EFFECT OF BODY WEIGHT AND SCROTAL CIRCUMFERENCE ON SEMEN PRODUCTION TRAITS IN CROSSBRED HOLSTEIN FRIESIAN BULLS

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ABSTRACT

The present study aimed to investigate the influence of body weight and scrotal circumference and its phenotypic correlation with semen production traits in crossbred Holstein Friesian bulls. Overall least-squares mean for semen volume, sperm concentration, mass activity, initial sperm motility, post-thaw motility and number of doses/ejaculate were 4.10**±0.06 ml,** 842.7**±21.7 million/ml,** 2.11**±0.03, 55**.6**±0.0%,** 49.8**±0.0% and 196**.92**±5.4, respectively.** The body weight and scrotal circumference of crossbred bulls influenced (p<0.01) all semen production traits. The body weight was positively correlated (p<0.01) with scrotal circumference (0.85), semen volume (0.56), sperm concentration (0.12), mass activity (0.41) and number of doses/ejaculate (0.49). The phenotypic correlations of scrotal circumference with semen volume (0.47), sperm concentration (0.06), mass activity (0.39) and number of doses/ejaculate (0.36) were positive (p<0.05). In brief, the bulls having body weight between 450 to >650 kg and scrotal circumference >36 cm exhibited better performance with regard to majority of the semen production traits.

Keywords: Body weight, Bulls, Phenotypic, Scrotal circumference, Semen

INTRODUCTION

The body weight and scrotal circumference are important reproductive parameters and widely used to predict the sperm producing ability of breeding bulls during the post-pubertal period. At frozen semen stations, early selection of breeding bulls entirely depends on these parameters to ensure optimum semen production. Moreover, the body weight and scrotal circumference measurements are important decisive factors in breeding soundness examination of bulls. Hence, this study was undertaken to assess the influence of body weight and scrotal circumference on semen production traits in crossbred Holstein Friesian bulls.

MATERIALS AND METHODS

The data on 1,844 ejaculates of 29 crossbred Holstein Friesian bulls from two frozen semen stations during the period between 2013 and 2014 were collected. Each ejaculate consisted of following semen production traits viz, semen volume, sperm concentration, mass activity, initial sperm motility, post-thaw motility and number of doses per ejaculate. At the same time, the body weight of bulls under semen collection was recorded. Thus, based on recorded body weights, the bulls were classified as <350 kg, 350-450 kg, 450-550 kg, 550-650 kg and >650 kg. The scrotal circumference was measured and according to the Society of Theriogenology (1992), the scrotal circumferences were classified as <34 cm, 34-36 cm, 36-38 cm and >38 cm. The least-squares model for analysing the effects of body weight and scrotal circumference on semen production traits was as per Harvey (1996), $Y_{ijk} = \mu + B_i + C_j + e_{ijk}$, where, Y_{ijk} is kth semen production trait of a bull belonging to ith body weight and jth scrotal circumference, μ is overall mean, B_i is effect of ith body weight, C_j is effect of jth scrotal circumference and e_{ijk} is random residual error, NID (0 and σ^2_e). The differences between the least-squares mean for sub-classes under a particular effect were tested by using Scheffe test (1959) for their significance.

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

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.The phenotypic (r_P) correlation is calculated as

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

where, $\sigma_{w(xy)}$ is residual component of covariance between traits x and y, $\sigma_{s(xy)}$ is sire component of covariance between traits x and y, $\sigma^2_{w(x)}$ is residual component of variance for trait x, $\sigma^2_{w(y)}$ is residual component of variance for trait y, $\sigma^2_{s(x)}$ is sire component of variance for trait x, $\sigma^2_{s(y)}$ is sire component of variance for trait y. The sampling errors for correlations were obtained from the approximation by Meyer (2007).

RESULTS AND DISCUSSION

The body weight of crossbred bulls had impact (p<0.05) on all the semen traits studied in the present study (Table 1). With an increase in body weight, the seminal volume and sperm concnetration also increased with the highest (p<0.05) value in >650 kg group. The mass activity was also better (p<0.05) for bulls with 550-650 kg body weight. The initial sperm motility was highest for 450-550 kg group and lowest for 550-650 kg group (p<0.05). The post-thaw motility was not affected very much by the body weight of bulls. The number of doses per ejaculate was the lowest in <350 kg body weight group and it increased as the body weight increased and reached highest in >650 kg body weight group (p<0.05). Similar impact of body weight on semen characteristics in crossbred Holstein Friesian bulls was also recorded earlier by others (Sarder *et al.*, 2001; Siddiqui *et al.*, 2008).

The effect of scrotal circumference was present (p<0.05) on all semen production traits (Table 1). The variations in semen quality parameters of different scrotal circumference groups might be due to scrotal skin thickness. The highest seminal volume, sperm concentration and number of doses per ejaculate were recorded for 36-38 cm scrotal circumference (p<0.05). The highest initial and post-thaw sperm motility were observed with <34 cm scrotal circumference and their values started decreasing as the scrotal circumference increased (p<0.05). The lowest values for semen production traits, except mass activity, were observed with >38 cm scrotal circumference (p<0.05). The number of frozen semen doses produced per ejaculate were highest for 36-38 cm scrotal circumference (p<0.05). In our study, bulls having >38 cm scrotal circumference produced poor quality semen, which in contrary to an earlier study in Frieswal bulls (Tyagi *et al.*, 2003), in which they found that bulls with <34 cm scrotal circumference produced poor quality semen.

The phenotypic correlations of body weight and scrotal circumference with semen production traits revealed that body weight was positively (p<0.05) correlated with scrotal circumference (0.85), seminal volume (0.56), sperm concentration (0.12), mass activity (0.41) and number of doses per ejaculate (0.49). The body weight was negatively (p<0.05) correlated with initial sperm motility (-0.34) and post-thaw motility (-0.15). The phenotypic correlations of scrotal circumference with seminal volume (0.47), sperm concentration (0.06), mass activity (0.39) and number of doses per ejaculate (0.36) was positive (p<0.05). A negative (p<0.05) phenotypic correlation of scrotal circumference was observed with initial sperm motility (-0.39) and post thaw motiltiy (-0.17). Our results are in agreement with earlier studies in crossbred bulls of Kerala (Sudheer, 2000) and in Frieswal bulls (Tyagi *et al.*, 2003) with respect to correlations of scrotal circumference with semen production traits such as seminal volume and sperm concentration except initial sperm motility.

In brief, the body weight and scrotal circumference of crossbred HF bulls influenced all semen production traits. Bulls having a body weight between 450 to

Table 1: Effect of body weight and scrotal circumference on semen production traits in crossbred Holstein Friesian bulls

Effects	**Semen vol**, ml	**Sperm conc.**, million/ml	**Mass activity**, 0-5 scale	**Initial sperm motility**, %	**Post-thaw motility**, %	**Doses/ ejaculate**
Overall	4.10±0.06 (1844)	842.7±21.7 (1844)	2.11±0.03 (1844)	55.6±0.0 (1844)	49.8±0.0 (1443)	196.9±5.4 (1441)
Body weight, kg						
<350	2.76±0.19^{d} (60)	718.0±67.6^{b} (60)	2.08±0.1^{b} (60)	56.2±0.1^{b} (60)	47.8±0.0^{c} (26)	111.6±19.0^{d} (24)
350-450	4.35±0.19^{c} (67)	763.4±64.5^{b} (67)	2.13±0.1^{a} (67)	63.5±0.1^{a} (67)	50.0±0.0^{b} (65)	150.7±12.3^{b} (65)
450-550	4.48±0.07^{b} (824)	986.7±23.8^{a} (824)	2.20±0.0^{a} (824)	63.9±0.0^{a} (824)	50.4±0.0^{a} (802)	154.5±4.9^{b} (802)
550-650	4.44±0.11^{b} (210)	681.0±37.4^{c} (210)	2.00±0.1^{b} (210)	51.4±0.0^{c} (210)	50.5±0.0^{a} (165)	144.1±7.9^{c} (165)
>650	5.48±0.07^{a} (683)	1064.6±24.3^{a} (683)	2.15±0.0^{a} (683)	62.7±0.0^{a} (683)	50.3±0.0^{b} (385)	273.7±5.0^{a} (385)
Scrotal circumference, cm						
<34	4.08±0.07^{b} (666)	846.3±25.6^{b} (666)	1.71±0.0^{b} (666)	69.29±0.0^{a} (666)	50.9±0.0^{a} (610)	168.6±5.6^{b} (608)
36-38	4.55±0.08^{a} (756)	965.5±27.1^{a} (756)	1.69±0.0^{b} (756)	69.21±0.0^{a} (756)	50.2±0.0^{a} (705)	205.5±5.8^{a} (705)
>38	3.67±0.12^{c} (422)	716.4±42.6^{c} (422)	2.94±0.1^{a} (422)	58.07±0.0^{b} (422)	48.6±0.0^{b} (128)	126.6±10.7^{c} (128)

$^{a\ vs\ b\ vs\ c}$p<0.05 Means with different superscript within classes differ significantly; Figures in parentheses indicate number of observations

>650 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. Hence, crossbred HF bulls with a body weight of >450 kg and scrotal circumference of >36 cm produced better quality semen. However, further research with more number of bulls in each body weight and scrotal circumference groups and scrotal thickness of the bulls are needed to determine the optimum semen production in tropical countries.

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