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Persistency Measurement in HF × Sahiwal Cattle

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A B S T R A C T

The present study was undertaken to study the effect of various genetic and non-genetic factors on persistency of milk production and to identify the most appropriate persistency method that fits best in environment of Punjab. Effect of different non-genetic factors viz. year of calving, season of calving, level of production and genetic group of animals based on the level of exotic inheritance on persistency of milk yield in crossbred cattle were studied. Data on 577 first lactation daily milk yield records of crossbred cattle maintained at GADVASU dairy farm over a period of 25 years from 1991-2015 were utilized to calculate persistency coefficients by Khmel'Nit skii (P1) and Sturtevent (P2) methods. Overall least squares means for persistency by Khmel'Nit skii and Sturtevent (P2) methods were 0.56 ± 0.11 and 84.2 ± 1.45. Persistency of milk production was measured in Holstein Friesian × Sahiwal cattle up to 42nd week of lactation and overall persistency (%) for weekly milk production in first lactation was found to be 84.22%. Effect of genetic group on Khmel'Nit skii and Sturtevent methods was non-significant. Season of calving and level of production had significant ($P<0.01$) effect on persistency of milk yield by Sturtevent method. Effect of period of calving on persistency of milk yield was found to be significant ($P<0.05$) by Khmel'Nit skii method. Present study revealed that Holstein Friesian × Sahiwal cattle have good persistency of milk production in first lactation.

Introduction

Crossbred cattle hold a key position in the growth of dairy sector in India as crossbred cattle though merely 13.26 % of total bovine population of India, yet they contribute 24.46 % of total milk yield by bovines. In the state of Punjab, where dairy farming is more developed, wide acceptance of crossbred cattle is evident from the fact that 85.06 % of total cattle in Punjab are crossbreds (Basic Animal Husbandry Statistics, 2015). In India, there are 41 registered breeds of cattle (NBAGR 2017). In spite of large genetic resources, productivity remains low. Milk productivity can be increased by crossing low milk producing indigenous cattle with high yielding exotic cattle. Main aim of animal breeder is to enhance genetic improvement in important economic traits. The success of dairy industry is much dependent on level of production and reproductive traits of animals.

Main income for most dairy farmers is based on milk, fat and protein yields of their cattle. As a matter of fact, if profits are a function of returns minus costs, reduction of costs must be considered to improve profits when increases in returns are limited. A way to reduce costs is to distribute same total yield more equally over the whole lactation. This distribution of lactation yield is known under the name of persistency of lactation yields, often simply called persistency.

In cattle, economy of milk production depends mainly on milk produced in different lactations. According to Narain *et al.,* (1981) and Ramachandraiah *et al.,* (1990) milk yield in a lactation depends mainly on persistency, peak yield and lactation length. More persistent animal produces relatively higher milk and therefore, have longer productive life. Persistency of milk yield can be defined in many ways. According to Wood (1967), persistency is "the extent to which peak yield is maintained". Jamrozik *et al.,* (1998) defined persistency of lactation as ability of animal to continue producing milk at a high level after reaching peak of her lactation.

In dairy cattle, milk yield increases rapidly from calving to peak period of yield in a few weeks, thereafter it gradually decreases until milking is no longer practical (Leon-Velard *et al.,* 1995). Persistency of milk is always considered to have more advantages for selection. Solkner and Fuchs (1987) found that more persistent cows have lesser feed intake cost and contribute to more economic returns from animal by increasing the lactation milk yield, resulting in increased profitability. Low individual persistency of milk yield is governed by certain genetic and non-genetic factors. More persistent animals have been reported to have higher lactation milk yields as reported by Ludwick and Peterson (1943), Mahadeven (1951) and Saxena and Kumar (1960).

Materials and Methods

A total of 577 milk yield records (305-days/less) of first lactation from 1991 to 2015 (25 years) were collected for crossbred (HF × Sahiwal) cows sired by 84 bulls maintained at Directorate Livestock Farm, GADVASU, Ludhiana. Normal lactation was considered as the period of milk production by a cow for at least 200 days.

Data were divided into five periods of five year duration each *viz.,* 1991-1995, 1996-2000, 2001-2005, 2006-2010 and 2011-2015. Each year was divided into four seasons viz. winter, spring, summer, rainy of three month duration each. Animal were grouped on the basis of exotic inheritance into four groups viz., <75%, =75%, >75≤87.5% and >87.5%.

Level of production was divided into three classes viz., low producers (< 2861.45), medium producers (2861.45 - 4033.88) and high producers (>4033.88) based on 305 days milk yield. Different measures of persistency were calculated using ratios of milk production in different section of lactation as follows:

Khmel'Nit skii method

$$\text{Persistency} = \frac{\text{Peak yield}}{\text{305-day milk yield}} X100$$

Average weekly milk yield data for first lactation was utilized to estimate the persistency by the method of Sturtevent (1887) as modified by Pradhan and Dave (1973)

((8th week's yield / 7th week's yield) × 100 + (9th week's yield / 8th week's yield) ×100 + (42nd week's yield / 41th week's yield) ×100) / N-1

N = Total no. of weeks included (42 weeks)

Statistical model

Data were analyzed by using Least Squares Analysis as described by Harvey (1990) to study the effects of various genetic and non-genetic factors on persistency calculated by different methods using following model:

$$Y_{ijklmn} = \mu + B_i + S_j + P_k + L_l + GG_m + e_{ijklmn}$$

Where, Y_{ijklmn} = Persistency index of n^{th} cow sired by i^{th} bull, calved in j^{th} season, k^{th} period, having l^{th} level of production and m^{th} level of genetic group (level of exotic inheritance) **;** μ is overall population mean; B_i is random effect of i^{th} sire; S_j is fixed effect of j^{th} season; P_k is fixed effect of k^{th} period; L_l is fixed effect of l^{th} level of production; GG_m is fixed effect of m^{th} level of genetic group (level of exotic inheritance) and e_{ijklmn} is random error assumed to be NID (0, σ_e^2)

Results and Discussion

The overall least squares means of persistency indices calculated by Khmel'Nit skii (1974) and Strutevent (1987) method were found to be 0.56 ± 0.11 and 84.2 ± 1.45, respectively (Table 2). Effect of genetic group was found to be non-significant on persistency calculated by Khmel'Nit skii (1974) and Strutevent (1887) method as shown in (Table 1).

Effect of period of calving was found to be significant for P1 method. Persistency of milk yield was non-significantly (P<0.05) affected by level of production and season by P1 method. The persistency of milk production was measured in Holstein Friesian cattle up to 42^{nd} week of lactation and overall persistency (%) for weekly milk production in first lactation was observed to be 84.22 %. Patel *et al.,* (2015) reported 84.45% persistency of milk yield by P2 method and this was in accordance with our results. Values obtained by Zakariyya *et al.,* (1995) and Ahmad *et al.,* (2003) for persistency of milk yield by Ludwick and Peterson (1943) method were 91.31 ± 0.55 kg and 90.5±0.01 kg, respectively. Persistency of milk yield was significantly (P<0.05) affected by season of calving and level of production by Strutevent method. Significant effect of season of calving was observed by Pradhan and Dave (1973), Yadav *et al.,* (1992), Rao and Sundaresan (1982), Prasad *et al.,* (1999) and Kumar and Singh (2006) by Ludwick and Peterson method. On contrary, non-significant effect of season of calving was reported by Koley *et al.,* (1979) in Jersey × Hariana, Roy and Katpatal (1987) in Jersey cattle and Patond *et al.,* (2014) in Jersey cattle.

Effect of period of calving was found to be significant for P1 method in present study. Significant effect of period of calving on persistency was reported by Shah *et al.,* (1983) in HF crossbred and Patond *et al.,* (2014) in Jersey cattle by Ludwick and Peterson method. Similar significant effect of period of calving on persistency has also been reported by Wondifraw *et al.,* (2013) and Garudkar *et al.,* (2015) by Mahadevan method. However, non-significant effect of period of calving on persistency has been reported by Kumar and Singh (2006) in Karan Fries cattle and Patond *et al.,* (2014) in Jersey cattle by Mahadevan method.

Genetic group had non - significant effect on both persistency indices because most of animals in the herd had exotic inheritance of 75% or more than 75% as shown in Table 2. Significant effect of period of calving could be due to change in climate, feeding, management and genetic constituent of the herd over the years (periods). Significant effect of period of calving could be due to continuous availability of green fodder and conductive weather conditions for longer duration during pre-peak and post peak periods.

Table.1 Analysis of variance for factors affecting different measures of persistency indices

Source of variation	Degree of freedom	Mean sum of squares	
		P1	P2
Genetic group	3	0.021	0.479
Season	3	0.007	37.54*
Period	4	0.11**	2.54
Level of production	2	0.029	7.20**

Values carrying * and ** are significant at 0.05 and 0.01 levels of probability, respectively

Table.2 Least-squares means along with standard errors of different measures of persistency indices in crossbred cattle

Factor	No. of observations	P_1	P_2
Overall mean	577	0.56 ± 0.11	84.2 ± 1.45
Genetic group			
<75%	47	0.52±0.017	84.17±0.21
=75%	386	0.56±0.006	84.13±0.08
>75≤87.5%	116	0.55±0.011	84.24±0.13
>87.5%	28	0.56±0.02	84.36±0.28
Level of Production			
<2861.45	164	0.56±0.012	83.94±0.15
2861.45-4033.88	199	0.53±0.010	84.45±0.12
>4033.88	214	0.54±0.010	84.27±0.12
Season of calving			
Winter	139	0.55±0.010	83.68±0.13
Spring	174	0.54±0.010	84.70±0.13
Summer	134	0.55±0.011	84.63±0.14
Autumn	130	0.55±0.011	83.88±0.14
Period of calving			
1991-1995	137	0.58±0.012	84.05±0.15
1996-2000	166	0.57±0.011	84.37±0.14
2001-2005	101	0.52±0.013	84.14±0.16
2006-2010	91	0.57±0.013	84.37±0.17
2011-2015	82	0.49±0.014	84.19±0.18

However in winter calvers there is sharp decline in milk production during post peak period due to higher temperature of ensuing summer months by Strutevent method.

Thus it appears that it is not merely calving the season of calving but also the supply of nutritive diet through availability of green fodders at different stages of lactation which makes the cow persistent. In conclusion, different non-genetic factors affect persistency of milk yield in first lactation.

So, data should be adjusted for significant non-genetic factors to get accurate estimates of persistency.

Further, for first lactation milk yield good persistency can be obtained in Holstein Friesian × Sahiwal cattle.

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Conflict of Interest Statement

The authors declare that they have no conflict of interest.

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