STUDY ON BODY WEIGHT AND SCROTAL CIRCUMFERENCE AND ITS CORRELATIONS WITH SEMEN PRODUCTION TRAITS IN CROSSBRED JERSEY BULLS

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ABSTRACT

The present study was aimed to investigate the effects of body weight and scrotal circumference on semen production traits of 136 crossbred Jersey bulls, which were maintained at three frozen semen stations of Tamil Nadu, India. Semen production traits such as semen volume, sperm concentration, mass activity, initial sperm motility, post-thaw motility and number of doses per ejaculate were taken for this study. The overall mean values for semen volume (ml), sperm concentration (millions per ml), mass activity (0 to 5 scale), initial sperm motility (per cent), post-thaw motility (per cent) and number of doses per ejaculate were 4.18 ± 0.02, 1052.80 ± 7.26, 2.09 ± 0.07, 63.36 ± 0.00, 50.52 ± 0.00 and 215.50 ± 2.01 respectively. From this study, it revealed that the body weight and scrotal circumference of bulls significantly influenced all semen production traits except mass activity. Bulls having a body weight between 350 to 550 kg produced better quality semen and more number of frozen semen doses per ejaculate. When the scrotal circumference was >36 cm, majority of the semen production traits showed better values. The body weight was positively and significantly correlated with scrotal circumference, Semen volume and number of frozen semen doses produced per ejaculate. The scrotal circumference was positively and significantly correlated with semen volume, mass activity and number of doses per ejaculate; negatively and significantly correlated with initial sperm motiltiy.

KEY WORDS: Scrotal circumference, Crossbred Jersey bulls, Semen production traits

INTRODUCTION

In India, crossbred Jersey bulls (CBJY) are extensively used for production of frozen semen for field Artificial Insemination (AI) programme. Since the bull has more genetic influence on calves it sires and the fertile bull selection could be the most powerful method for genetic improvement in AI programme. In bull selection, the body weight is an important parameter, because it provides information about the physical and physiological maturity, semen output and birth weight of its offspring (Evans *et al*. 1995). The scrotal circumference has been widely used to predict the reproductive and spermatogenic capabilities in post pubertal period of a bull (Ahmad *et al*. 1989). In all frozen semen stations, body weight and scrotal measurement are recorded at early ages at monthly intervals, which will be used for selection of breeding bulls for semen production. Because every breed/genetic group has its minimum acceptable scrotal circumference and body weight which is a potential indicator for inducting into frozen semen production. Therefore, it is essential to study the association of body weight and scrotal circumference with semen production traits to select bulls at an early age. Hence, this study was designed to evaluate the effects of body weight and scrotal circumference and its correlation with semen production traits in CBJY bulls.

MATERIALS AND METHODS

The semen production data (2013-14) from three frozen semen production stations in Tamil Nadu were collected from a total of 139 apparently healthy CBJY bulls with different age groups and the total number of ejaculates used for this study was 11691. The semen production data which comprised of ejaculation number, semen volume (SV), sperm concentration (SC), mass activity (MA), initial sperm motility (ISM), post-thaw sperm motility (PTM) and number of doses per ejaculate were utilized.

Body weight

The body weight of each CBJY bull presently under semen collection was recorded using platform weighing balance. Based on body weight, the bulls were classified into five groups as bulls up to 350 kg, 350 to 450 kg, 450 to 550 kg, 550 to 650 kg and more than 650 kg.

Scrotal circumference

For measurement of scrotal circumference, the testicle was pushed firmly into the bottom of the scrotum by placing the thumb and fingers laterally on the side of the neck of the scrotum. A flexible metal tape was formed into a loop and slipped over the scrotum and scrotal circumference was measured in centimeters by pulling the tape snugly around its greatest diameter as recommended by Elmore *et al.* (1976). According to the Society of Theriogenology (1992), the scrotal circumferences were classified into: less than 34 cm, 34 to 36 cm, 36 to 38 cm and more than 38 cm.

Statistical analyses

The effects of body weight and scrotal circumference on various semen production traits and followed by Tukey's post hoc test to determine significant differences between the groups using the Statistical Package Software (SPSS Version 17; SPSS Inc. Chicago, IL).

Analysis of body weight and scrotal circumference on semen production traits

$Y_{ijk} = \mu + B_i + C_j + e_{ijk}$

Where,

Y_{ijk} = semen production trait of k^{th} individual observation
belonging to i^{th} body weight and j^{th} scrotal circumference

μ = overall mean

B_i = effect of i^{th} body weight

C_j = effect of j^{th} scrotal circumference

e_{ijk} = residual random error, NID (0 and σ^2_e)

The semen quality traits (in percentages) such as ISM and PTM were adjusted after angular transformation of the percentages as per Snedecor and Cochran (1987).

Phenotypic correlations

The phenotypic correlations (r_p) between body weight and scrotal circumference with semen production traits were estimated by sire component of variances and co-variances as follows:

The phenotypic (r_P) correlation was calculated as follows:

$r_P = (\sigma_{w(xy)} + \sigma_{s(xy)})/$ " $(\sigma^2_{w(x)} + \sigma^2_{s(x)})\ (\sigma^2_{w(y)} + \sigma^2_{s(y)})$

where,

$\sigma_{w(xy)}$ = residual component of covariance between traits x and y

$\sigma_{s(xy)}$ = sire component of covariance between traits x and y

$\sigma^2_{w(x)}$ & $\sigma^2_{w(y)}$ = residual component of variance for trait x and trait y

$\sigma^2_{s(x)}$ & $\sigma^2_{s(y)}$ = sire component of variance for trait x and trait y

Sampling errors for correlations were obtained from the approximation by Meyer, (2007).

RESULTS AND DISCUSSION

The least-squares means of semen production traits for body weight and scrotal circumference are given in Table 1.

Body weight:

Body weight of the bulls was found to have highly significant (P<0.01) effect on all the semen production traits studied except mass activity. As the body weight increased from 350 to 550 kg, the SV increased from 3.98 ± 0.07 ml to 4.38 ± 0.04 ml and thereafter it started decreasing to 4.17 ± 0.06 ml when the body weight was more than 550 kg. The bulls of 450 to 550 kg body weight donated maximum volume of semen (4.38 ml) and the least semen volume was from bulls weighing less than 350 kg. There was no difference in SV of bulls classified under 350 to 450, 550 to 650 and >650 kg body weight groups. Highest SC (1144.50 million per ml) was obtained from bulls weighing between 550 to 650 kg. The mean SC varied between bulls of 450 to 550 and >650 kg groups. Bulls weighing 350 to 450 kg had the least SC of 931.93 million per ml. But, the SC was found to fluctuate from 1058.39 ± 22.12 million per ml at a body weight of up to 350 kg to 1132.84 ± 15.33 million per ml at a body weight of > 650 kg.

The MA non-significantly varied from 2.01 for bulls with <350 kg body weight to 2.13 for bulls in the body weight group of >650 kg. The ISM was maximum for 450 to 550 kg group (67.49%) and it was least (59.90%) for >650 kg group. The PTM was found to be the highest (51.88 %) at 550 to 650 kg body weight. The PTM increased with the increase in body weight up to 650 kg after which it decreased in >650 kg group even though the difference was not significant. Even in the body weight group of <350 kg, the PTM was found to be at acceptable level (49.84 %). The number of frozen semen doses produced per ejaculate was highest in 550 to 650 kg (236.04 ± 2.97) and >650 kg body weight groups. The number of doses produced was almost the same in 350 to 450 and 450 to 550 kg groups and it was the least in <350 kg body weight group. Overall highest SC, PTM and number of doses per ejaculate were found in 550 to 650 kg body weight group and the highest SV and ISM were observed in 450 to 550 kg body weight of CBJY bulls. The optimum body weight for semen production in CBJY bulls was found to be between 450 and 650 kg.

Scrotal circumference

Scrotal circumference was a highly significant (P<0.01) source of variation in influencing all semen production traits except mass activity.

The SV was found to be maximum when the scrotal circumference was between 36 and 38 cm or >38 cm. When the scrotal circumference was <34 cm, the SV was significantly less than the other groups. The SC (from 977.08 to 1130.96 million per ml) and number of doses per ejaculate (202.04 to 232.91) increased with increase in scrotal circumference. The SC was maximum at >38 cm scrotal circumference group. There was no difference in SC in the rest of scrotal circumference groups.

The per cent ISM (65.83 ± 0.00) and MA (2.11 ± 0.07) were significantly higher in scrotal circumference of 36 to 38 cm and 34 to 36 cm respectively. The MA was maximum (2.11) in 34 to 36 cm scrotal circumference group without any significant differences among other groups. The ISM fluctuated along with the scrotal circumference. It was found to be highest in the bulls with scrotal circumference of <34 cm and decreased thereafter. However, the number of frozen doses produced per ejaculate was highest for the scrotal circumference of >38 cm and the number got proportionately reduced as the scrotal circumference of the bulls decreased. There was no uniform pattern of influence of scrotal circumference on the semen production traits. As there is want of literature on the effect of scrotal circumference on semen production traits in crossbred Jersey bulls, the results obtained in the present study could not be compared.

Table 1. Least-squares means (± S.E.) for effect of body weight and scrotal circumference on semen production traits in CBJY bulls

Effects	SV (ml)	SC (millions per ml)	MA (0 to 5 scale)	ISM (per cent)	PTM (per cent)	No. of doses per ejaculate
Overall	4.18 ± 0.02 (11691)	1052.80 ± 7.26 (11691)	2.09 ± 0.07 (11691)	63.36 ± 0.00 (11691)	50.52 ± 0.00 (9038)	215.50 ± 2.01 (9037)
Body weight (kg)	**	**	NS	**	**	**
up to 350	3.98^{c} ± 0.07 (1054)	1058.39^{b} ± 22.12 (1054)	2.01 ± 0.08 (1054)	62.97^{c} ± 0.01 (1054)	49.84^{b} ± 0.00 (794)	190.11^{c} ± 5.93 (794)
350 to 450	4.18^{b} ± 0.06 (1412)	931.93^{c} ± 18.28 (1412)	2.10 ± 0.08 (1412)	61.14^{c} ± 0.00 (1412)	48.90^{b} ± 0.00 (920)	208.39^{c} ± 5.17 (919)
450 to 550	4.38^{a} ± 0.04 (2813)	996.35^{c} ± 11.56 (2813)	2.10 ± 0.07 (2813)	67.49^{a} ± 0.00 (2813)	50.12^{a} ± 0.00 (2379)	208.38^{c} ± 3.16 (2379)
550 to 650	4.16^{b} ± 0.04 (4249)	1144.50^{a} ± 11.10 (4249)	2.09 ± 0.07 (4249)	65.17^{b} ± 0.00 (4249)	51.88^{a} ± 0.00 (3418)	236.04^{a} ± 2.97 (3418)
> 650	4.17^{b} ± 0.05 (2163)	1132.84^{a} ± 15.33 (2163)	2.13 ± 0.07 (2163)	59.90^{c} ± 0.00 (2163)	51.85^{a} ± 0.00 (1527)	234.56^{b} ± 4.34 (1527)
Scrotal circumference (cm)	**	**	NS	**	**	**
< 34	3.57^{d} ± 0.04 (2806)	979.08^{b} ± 12.71 (2806)	2.08 ± 0.07 (2806)	65.07^{a} ± 0.00 (2806)	51.50^{a} ± 0.00 (1911)	202.04^{c} ± 3.41 (1911)
34 to 36	3.76^{c} ± 0.04 (2253)	1057.13^{b} ± 13.03 (2253)	2.11 ± 0.07 (2253)	60.00^{c} ± 0.00 (2253)	50.75^{a} ± 0.00 (1602)	211.57^{c} ± 3.56 (1602)
36 to 38	4.34^{a} ± 0.03 (3882)	1044.05^{b} ± 10.51 (3682)	2.10 ± 0.07 (3682)	65.83^{a} ± 0.00 (3682)	50.00^{b} ± 0.00 (3309)	215.47^{b} ± 2.76 (3308)
>38	4.33^{b} ± 0.04 (2750)	1130.96^{a} ± 12.74 (2950)	2.06 ± 0.07 (2950)	62.45^{b} ± 0.00 (2950)	49.83^{b} ± 0.00 (2216)	232.91^{a} ± 3.45 (2216)

** - Highly significant (P< 0.01) and NS- Non-significant; Means with at least one common superscript within classes do not differ significantly (P>0.05); Figures in parentheses indicate number of observations.

Table 2. Phenotypic correlations of body weight and scrotal circumference with semen production traits in CBJY bulls

Traits	Scrotal circumference	Semen volume	Sperm concentration	Mass activity	Initial sperm motility	Post-that motility	No. of doses per ejaculate
Body weight	0.66**	0.27**	-0.06**	-0.10**	-0.16**	0.23 ^{NS}	0.17**
Scrotal circumference		0.18**	-0.11^{NS}	0.05 **	-0.65**	0.01 ^{NS}	0.14**
Semen volume			-0.11**	0.03**	-0.87**	0.02 ^{NS}	-0.55**
Sperm concentration				0.14 ^{NS}	0.10**	-0.08**	0.64**
Mass activity					0.13**	0.04**	0.18 ^{NS}
Initial sperm motility						0.15**	0.02 ^{NS}
Post-that motility							0.04**

** - Highly significant (P<0.01); * - Significant (P<0.05) and NS- Non-significant

Phenotypic correlations

The phenotypic correlation coefficients among semen production traits, body weight and scrotal circumference are furnished in Table 2.

The body weight was highly significantly ($P<0.01$) and positively correlated with scrotal circumference (0.66), SV (0.27) and number of doses per ejaculate (0.17) but negatively correlated with SC (-0.06), MA (-0.10) and ISM (-0.16). The body weight had a positive but not-significant correlation with PTM (0.23). Correlation coefficients between scrotal circumference and SV (0.18) and number of doses per ejaculate (0.14) were highly significant ($P<0.01$) and positive. Highly significant ($P<0.01$) and negative phenotypic correlation was observed between scrotal circumference and ISM (-0.65).

CONCLUSION

The body weight and scrotal circumference of bulls significantly influenced all semen production traits except MA in CBJY bulls. Bulls having a body weight between 350 to 550 kg produced better quality semen and more number of frozen semen doses per ejaculate. When the scrotal circumference was >36 cm, majority of the semen traits showed better values.

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