

RESEARCH ARTICLE

Non-genetic Factors affecting Body Weight and Scrotal Circumference at First Semen Collection and Semen Production Traits of Kankrej Bulls

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ABSTRACT

This study was conducted on 13 bulls of Kankrej cattle breed maintained at Dama semen station of Banas dairy (Gujarat) to study the effects of non-genetic factors, viz., season of birth and year of birth on body weight at first semen collection (BWFSC) and scrotal circumference at first semen collection (SCFSC) as well as the effect of BWFSC and SCFSC on future semen production traits like semen production period, age of bull at disposal and lifetime production of frozen semen doses per bull. The overall least squares means for body weight of bulls and scrotal circumference of bulls at first semen collection, semen production period, age of bull at disposal and lifetime production of frozen semen doses per bull were 578.68 ± 25.18 kg, 30.86 ± 1.60 cm, 704.3 ± 151.22 days, 1875.73 ± 135.95 days and 55243.83 ± 21307.60 doses, respectively. Results of the present study revealed that body weight and scrotal circumference of bulls at first semen collection were not significantly affected by season of birth and year of birth. Similarly, BWFSC and SCFSC had no significant effect on semen production traits.

Keywords: Age, Body weight, First semen collection, Kankrej bulls, Scrotal circumference.

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INTRODUCTION

A key component of bovine breeding and dairy development policy is a high fertility level of each breeding animal in a herd. The genetic improvement in functional traits like reproduction can be achieved through use of superior bulls by natural mating or Artificial Insemination (AI) programme. Prior to the use of males in AI programme, many males of high pedigree performance are disposed-off based on poor growth, poor health, poor libido, unsatisfactory semen quality and freezability (Dangar *et al.*, 2021).

The genetic impacts of superior bulls are limited by the semen volume, sperm concentration and motility, which are directly associated with growth of reproductive organs. Bulls' selection with early age at first semen collection along with other traits like body weight and scrotal circumference at first semen collection would provide some knowledge about reproductive performance of their offspring. Therefore, early onset of puberty followed by sexual maturity and subsequent early recruitment of young bulls in AI is very important (Dangar *et al.*, 2021). However, there is little information on the effect of season of birth and year of birth on body weight (BW) and scrotal circumference (SC) of Kankrej bulls at first semen collection (FSC) as well as effect of BWFSC and SCFSC on future semen production traits, hence the present study was conducted to analyze the effect of these traits.

MATERIALS AND METHODS

Evaluation of age, body weight and scrotal circumference was carried out on 13 Kankrej cattle bulls of Dama Semen

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Production Unit, Dama, managed by Banaskantha District Cooperative Milk Producer's Union Limited (Banas Dairy), Palanpur, Gujarat. Data on these bulls included bull number, date, season and year of birth, date and age of first semen collection, number of semen doses per ejaculate, body weight (kg) and scrotal circumferences (cm) of bulls at first semen collection and the date and age of disposal. Collected data were used to estimate other traits like semen production period, age of bull at disposal and lifetime production of frozen semen doses per bull.

Body weight of bull was measured at monthly interval regularly using digital weighing balance. Scrotal circumference was measured in cm using a flexible measuring tape looped and slipped over the scrotum around its greatest diameter.

Data recorded by the semen stations regarding date of first semen collection and date of last semen collection of the bulls were used to estimate semen production period (days). Similarly, date of birth and date of last semen collection were

Table 1: Codes for season of birth and body weight of bull at first semen collection

Season of birth	Code of bull	Body weight (kg)	Code of bull
November to February	SB1 (Winter)	< 500	BWFSC1
March to June	SB2 (Summer)	500–599	BWFSC2
July to October	SB3 (Monsoon)	>= 600	BWFSC3

Table 2: Code for Period of birth and scrotal circumferences of bull at first semen collection

Year of birth	Code of Bulls	Scrotal Circumferences (cm)	Code of Bulls
2006-07	PB1	< 24	SCFSC1
2008-09	PB2	24–25	SCFSC2
2012-13	PB3	26–27	SCFSC3
2014-15	PB4	28–29	SCFSC4
		30–31	SCFSC5
		>= 32	SCFSC6

Table 3: Least-squares means of body weight and scrotal circumference at first semen collection for non-genetic factors in Kankrej bulls

Non-genetic factors	n	Body weight at first semen collection (kg)	Scrotal circumference at first semen collection (cm)
Overall	13	578.68 ± 25.18	30.86 ± 1.60
Season of birth		ns	ns
SB1 (Winter)	5	572.04 ± 34.35	28.59 ± 2.18
SB2 (Summer)	6	580.00 ± 23.78	34.00 ± 1.51
SB3 (Monsoon)	2	584.00 ± 45.54	30.00 ± 2.89
Period of birth		ns	ns
PB1 (2006-07)	1	692.68 ± 59.89	36.86 ± 3.80
PB2 (2008-09)	6	569.49 ± 23.70	32.90 ± 1.51
PB4 (2012-13)	1	481.68 ± 59.89	23.86 ± 3.80
PB5 (2014-15)	5	570.86 ± 25.22	29.83 ± 1.60

Table 4: Least-squares analysis of variance for non-genetic factors affecting body weight and scrotal circumference at first semen collection in Kankrej bulls

Source of variation	Degree of freedom	Body weight at first semen collection		Scrotal circumference at first semen collection	
		F Value	P Value	F Value	P Value
Season of birth	2	0.04	0.9589	2.72	0.1338
Period of birth	3	2.5	0.1432	3.05	0.1015
Error	7	Mean sum of squares 3016.2328		Mean sum of squares 12.1693	

used to calculate age of bull at disposal (days). Number of semen doses per ejaculate of bull from first ejaculate to last ejaculate was used to estimate lifetime production of frozen semen doses per bull.

Kankrej bulls were grouped as per season of birth, year of birth, body weight and scrotal circumference of bull at first semen collection as classified in following Table 1 and 2.

The effect of non-genetic factors, viz., season and year of birth on BWFSC and SCFSC as well as effect of BWFSC and SCFSC on traits like semen production period, age of bull at disposal and lifetime production of frozen semen doses per bull were studied by multivariate analysis under general linear model having season and year of birth, and BW and SC at first semen collection as fixed effect. The data was analysed using SAS software version 9.3 and PROC GLM as base command.

The differences between the least squares mean for sub-classes under a particular effect were tested by using Scheffe test (Scheffe, 1959) to check the significance. The high heterogeneous variances between the subclasses lead to use of Scheffe test as other tests such as Duncan's multiple range test and least significant difference test failed to find out the significance between the least squares subclass means.

RESULTS AND DISCUSSION

The Least-squares means (LSMs) of body weight and scrotal circumference of bulls at first semen collection as well as semen production period, age of bull at disposal and lifetime production of frozen semen doses (FSDs) per bull with the fixed effect of non-genetic factors such as season of birth and period of birth are given in Tables 3 and 5. The least squares analysis of variance for the factors affecting these traits are given in Tables 4 and 6, respectively.

Body Weight of Bull at First Semen Collection

The overall LSM for body weight of bulls at first semen collection was 578.68 ± 25.18 kg. The influence of season of birth on body weight of bulls at first semen collection was found to be statistically non-significant (Table 3), which concurred well with the report of Naha *et al.* (2019). Bulls born during 2006 to 2016 were taken into consideration for the present study. Based on the different periods of birth, body weight of bull at first semen collection ranged from 481.68 ± 59.89 to 692.68 ± 59.89 kg.

The body weight of Kankrej bulls was higher as compared to Karan Fries bulls (360 kg) and crossbred bulls (284.7 kg),



Table 5: Least-squares means (\pm SE) of semen production related traits for non-genetic factors in Kankrej bulls.

Factors	n	Semen production related traits		
		Semen production period (days)	Age of bull at disposal (days)	Lifetime production of FSDs per bull (number of doses)
Overall	9	704.3 \pm 151.22	1875.73 \pm 135.95	55243.83 \pm 21307.6
BW at first semen collection		ns	ns	ns
BWFSC1	2	707.00 \pm 292.83	1783.00 \pm 263.26	68350.00 \pm 41261.98
BWFSC2	5	757.40 \pm 185.20	2042.20 \pm 166.50	51394.00 \pm 26096.37
BWFSC3	2	648.50 \pm 292.83	1802.00 \pm 263.26	45987.50 \pm 41261.98
SC at first semen collection		ns	ns	ns
SCFSC1	1	1013.00 \pm 447.34	2100.00 \pm 375.37	105290.00 \pm 63474.69
SCFSC3	1	401.00 \pm 447.34	1466.00 \pm 375.37	31410.00 \pm 63474.69
SCFSC4	2	730.00 \pm 316.32	1907.00 \pm 265.42	63400.00 \pm 44883.39
SCFSC5	4	778.75 \pm 223.67	2083.00 \pm 187.68	51888.75 \pm 31737.35
SCFSC6	1	509.00 \pm 447.34	1669.00 \pm 375.37	14590.00 \pm 63474.69

Table 6: Least-squares analysis of variance for non-genetic factors affecting semen production traits in Kankrej bulls.

Source of variation	Degree of freedom	MSS of Semen production related traits		
		Semen production days	Age of bull at disposal	Lifetime production of FSDs per bull
BW at first semen collection	2	6728 ^{NS}	1568 ^{NS}	391160450 ^{NS}
SC at first semen collection	3	78436.3167 ^{NS}	89882.9333 ^{NS}	1568542921 ^{NS}
Error	3	264570.917	187342.6667	5241661873

reported by Sethi *et al.* (1989) and Siddiqui *et al.* (2007), respectively.

Scrotal Circumference of Bull at First Semen Collection

The overall LSM for scrotal circumference (SC) of bulls at first semen collection was 30.86 \pm 1.60 cm. Effects of non-genetic factors like season of birth and period of birth were non-significant ($p > 0.05$) on scrotal circumference of bull at first semen collection. The SC of Kankrej bulls was higher as compared to 28.20 cm reported by Siddiqui *et al.* (2007) in crossbred cattle.

Semen Production Period (SPP)

The overall LSM for semen production period was 704.30 \pm 151.22 days. Body weight and scrotal circumference of bulls at first semen collection were non-significant ($p > 0.05$) sources of variation for semen production period. The productive life in Kankrej cattle bull at Dama Semen station was found around 2 years, whereas the productive life of Sahiwal bulls ranged up to 14 years and about 50% of bulls produced semen for 3–4 years minimum with common duration of productive life between 1 to 6 years (Khan *et al.*, 2007).

Higher semen production period of 884.24 and 1167.1 days compared to the result of present study was reported by Mukhopadhyay *et al.* (2010) and Khatun *et al.* (2013) in Punjab for Karan Fries bulls, respectively. Vijetha *et al.* (2014) observed that the average SPP in crossbred bulls was 838.64 days, with the highest SPP in 50% inter-se (889.60 days) bulls, followed by F1 bulls (860.40 days) and 75% crossbred bulls (641.14 days) of

HF X Tharparkar crossbred bulls. Panmei *et al.* (2016) reported higher SPP in Tharparkar (1209.31 days) as compared to Interbred Friesian X Tharparkar crossbred, 3/4 or above Friesian X Tharparkar crossbred and F1 Friesian X Tharparkar crossbreds (744.93, 681.73 and 691.34 days, respectively).

Semen production periods for the bulls weighing <500, 500–599 and \geq 600 kg body weight at first semen collection were 707.00 \pm 292.83, 757.40 \pm 185.20 and 648.50 \pm 292.83 days, respectively. Scrotal circumference of bull at first semen collection ranged from 24 to 32 cm, for which semen production period varied from 401.00 \pm 447.34 to 1013.00 \pm 447.34 days. The productive life did not differ for body weight or SC at first collection (Tables 5, and 6).

Age of Bull at Disposal

The overall LSM for age of bull at disposal was 1875.73 \pm 135.95 days. Effects of body weight and scrotal circumference of bull at first semen collection were non-significant ($p > 0.05$) on age of bull at disposal. Lower age of bull at disposal compared to the present study results was reported by Mukhopadhyay *et al.* (2010) as 1768.94 and 1649.79 days for Karan Fries and Sahiwal bulls, respectively. Similarly, Panmei *et al.* (2016) reported that the age of bull at disposal in Tharparkar, Interbred Friesian X Tharparkar crossbred, 3/4 or above Friesian X Tharparkar crossbred and F1 Friesian X Tharparkar crossbred were 1814.21, 1456.31, 1453.93 and 1393.08 days, respectively.

Higher age of bull at disposal as 1906, 1923, 1714 and 1848 days in F1 Friesian X Tharparkar crossbred, 50% inter

se Friesian X Tharparkar crossbred and 75% of Friesian X Tharparkar crossbred and Karan Fries bulls, respectively, has been reported by Chauhan *et al.* (2010), while Khatun *et al.* (2013) observed that the age of bull at disposal was 2231.8 days in HF crossbred bulls in Punjab.

Age of bull at disposal was found to range from 1783.00 \pm 263.26 to 2042.20 \pm 166.50 days for the different body weight of bulls at first semen collection, whereas it ranged from 1466.00 \pm 375.37 to 2100.00 \pm 375.37 days for bulls with different scrotal circumference.

Lifetime Production of Semen Doses per Bull

The overall LSM for lifetime production of semen doses per bull was 55243.83 \pm 21307.60. Body weight of bull and scrotal circumference of bull at first semen collection had no significant influence ($P > 0.05$) on lifetime production of semen doses per bull (Table 5, 6). Average number of semen doses produced by Sahiwal bulls in their production life was 17143 as reported by Khan *et al.* (2007), which was lower as compared to present finding in Kankrej bulls.

Bulls with body weight of less than 500 kg at first semen collection produced non-significantly higher FSDs (68350 \pm 41261.98) than those with body weight 500-599 kg and \geq 600 kg (51394.00 \pm 26096.37 and 45987.50 \pm 41261.98) in their productive life (Table 5). Based on the different groups of scrotal circumferences at first semen collection, lifetime production of semen doses per bull ranged from 14590.00 \pm 63474.69 to 105290.00 \pm 63474.69.

CONCLUSIONS

The present study based on limited number of bulls revealed that the body weight and scrotal circumference of bull at first semen collection do not produce any significant effect on future semen production traits like semen production period, age of bull at disposal and lifetime production of frozen semen doses per bull in Kankrej cattle.

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