

RESEARCH ARTICLE

Effect of Season and Year of Birth on Pubertal Age, Body Weight and Scrotal Circumference of Kankrej Bulls at First Semen Collection

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ABSTRACT

Data on 26 bulls of Kankrej cattle (birth date from 2006 to 2017) inducted at a semen station from 2010 to 2020 were analyzed to study the effects of season and year of birth on age, body weight and scrotal circumference of bull at first semen collection. The overall least-squares means for age, body weight, and scrotal circumference of bulls at first semen collection were 1122.36 ± 86.9 days, 537.69 ± 10.51 kg and 30.86 ± 1.60 cm. Non-genetic factors like season and year of birth did not contribute significantly ($p > 0.05$) to these parameters' variations. Results of the study revealed well adaptation of Kankrej cattle breed to seasonal changes and farm management took care of yearly variation in such a way that age, body weight and scrotal circumference of Kankrej bulls at first semen collection did not vary significantly.

Keywords: Age, Bodyweight, First semen collection, Kankrej, Scrotal circumference, Season of birth.

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INTRODUCTION

A key component of bovine breeding and dairy development policy is high fertility level of each breeding animal in the herd. The genetic improvement in functional traits like reproduction can be achieved through use of superior bulls by natural mating or artificial insemination (AI) program. Prior to the use of males in AI program, many males of high pedigree performance are disposed-off on the basis of poor growth, poor health, poor libido, unsatisfactory semen quality, and freezability.

Obtaining semen at the earliest possible age with optimum body weight and scrotal circumference from bulls is desirable to hasten the identification and use of superior bulls. The genetic impacts of superior bulls are limited by the semen volume, sperm concentration and motility, which is directly associated with reproductive organs' growth. Bulls' selection with early age at first semen collection along with other traits like body weight and scrotal circumference would provide some knowledge about the reproductive performance of their offspring. Therefore, the early onset of puberty followed by sexual maturity and subsequent early recruitment of young bulls in AI is very important. Each of these factors contributes differentially in different species of livestock and in different breeds. However, there is little information on the effect of non-genetic factors like season and year of birth on Kankrej bulls' traits; hence this study was undertaken.

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MATERIALS AND METHODS

Evaluation of age, body weight and scrotal circumference (SC) was carried out on 26 Kankrej cattle bulls of Dama Semen Production Unit (DSPU), Dama, North Gujarat.

Data Structure

Data on bulls included bull number, date of birth, date of semen collection, body weight (kg) and scrotal circumference (cm). These data were used to estimate other traits like the season of birth, year of birth, as well as age, body weight, and scrotal circumference of bulls at first semen collection.

Bodyweight of each bull was measured using digital weighing balance at regular monthly intervals. Bodyweight (kg) of the bull in the month of first semen collection was used for the present study. Scrotal circumference was measured monthly by pushing testicles firmly into the bottom of the scrotum by placing the thumb and fingers laterally on the side of the scrotum's neck and pushed ventrally. A flexible metal measure tape was formed into a loop and slipped over the scrotum around its greatest diameter to measure SC in centimeters. Data recorded by the semen stations regarding date of birth and date of first semen collection of the bulls were used to estimate age of the bull at first semen collection (days).

Classification of Non-Genetic Factors

Kankrej bulls were grouped as per seasons considering their birth in winter (November to February), summer (March to June) and monsoon (July to October).

Data collected for Kankrej bulls were grouped biannually as per the year in which particular bull was born from 2006 to 2017 as PB1, PB2, PB3, PB4, PB5 and PB6, considering the fact that the every 2-year environmental condition show change and accordingly the managerial practices were changing over the particular year, which affects the semen production traits under study. However, no bull was inducted with the birth year of 2010-11, PB3.

Statistical Analysis

The effect of non-genetic factors on traits like age, body weight and scrotal circumference of Kankrej bull at first semen collection were studied by multivariate analysis under a general linear model having a fixed effect non-genetic factor, *i.e.*, the season of birth and year of birth. The data was analyzed using SAS software version 9.3 and PROC GLM as a base command.

The differences between the least-squares mean for subclasses under a particular effect were tested by using Scheffe test (1959) to check the significance. The high heterogeneous variances between the subclasses lead to Scheffe test as Duncan's multiple range test and least significant difference test failed to find out the significance between the least-squares subclass means. As the number of bulls available for analysis were different for age, body weight and scrotal

circumference at first semen collection, two different models were designed.

Analysis of non-genetic factors on age of bull at first semen collection

$$Y_{ijx} = \mu + S_i + T_j + e_{ijx}$$

Where,

- Y_{ijx} = Semen production trait of x^{th} individual observation belonging to i^{th} season of birth, j^{th} year of birth
- μ = Overall mean
- S_i = effect of i^{th} season of birth ($i = 1$ to 3)
- T_j = Effect of j^{th} year of birth ($j = 1, 2, 4, 5,$ and 6)
- e_{ijx} = Residual random error, NID (0 and σ_e^2)

Analysis of non-genetic factors on body weight and SC of bull at first semen collection

$$Y_{ijx} = \mu + S_i + T_j + e_{ijx}$$

Where,

- Y_{ijx} = Semen production trait of x^{th} individual observation belonging to i^{th} season of birth, j^{th} year of birth
- μ = Overall mean
- S_i = effect of i^{th} season of birth ($i = 1$ to 3)
- T_j = Effect of j^{th} year of birth ($j = 1, 2, 4$ and 5)
- e_{ijx} = Residual random error, NID (0 and σ_e^2)

RESULTS AND DISCUSSION

The LSMs of age, body weight and scrotal circumference of Kankrej bulls at first semen collection with the fixed effect of non-genetic factors such as season of birth and year of birth are given in Table 1, and its least-squares analysis of variance is given in Table 2.

Age of Bull at First Semen Collection

The overall LSM for age of Kankrej bulls at first semen collection was 1122.36 ± 86.90 days. Non-genetic factors like a season of birth and year of birth contributed non-significantly to the variation in age of bulls at first semen collection. As compared to present findings, Naha *et al.* (2015 and 2019) reported little higher age at first semen collection in Sahiwal bulls, while others recorded lower age at first semen collection as 1111.37 days in Tharparkar bulls (Panmei *et al.*, 2016) and 798 to 937 days in various zebu x taurine crossbred bulls (Sethi *et al.*, 1989; Rao and Rao, 1995; Siddiqui *et al.*, 2007; Chauhan *et al.*, 2010; Mukhopadhyay *et al.*, 2010; Khatun *et al.*, 2013; Vijetha *et al.*, 2014; Panmei *et al.*, 2016).

The mean age at first semen collection for winter, summer and monsoon born bulls was 1233.17 ± 120.30 , 1036.69 ± 94.16 and 1097.22 ± 129.95 days; however, the differences between them were non-significant. Similarly, Chauhan *et al.* (2010), Mukhopadhyay *et al.* (2010), Khatun *et al.* (2013) and Panmei *et al.* (2016) reported a non-significant effect of season of birth on age at first semen collection in different breeds of bulls.

Based on the different biannual years of birth, the age of bulls at first semen collection ranged from $910.16 \pm$



Table 1: Least-squares means of age at first semen collection for non-genetic factors in Kankrej bulls

Non-genetic factors	Age of bull at first semen collection (days)	Bodyweight at first semen collection (kg)	Scrotal circumference at first semen collection (cm)
Overall (n)	1122.36 ± 86.9 (26)	578.68 ± 25.18 (13)	30.86 ± 1.60 (13)
Season of birth	NS	NS	NS
SB1 (Winter)	1233.17 ± 120.3 (8)	572.04 ± 34.35 (5)	28.59 ± 2.18(5)
SB2 (Summer)	1036.69 ± 94.16 (12)	580.00 ± 23.78 (6)	34.00 ± 1.51(6)
SB3 (Monsoon)	1097.22 ± 129.95 (6)	584.00 ± 45.54 (2)	30.00 ± 2.89(2)
Year of birth	NS	NS	NS
PB1 (2006-07)	1151.67 ± 261.95 (1)	692.68 ± 59.89 (1)	36.86 ± 3.80 (1)
PB2 (2008-09)	1101.25 ± 73.33 (13)	569.49 ± 23.70 (6)	32.90 ± 1.51(6)
PB4 (2012-13)	1150.67 ± 261.95 (1)	481.68 ± 59.89 (1)	23.86 ± 3.80 (1)
PB5 (2014-15)	1298.05 ± 85.02 (9)	570.86 ± 25.22 (5)	29.83 ± 1.60 (5)
PB6 (2016-17)	910.16 ± 181.66 (2)	-	-

n = number of observations or bulls. NS – Non-significant.

Table 2: Least-squares analysis of variance for non-genetic factors affecting age at first semen collection in Kankrej bulls

Source of variation	Degree of freedom	Age of bull at first semen collection		Degree of freedom	Body weight at first semen collection		SC at first semen collection	
		F Value	P Value		F Value	P Value	F Value	P Value
Season of birth	2	1.32	0.290	2	0.04	0.959	2.72	0.134
Year of birth	4	1.30	0.306	3	2.50	0.143	3.05	0.102
Error	19	MSS		7	MSS		MSS	
		63387.49			3016.2328		12.1693122	

MSS = Mean sum of squares

181.66 to 1298.05 ± 85.02 days, which was also found to be non-significant in the present study. Contrarily, a significant effect of year of birth on age at first semen collection was reported by Chauhan *et al.* (2010), Mukhopadhyay *et al.* (2010), Khatun *et al.* (2013), and Panmei *et al.* (2016) in purebred and crossbred bulls.

Body Weight of Bull at First Semen Collection

The overall LSM for body weight of Kankrej bulls at first semen collection was 537.69±10.51 kg. Non-genetic factors like a season of birth and year of birth contributed non-significantly for variation in body weight of bull at first semen collection. The overall LSM for the body weight of bull at first semen collection was higher than 360 and 284.7 kg reported by Sethi *et al.* (1989) in Karan Fries cattle and Siddiqui *et al.* (2007) in crossbred cattle, respectively.

The mean body weight of winter, summer and monsoon born bulls at first semen collection was found to be 572.04±34.35, 580.00±23.78 and 584.00±45.54 kg, respectively, which did not vary statistically. Naha *et al.* (2019) also reported a non-significant effect of season of birth on Sahiwal bulls' body weight at first semen collection.

Bulls born from 2006 to 2017 were taken in to consideration for the present study. Based on the different biannual years of birth, bulls' mean body weight at first semen collection ranged from 481.68±59.89 to 692.68±59.89 kg, without statistical differences.

Scrotal Circumference of Bull at First Semen Collection

The overall LSM for scrotal circumference of Kankrej bulls at first semen collection was 30.86±1.60 cm. The effects of season of birth and year of birth were non-significant on the bull's scrotal circumference at first semen collection. However, this observation was higher than 28.20 cm reported by Siddiqui *et al.* (2007) in crossbred bulls.

Bulls born during winter, summer and monsoon seasons had mean scrotal circumference of 28.59 ± 2.18, 34.00 ± 1.51, and 30.00 ± 2.89 cm at first semen collection, and it ranged from 23.86 ± 3.80 to 36.86 ± 3.80 cm during the different biannual years of birth.

CONCLUSIONS

Kankrej bulls showed well adaptation to the seasonal changes while farm management like nutrition and environmental changes take care of yearly variation so that age, body weight and scrotal circumference of bulls at first semen collection did not vary.

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