd constitution (l=1, 2, 3, 4)

L_m = the effect of lactation order (m=1, 2, 3, 4, 5)

S_n= the effect of season of calving (n=1, 2, 3).

Z_o=the effect of farming system (0=1, 2).

eijklmnop = The random error which is distributed normally and independently with mean 0 and variance Duncan's Multiple Range test (DMRT) as modified by Kramer (1957) was used for pairwise comparison of the least squares and means.

Primary Survey : The primary survey was conducted in the private dairy units popularly known as "Khatals" located in a radius of 15 km in and around Madhepura. "Khatals" consisting of at least three or more Desi or crossbred cows either alone or in combination were enumerated through a "door to door survey" method in this study. The animals were fed poor quality of roughages, and there was a deficiency of greens in the feed because the dairy khatals owners had the only aim of profit.General practices of. There were no uniform managerial practices in the Khatals. The cows, in general, were stall-fed with individual feeding. Cows were provided the concentrates depending on their physical and physiological status such as the size of the body, milk production, stage and sequence of lactations, and dry period.

In general, homemade concentrate mixtures were fed to the animals, with few exceptions too. The most common items of dry fodder consisted of wheat Bhoosa and chaffed paddy. The main source of the green fodders included seasonal cultivated and uncultivated grasses. There was a general practice to add the mineral mixture, vitamins, and common salt to balance the ration. Majority of the dairy units did not follow the scientific schedule of vaccination completely; however, the farmers considerably took prophylactic and curative measures against various diseases. Besides, A.I. was also in common practice for breeding the cows in the dairyunits.

RESULTS AND DISCUSSION

Lactation Milk Yield(LMY) : Least squares mean of LMY in Desi, HFX, and JX cows under genetic and various non-genetic factors are depicted in Table1.

Mean Lactation Yield : The mean LMY (kg) of Desi, HFX, and JX cows was found to be1032.049±14.253,2445.028±24.159,and 2036.113 ± 22.857, respectively, in this study Table-1. Thesefindingsareobservedtofallintherangesof693.2 kg to 1935.61 kg for Desi cows, 1933.2 kg (Parmar *et al*, 1986) to 3655.1 kg (Singh *et al* 1986a) for Holstein Friesian crossbreds, and 1256.8 kg (Thakur *et al,* 1999) to 2681.11 kg (Patel and Trivedi, 1989) for JX cows as mentioned in the literature and noted in (Table 1). Variations in breeds of indigenous cows and levels of exotic inheritance for crossbreds along with management and environmental differences might be attributed to variations in average LMY reported by variousauthors.

Influence of Genetic Factors : As mentioned in Table 1, least squares analysis of variance revealed significant ($p < 0.01$) influence of the genetic group on LMY. HF crossbred cows had the highest (2445.028 kg) LMY which was significantly ($p< 0.05$) higher by 1412.979 kg and 408.915 kg than Desi and JX cows, respectively. Besides, JX cows had also significantly ($p < 0.05$) 1004.064 kg higher LMY than Desi cows.

Trait-wise and column-wise means bearing different superscripts differ significantly ($p<0.05$). LMY: Lactation milk yield, HFX: Holstein Frisian crossbred, JX: Jersey crossbred, SE: Standard errorthe cows of different genetic groups presented the fact that both HFX and JX cows had more than double LMY (kg) than those yielded by Desi cows. This reflected that both HFX and JX cows are well adapted in the agroclimatic region of Madhepura district of Bihar.Kumar (1985) also mentioned nearly double LMY in JX cows than Hariana cows. Kumar (2005) reported the LMY of HFX and JX cows to be nearly 3 times more than Desi cows in and around Patna (Bihar). Besides, Kumar (2006) also observed that both HFX and JX cows had more than double LMY than Desi cows in and around Biharsharif of

Table-1: Least squares means of LMY and LL under different genetic and non-genetic factors.

Genetic and non-genetic factors	Lactation milk yield (kg) mean±SE	LL (days) mean ± SE
Genetic factors		
Desi	1032.049a±14.253	262.585a±1.473
HF crossbred	2445.028b±24.159	311.382b±2.496
Jersey crossbred	2036.113c±22.857	300.682c±2.361
Non-genetic factors		
Location of herd (zones)		
I	1799.410a±17.642	289.210a±1.823
II	1880.472b±23.160	295.805b±2.393
III	1835.141a±21.206	294.961b±2.191
IV	1835.896a±28.397	286.223a±2.934
Herd size		
3-4	1857.887±14.515	289.988±1.500
5-7	1818.772±21.968	290.361±2.270
8 and above	1836.531±28.300	294.299±2.924
Herd constitution		
One group alone	1862.589±26.261	297.738a±2.713
D+HFX	1819.846±24.270	289.826b±2.507
D+JX	1823.324±24.580	290.594b±2.539
D+HFX+JX	1845.161±19.963	288.041b±2.062
Season of calving		
Winter	1854.959±18.544	293.141a±1.916
Summer	1826.758±18.117	287.810b±1.872
Rainy	1831.472±21.054	293.698a±2.175
Lactation order		
1st	1798.845a±22.269	289.367a±2.301
2nd	1819.893a±22.681	291.128a±2.343
3rd	1948.840b±19.211	297.405b±1.985
4th	1894.629c±22.813	293.066ab±2.357
5th and above	1726.442d±29.577	286.782a±3.056
Farming system		
Dairying alone	1739.246a±19.014	283.894a±1.964
Agriculture + Dairying	1936.214b±15.498	299.205b±1.601

Nalanda district (Bihar) under farmers' managemental condition. The findings of the present study also proved the superiority of HFX over JX cows with respect to LMY which might suggest more use of HFX than JX in and around Madehpura (Bihar).

Kumar (2005) and Kumar (2006) also reported the superiority of HFX over JX cows under farmers' managemental condition in and around Patna and Biharsharif of Bihar, respectively. Jadhav*et al* (1991), Singh *et al* (1993), Bhattacharya *et al* (2002), Raj (2002), Akhter *et al* (2003), Bhadauria and Katpatal (2003), Kumar1 (2004), Kumar2 (2004), Kumar (2005), and Kumar (2006) also observed significant (p < 0.01) effect of genetic groups on LMY. The findings of the present study are in close agreement with the findings of Kumar1 (2004), Kumar (2005), Sharan (2005), and Kumar(2006).It is worth mentioning here that JX cows are also well adapted in Madhepura district as well as other districts of Bihar and yielded more than double LMY than Desi cows. During the estionnaires made from the farmers' of Madhepura district, many of them preferred JX cows over Holstein Friesian crossbred cows due to higher fat percentage in the milk of JX cows, more docile in nature, and more use of JX male calves.

Effect of Non-genetic Factors

Location of herd (zones) : As revealed through least squares of analysis of variance (Table 1), different zones had significant ($p< 0.05$) effect on LMY. Table 1 presented that zone-II had the highest (1880.472 kg) LMY, which was significantly ($p < 0.01$) higher by 81.062 kg, 45.33 kg, and 44.576 kg than LMY of zones I, III, and IV, respectively. The LMY of zone I, III, and IV, however, did not differ significantly.

Hyatnagarkar *et al* (1990), Jadhav*et al* (1991), Kumar (2005), and Kumar (2006) also reported significant ($p < 0.05$) effect of zones on LMY. The findings obtained in the present study are in conformity with the results obtained by the various authors mentioned above. However, Raj (2002) and Kumar1 (2004) reported a non-significant effect ofthe location of the herd on LMY. The reason for higher LMY might be attributed to better feeding and management of zone II cows in comparison to cows maintained in other zones.

Herd size : Least squares analysis of variance (Table 1) revealed that the size of the herd did not influence LMY significantly. Raj (2002) also observed non-significnat effect of herd size on LMY. However, Shrivastavaet al (1998), Kumar1 (2004), Kumar (2005), and Kumar (2006) reported significant ($p < 0.05$) effect of herd size on LMY.

Herd constitution : Herd constitution had no significant effect on LMY which is similar to the findings of Kumar (2004) and Kumar (2005). However, Kumar (2006), contrary to the finding of the present study, observed significant ($p < 0.05$) effect of herd constitution on LMY.

Season of Calving : Season of calving did not play a significant role in LMY (Table 1). However, the winter season had the highest LMY followed by rainy and summer in this study. The findings of the present study are similar to the results obtained by Jadhav*et al* (1991), Yadav and Rathi (1992), Singh *et al* (1993), Raheja (1997),Thakur *et al* (1999), Raj (2002), Prasad (2003), Bhaduria and Katpatal (2003), and Kumar2 (2004). However, a few authors such as Shettar and Govindaiah (1999), Akhter *et al* (2003), Kumar1 (2004), and Kumar (2006) observed significant ($p < 0.05$) effect of the season of calving on LMY.

Lactation Order : Least squares analysis of variance presented significant ($p < 0.01$) effect of lactation order (table-01) on LMY. The lactation order, observed in this study, presented a clear cut trend. The LMY increased with the increase of lactation order and attained the highest (1948.840 kg) in 3rd lactation and thereafter tended to decline gradually in subsequent lactations. The LMY increased by 21.048 kg in 2nd lactation from the 1st and also by 128.947 kg in 3rd lactation from 2nd after which the LMY declined in 4th and 5th and above lactationsby54.211 kg and 222.398 kg, respectively, from 3rd. Kumar (1985), Raj (2002), Shiv Prasad (2003), and Kulkarni *et al* (2003) also reported significant ($p < 0.01$) effect of lactation order on LMY. All the above authors also reported a gradual increase in LMY with the advancement of lactation order which attained its maximum in a 3rd sequence of lactation, a similartrend obtained in the present study. However, contrary to the finding of the present study, Kumar2 (2004) and Kumar (2006) could not find a significant effect of lactation order on LMY.

Farming System : Least squares analysis of variance (Table 1) presented significant ($p < 0.01$) effect of farming system on LMY. DMRT revealed that the cows maintained in the dairy units integrated with agriculture had significantly ($p < 0.01$) 196.968 kg more LMY than those maintained in the units involving dairying alone in the private dairy units in and around Madhepura (Bihar). Kumar (2005) and Kumar (2006) also reported that the cows managed in the dairy units along with agriculture farming had significantly ($p < 0.01$) higher LMY than those units maintaining dairyingalone. However, Kumar1 (2004) observed the non- significant effect of farming system on LMY under farmers' managemental condition.

Lactation Length (LL) : The least squares mean of LL (days) in Desi, HFX, and JX cows was obtained as 262.585 ± 1.473, 311.382± 2.496, and 300.682 ± 2.361, respectively (Table-1). The ranges of LL (days) as reported in literature varied from 268.82 days (Yadav and Rathi, 1992) to 385.3 days (Parmar *et al*, 1986) for indigenous cows, 247.87 days (Bhattacharya *et al*, 2002) to 432.87 (Parmar *et al*, 1986) for HFX, and 306.08 days (Singh *et al*, 1993) to472.69days (Kumar2, 2004) for JX cows. Except for Desi cows, the average LL days of HFX and JX cows fall in the ranges mentioned above. The average LL of desi cows obtained in this study was a little lower than mentioned in literature. It is worth mentioning here that the above authors studied established indigenous breeds only whereas the present study was based on both local and established indigenous breeds. Besides, the finding of the present study is very close to the findings of for Desi cows, Singh *et al* (1986b) for HFX, and Deshmukh*et al* (1995) for JXcows.

Effect of Genetic Groups : Least squares analysis of variance (Table 1) presented significant ($p < 0.01$) effect of genetic group on LL (days). DMRT revealed that HFX cows had significantly ($p < 0.05$) 46.235 days and 10.70 days longer LL (days) than Desi and JX cows, respectively. Besides, JX cows had also significantly ($p < 0.05$) 38.097 days longer LL than Desi cows. Significant effect of genetic group on LL (days) have also been reported by Thakur *et al* (1999), Raj(2002),Kumar2 (2004), Sharan (2005), and Kumar (2006) in different genetic groups of cows. However, contrary to the finding of the present study, Kumar (1985) in JX H (F1), Singh *et al* (1993) in Sahiwal, and its crosses with Jersey and Red Dane, Shettar and Govndaiah (1999) in different levels of HF, J, and RedDaneinheritancewithindigenouscowsandKumar *et al* (2007) in Desi, HFX, and JX cows under farmers' managemental condition observed non- significant effect of genetic group on LL (days).

Effect of Non-genetic Factors Location of herd : Although there was significant ($p < 0.05$) effect of zones on LL (days), the differences in LL days in various zones were found to be very small. The LL days ranged from 286.223 days in Zone-IV to 295.805 days in Zone-II. Jadhav*et al* (1991) alsoreported significant ($p < 0.01$) effect of the location of farm on LL (days). However, Raj (2002), Kumar1 (2004), Kumar (2006), and Kumar *et al* (2007) reported the non-significant effect of zones on LL days in Desi and crossbred cows under farmers' managemental condition.

Herd size : Least squares analysis of variance (Table 1) reflected the non-significant effect of herd size on LL days. The LL days ranged from 289.988 days in the herd size of 3-4 to 294.299 days in 8 and above herd size. Raj (2002) Kumar1 (2004), and Kumar et al (2007) also observed the non-significant effect of herd size on LL (days) which are similar to the finding of the present study. However, Kumar (2006) reported significant ($p < 0.05$) effect of herd size on LL (days).

Herd constitution : Least squares analysis of variance (Table 1) presented significant ($p < 0.05$) effect of herd constitution on LL days. The least squares mean revealed the highest (297.738±2.713) LL days in "one group alone" whereas the lowest (288.041±2.062)LL (days) was observed to be in the group consisting of Desi, HFX, and JX cows. Kumar et al (2007) also reported significant ($p < 0.05$) effect of herd constitution on LL (days). However, Kumar1 (2004) and Kumar (2006) did not find any significant role of herd constitution on LL (days).

Season of Calving : Season of calving played a significant role ($p < 0.05$) on LL in Desi, HFX, and JX cows under farmers' managemental condition in this study. Winter and rainy seasons of calving had significantly ($p <0.05$)5.331 days and 5.888 days longer LLs than summer calving. However, the average days of lactation of winter and rainy calvings did not differ significantly. Significant ($p < 0.05$) effects of season of calving have also been reported by Raj (2002), Kumar (2006), and Kumar *et al* (2007) on LL days in Desi and crossbred cows. Raj (2002) also reported longer LL days of winter calvers than summer which is in close agreement with the findings of the present study. However, Singh *et al* (1993), Shettar and Govindaiah (1999), Thakur *et al* (1999), Kumar1 (2004), Kumar2 (2004), Sharan (2005), and Kumar (2006) observed non-significant effect of season of calving on LL days in Desi and crossbred cows.

Lactation Order : Least squares analysis of variance (Table 1) revealed significant ($p < 0.01$) effect of lactation order on LL days. There was a gradual increase in LL days from 1st to 3rd lactation after which it gradually declined in 4th and 5 and above lactations. The mean LL days increased by 1.761 days in 2nd lactation from 1st. However, this increase was non-significant. The mean LL days of 3rd lactation increased significantly ($p< 0.05$) by 8.038 days and 6.277 days from 1st to 2nd sequences of lactation. The mean LL days of the 4th lactation decreased by 4.339 days from 3rd lactation whereas the mean LL days of 5th and above lactation decreased by 6.284 days from 4th lactation. In Hariana cows, Yadav *et al* (1992) in Sahiwal cows, Singh and Nagarcenkar (1997) in Sahiwal cows, Sethi *et al* (2000) in Sahiwal cows, in different genetic groups of crossbred, Raj (2002) in crossbred cows, Kumar1 (2004) in different genetic groups of cows, and Kumar (2006) in Desi, HFX, and JX cows also observed significant effect of sequence of lactation on LL days. However, Kumar (2004), Kumar (2005), Sharan (2005), and Kumar *et al* (2007) found the non-significant effect of lactation order on LL days in Desi and crossbred cows under farmers' managemental condition in Bihar.

Farming System : Least squares analysis of variance (Table 1) presented significant ($p < 0.01$) effect of farming system on LL days in this study. The average LL days of the cows maintained in the dairy units integrated with agriculture farming was observed to be significantly ($p < 0.01$) 15.311 days longer than those units maintaining in dairying alone. It is worth mentioning here that the average LMY of the cows maintained in agriculture integrated with dairying was significantly ($p < 0.01$)196.168 days higher than those maintainedin dairying alone. Higher LMY and longer LL days in the cows maintained in dairy units integrated with agriculture might be attributed to the production of quality feeds and timely green fodders by the farmers for their dairy cows. Kumar (2006) and Kumar *et al* (2007) also reported a significant increase in LL days in the private dairy units integrated with agriculture than those maintained in dairying alone. The findings of the above authors are very similar to the findings obtained in the present study. However, Kumar1 (2004) could not find a significant effect of farming system on LL days.

CONCLUSIONS

The least squares mean of LL (days) in Desi, HFX, and JX cows was obtained as 262.585±1.473, 311.382±2.496, and 300.682±2.361, respectively. The findings of this study reflected that short lactation problem may be alarming for the indigenous herd. Since LL is mainly influenced by environmental factors, therefore proper management measures and good feeding practices are of paramount importance to reduce the occurrence of short lactation in indigenous herds. Furthermore, a study on large-scale data is pertinent to assess the problem of short lactation in a real sense, which may pave the way for ameliorative actions needed to increase milking days of indigenous milch animals in years tocome.

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