

ORIGINAL ARTICLE

## Least Square Means and Effects Of Non-Genetic Factors On Production Performance Traits in Hardhenu Cattle

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### ABSTRACT

The overall least-squares means for first lactation average milk yield (AMY), first lactation milk yield per day of first calving interval (MCI) and first lactation milk yield per day of age at second calving (MSC) were in the present study was  $7.36 \pm 0.18$  kg/day,  $5.35 \pm 0.18$  kg/day and  $1.39 \pm 0.05$  kg/day respectively in Hardhenu cattle. With regard to performance traits, the effect of period of calving was statistically significant on all the performance traits. All the production performance traits under study exhibit improved performance over periods that could be attributed to better selection, improved management and nutrition followed at the farm over time in all the traits under present study in Most of performance traits exhibited better performance during sixth period (2015-2018) in both the species understudy. In Hardhenu cattle, the effect of season of calving was statistically significant on AMY and MCI. The effect of linear and quadratic regression of age at first calving was statistically non-significant on all the performance traits under study except MSC in Hardhenu cattle; The result further revealed that by increase by one day of age at first calving there would be a decrease for 0.00069 for MSC in Hardhenu cattle. Effects of various non genetic factors found significant on performance traits.

**Keywords:** LSM, Non-genetic factors, Hardhenu Cattle

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### INTRODUCTION

India has 192.49 million cattle and 109.85 million buffalo population [1] making it 2th in world's largest cattle inventory holding country [7-9]. Productivity importance of buffalo and crossbred cattle is towards higher side as compared to indigenous/nondescript cattle [7]. Dairy animal breeders aim is focused on high milk yield per animal until now. The improvement in the bovine population principally depends on selection and breeding for traits of economic importance. Performance traits are economically important traits in livestock. Performance traits include both high production and in long run, resulting it to became trait of desire having high weightage in index. Performance traits were affected by several environmental factors like period of calving and season of calving. In order to get improvement of Hardhenu cattle by developing better breeding schemes; evaluation of the non genetic values of performance traits becomes necessary [10]. The present study was planned to determine the influence of Period of calving, Season of calving and Age at first calving on several production traits of Hardhenu cattle maintained at an organised farm at LUVAS, Hisar.

### MATERIAL AND METHODS

#### Estimation of non-genetic effects and parameters of Performance traits

The relevant data on 341 Hardhenu cattle to performance traits of various first lactation milk records were collected from history cum pedigree sheets over a period of 24 years (1995-2018) maintained at Cattle Breeding Farm, Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar.

#### Traits under study

1. First lactation Average milk yield (AMY): Total milk produced during first lactation period divided by number of days in that lactation period of animal.
2. First lactation milk yield per day of first calving interval (MCI): Total milk produced during first lactation period divided by the number of days in that lactation period of animal.

3. First lactation milk yield per day of age at second calving (MSC): Total milk produced during the first lactation period divided by the number of days to attain second calving for that animal.

Data pertaining to animals having abnormal records, abortions, lactation length less than 150, chronic illness, and mastitis etc. was excluded from the present study

#### **Classification of the data:**

Entire period of twenty four years was divided into six periods by assuming that there is not much variation in adjacent years, each consisting of four consecutive years. Each year was further delineated into four seasons of calving according to the geo-climatic conditions in the area.

**Period:** Period 1 (P1): 1995 to 1998, Period 2 (P2): 1999 to 2002, Period 3 (P3): 2003 to 2006, Period 4 (P4): 2007 to 2010, Period 5 (P5): 2011 to 2014, Period 6 (P6): 2015 to 2018

**Season:** Summer (S1): April to June, Monsoon (S2): July to September, Autumn (S3): October to November, Winter (S4): December to March

**Statistical analysis:** Considering the non-orthogonality of the data due to unequal subclass frequencies, least squares maximum likelihood computer program of Harvey [10] using Henderson's Method III [11] were utilized to estimate the effect of various non-genetic factors on performance traits and to estimate genetic and phenotypic parameters

The following mixed mathematical model were used:-

$$Y_{ijkl} = \mu \pm S_i \pm h_j + c_k + b_1(A_{ijkl} - \bar{A}) + b_2(A_{ijkl} - \bar{A})^2 + e_{ijkl}$$

Where

$Y_{ijkl}$  = ith record of individual pertaining to ith sire calved in jth period and kth season

$\mu$  = is the overall population mean

$S_i$  = is the random effect of ith sire

$h_j$  = is the fixed effect of jth period of calving

$c_k$  = is the fixed effect of kth season of calving

$b_1$  &  $b_2$  = are linear and quadratic partial regression coefficients of age at first calving on trait(s), respectively

$A_{ijki}$  = is the age at first calving.

$\bar{A}$  = is the mean for age at first calving.

$e_{ijkl}$  = is the random error associated with each and every observation and assumed to be normally and independently distributed with mean zero and variance  $\sigma^2 e$

## **RESULTS AND DISCUSSION**

### **First lactation Average milk yield (AMY)**

The overall least-squares means for first lactation average milk yield (AMY) in Hardhenu cattle and was  $7.36 \pm 0.18$  kg/day. In Hardhenu crossbred cattle similar estimate for AMY was reported by Verma *et al.* [13]. Wondifraw *et al.* [14] reported lower AMY in HF x Deoni cattle. Higher estimates for AMY were reported in Karanfries [11, 12, 4], Vrindavani cattle [2] and HF x Jersey x Sahiwal [3].

#### **Effect of period of calving**

The present study revealed that the effect of calving period on AMY was significant. Other authors also found similar significant effects of calving period on AMY in various crossbred cattle, e.g. Hardhenu cattle [13], Karanfries [6, 11], HF x Deoni [14] and Vrindavani cattle [2]. However, Saha *et al.* (2010) reported non-significant effect of calving period on AMY in Karanfries crossbred cattle. The period wise least-squares mean for AMY indicated that it was the highest (11.03 kg/day) for Hardhenu cattle calved during sixth-period (2015-2018) and the lowest (4.56 kg/day) for cattle calved during first-period (1995-1998). The least squares mean of AMY for cows calved during sixth-period differed significantly with all other periods; however, third-period calvers did not differ significantly with all other periods except sixth-period. Further, estimates of first and second-period calvers differed significantly from those cows calved during fourth and fifth period calvers. Also, an increasing trend was obtained from means of AMY over periods suggesting the selection was in the right direction for this trait.

#### **Effect of season of calving**

Significant effect of calving season on AMY was obtained in Hardhenu cattle under present investigation. Similar results for a significant effect of calving season on AMY was reported by Verma *et al.* [13] in Hardhenu cattle. Other authors also reported significant effect of calving season on AMY in crossbred cattle, i.e. HF x Deoni [14], Karanfries [11] and Vrindavani cattle [2]. However, Divya *et al.* [6] reported none significant effect of calving season on AMY in Karanfries cattle.

The season-wise averages for AMY indicated that it was the highest (7.97 kg/day) for Hardhenu cattle calved during autumn-season (Oct-Nov) and the lowest (7.01 kg/day) for winter season calvers.

#### **Effect of age at first calving**

The effect of regression of age at first calving (linear) in Hardhenu cattle was non-significant on AMY. Similar non-significant effect of age at first calving was reported by Divya *et al.* 2014 in Karanfries crossbred cattle.

#### **First Lactation Milk Yield per Day of Calving Interval**

The overall least-squares mean for first lactation milk yield per day of first calving interval (MCI) was found as  $5.35 \pm 0.18$  kg/day in Hardhenu cattle. Similar estimate for MCI in Hardhenu cattle were reported by Verma *et al.* [13]. MCI value was reported comparatively higher in Karanfries [12, 4, 6, 12] than the present investigation.

##### Effect of period of calving

Significant effect of period of calving on MCI in Hardhenu cattle was obtained under the present study. Further, Dash *et al.* [4] and Japheth *et al.* [12] in Karanfries cattle reported a significant effect of calving period on MCI. Contrarily, Verma *et al.* [13] reported a non significant effect of calving period in Hardhenu cattle.

The period-wise least-squares means for MCI indicated that it was the highest (9.04 kg/day) for Hardhenu cattle calved during sixth-period (2015-2018) and the lowest (1.58 kg/day) for cows calved during first-period (1995-1998). The perusal of results indicated that least-squares means of MCI for Hardhenu cattle calved during first and sixth periods differed significantly among themselves and with all other periods. However, third and fourth period did not differ significantly from those calved during second and fifth period. In addition to this, values for second period calvers differed significantly from cows calved in fifth period. Moreover, an increasing trend was obtained for means of MCI over periods showed an improvement in performance.

##### Effect of season of calving .

The effect of season of calving on MCI was significant in Hardhenu cattle. Similar significant effect of season of calving was reported by Japheth *et al.* (2015) and Dash *et al.* [4] in Karanfries cattle. At the same time, the opposite (non significant) was reported by Saha *et al.* [12] and Divya *et al.* [6] in Karanfries cattle. However, Verma *et al.* [13] reported a non-significant effect of calving period on MCI in Hardhenu cattle. The season-wise averages for MCI indicated that it was the highest (6.10 kg/day) for cows calved during autumn season (Oct-Nov) and the lowest (5.01 kg/day) for winter season calvers. Cattle calved during autumn and winter seasons (Oct-March) differ significantly with summer and monsoon season calvers (Apr-Sept).

##### Effect of age at first calving

The effect of linear and quadratic regression of age at first calving was non-significant MCI. Effect of age at first calving on MCI was also reported non-significant in Karanfries cattle [4, 6].

#### **First Lactation Milk yield per day of age at Second Calving**

The overall least-squares mean for first lactation milk yield per day of age at second calving (MSC) averaged as  $1.39 \pm 0.05$  kg/day in Hardhenu cattle. Estimates observed in the present study for MSC in Hardhenu cattle were higher than reported by Verma *et al.* [13] in Hardhenu cattle.

##### Effect of period of calving

Significant effect of the period of calving on MSC was obtained in animals under the present study. Similar significant effect of calving period was also reported in Hardhenu cattle [13, 5].

The period-wise least-squares mean for MSC indicated that it was the highest (2.12 kg/day) for Hardhenu cattle calved during sixth-period (2015-2018) and the lowest (0.60 kg/day) for cattle calved during first-period (1995-1998). Furthermore, the least-squares means of MSC for cows calved during sixth-period differed significantly from those calved during the other five periods. First-period calvers differed significantly from rest of all periods except the second period. Second, third, fourth and fifth period did not differ significantly among themselves. An increasing trend was obtained suggesting that selection for this trait was in a positive direction.

##### Effect of season of calving

The effect of season of calving on MSC was non-significant in both species under study. Similar non-significant effect was reported in Hardhenu cattle [13, 5]. The season-wise averages for MSC was the highest (1.51 kg/day) for Hardhenu cattle calved during autumn-season and the lowest for winter-season calvers (1.31 kg/day).

##### Effect of age at first calving

The effect of age at first calving was found non-significant in Hardhenu cattle.

**Table 1. Least Squares Means with standard errors for various performance traits (Cattle)**

Effects	Obs	Least Sq. Means with std. error		
		AMY(Kg/day)	MCI (Kg/day)	MSC (Kg/day)
<b>Overall means</b>	341	7.36 ±0.18	5.35 ±0.18	1.39 ±0.05
<b>Period of calving</b>				
1995-1998	33	4.56c ±1.39	1.58d ±1.48	0.60c ±0.40
1999-2002	28	5.91c ±0.68	4.21c ±0.72	1.12bc ±0.19
2003-2006	67	6.81bc ±0.48	5.26bc ±0.51	1.40b ±0.14
2007-2010	51	7.58b ±0.54	5.65bc ±0.57	1.52b ±0.15
2011-2014	71	8.24b ±0.56	6.34b ±0.59	1.55b ±0.16
2015-2018	91	11.03a ±0.69	9.04a ±0.73	2.12a ±0.20
<b>Season of calving</b>				
Summer (Apr-June)	97	7.15ab ±0.24	5.05b ±0.25	1.41ab ±0.067
Monsoon (July-Sept)	69	7.30a ±0.27	5.23b ±0.29	1.32b ±0.076
Autumn (Oct-Nov)	50	7.97a ±0.31	6.10a ±0.32	1.51a ±0.086
Winter (Dec-March)	125	7.01b ±0.23	5.01b ±0.24	1.31b ±0.064
<b>AFC(linear)</b>		-0.00018 ±0.00062	0.00023 ±0.00066	-0.00069 ±0.00018
<b>AFC(Quad)</b>		0.00000042 ±0.00000099	-0.00000025 ±0.0000010	0.00000039 ±0.00000028

Mean with different superscripts differ significantly among themselves

DMRT as modified by Kramer (1957) is used to find significant difference among various performance traits

**Table 2 Analysis of variance for various production performance traits (cattle)**

Source of variance	D.F.	Mean Squares		
		AMY	MCI	MSC
Sire	50	4.58	4.80	0.34
Period	5	22.30**	21.33**	0.92**
Season	3	8.77*	12.12*	0.44
Regressions				
AFC (Linear)	1	0.25	0.41	3.60**
AFC (Quad)	1	0.53	0.19	0.45
Remainder	280	2.94	3.32	0.24

\*p<0.05, \*\*p<0.01

## CONCLUSION

Least-squares means for first lactation average milk yield (AMY), first lactation milk yield per day of first calving interval (MCI) and first lactation milk yield per day of age at second calving (MSC) were in the present study was 7.36±0.18 kg/day, 5.35±0.18 kg/day and 1.39±0.05 kg/day respectively. With regard to performance traits, the effect of period of calving was statistically significant on all the performance traits. All the production performance traits under study exhibit improved performance over periods that could be attributed to better selection, improved management and nutrition followed at the farm over time in all the traits under present study. In Hardhenu cattle, the effect of season of calving was significant on AMY and MCI. The result further revealed that by increase by one day of age at first calving there would be a decrease for 0.00069 for MSC in Hardhenu cattle. AMY, MCI and MSC explain the productivity of any animal in a better way thus these traits should be used in genetic index with more weightage.

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