Journal of Animal and Veterinary Advances 4 (10): 885-888,2005


# Seasonal and Genotype Variations in Libido, Semen Production and Quality in Artificial Insemination Boars

[1]Chukwuemeka Okere, Avis Joseph and Michael Ezekwe
Swine Development Center, Alcorn State University, Agriculture Experiment Station
1000 ASU Drive # 1374, Alcorn State, Mississippi, MS 39096-7500

**Abstract:** The aim of this study is to access libido (sex drive) and examine the quality of ejaculates collected from Yorkshire (Large White) and Landrace boars, taking into account the potential effects of season and breed over a test period of one year. Two sexually mature boars (one from each breed, Yorkshire and Landrace) were trained to mount a dummy and ejaculate. Libido scores were assigned to boars during each semen collection. Scores ranged from zero to four, with zero indicating minimum and four indicating maximum libido. Upon collection, standard laboratory tests were utilized to evaluate volume of ejaculate, raw and forward progressive motility of sperm cells. Both breed of boar and season of semen collection significantly influenced the ejaculate volume ($p< 0.01$). The Yorkshire boar showed overall superiority in quantity of semen produced when compared to Landrace boar (336.05±168.2 vs. 144.42±100.0 mls; $p< 0.01$). Both the percentage of motile sperm cells and raw motility estimates were not significantly affected by season of ejaculate collection ($p>0.05$). However, breed of boar significantly affected both the proportion of motile sperm cells and the raw motility estimates of sperm cells ($p< 0.01$). Mean libido scores did not differ significantly ($p> 0.05$) between boars (3.49±0.29 vs. 3.19±0.20; for York and Landrace boars respectively, although there was a tendency for the Landrace boar to express lower libido in summer and fall. It is envisaged that the incorporation of the results from this project would greatly enhanced widespread use of artificial Insemination as a genetic improvement tool by limited -resource swine producers.

**Key words**: Genotype, season, semen, libido, boar

## INTRODUCTION

Artificial Insemination (AI) is arguably the single most important tool in improving swine genetics. In North America in 1994, artificial Insemination (AI) was used in 15% of all swine breeding. That number reached 50% in 1999[1] and AI is predicted to cover 90% of all mating by 2005. The success in adopting AI technology is dependent upon identifying and selecting boars whose reproductive performance judged by libido, mating ability and semen quality are outstanding. Several factors such as breed, age of boar, season, heat stress and social environment can influence boar semen quantity and quality[2]. It is also evident that between and within genotype, differences in boar semen output exist, although many relevant aspects of this phenomenon are poorly understood. Certainly, semen quality in diary bulls can be inherited[3] and boars selected for 10-11 generations on large scrotal circumference produced more sperm than control boars[4].

The environment of the boar is made up of many parts, which include temperature, light and handling. There is no question that high temperatures damage sperm production (volume, sperm concentration and sperm morphology) in animals like the pig that cannot sweat, they naturally will wallow in cool wet places to help cool themselves when it is hot. Modern swine housing facilities cannot provide wallows. Because the process of producing a sperm cell takes approximately 60 days in a boar, the effect of a heat episode (be it a heat wave or a fever) often is felt any time over the subsequent 6-8 weeks period[5].

It is conceivable that libido (sex drive) in the boar may be affected by external stimuli (day length or temperature). An earlier review[5]. noted that the majority of boars have sufficient extra-gonadal reserves to permit twice daily collection. This use is only possible, if sufficient sex drive is present. The optimal managerial regimen for an AI boar, therefore, would be one that maximizes libido without loss ofreproductive efficiency. Differences in libido and mating behaviour have been reported between breeds and strains of swine, as well as differences in the duration of ejaculation. There are very few investigations on the interaction between season,

**Corresponding Author:** Chukwuemeka Okere, Swine Development Center, Alcorn State University, Agriculture Experiment Station 1000 ASU Drive # 1374, Alcorn State, Mississippi, MS 39096-7500 Tel: 601 877 6553

Table 1: Meteorological data for southwest mississippi (May 2004 – April 2005)

| Month | Max Temp °C | Min Temp °C | Rainfall (mm) | Max rel. Hum (%) | Min rel. Hum (%) | Max wind speed km $h^{-1}$ | Min wind speed |
|---|---|---|---|---|---|---|---|
| May | 29.16 | 15.94 | 3.04 | 96.9 | 46.0 | 28.96 | 6.71 |
| June | 30.86 | 20.07 | 6.91 | 96.5 | 53.6 | 29.40 | 5.10 |
| July | 32.98 | 20.28 | 3.51 | 96.4 | 47.9 | 27.37 | 4.39 |
| August | 30.94 | 18.23 | 3.29 | 95.9 | 47.8 | 27.98 | 5.77 |
| September | 29.86 | 16.92 | 2.98 | 95.6 | 46.6 | 28.21 | 6.48 |
| October | 27.81 | 15.80 | 5.64 | 95.9 | 55.7 | 26.97 | 5.63 |
| November | 20.68 | 8.80 | 6.25 | 94.5 | 4.28 | 30.49 | 7.48 |
| December | 9.49 | 0.26 | 2.66 | 94.5 | 43.3 | 33.63 | 8.20 |
| January | 16.43 | 3.64 | 3.85 | 94.4 | 50.6 | 31.16 | 9.61 |
| February | 16.68 | 5.0 | 4.59 | 95.6 | 52.0 | 30.15 | 8.19 |
| March | 19.22 | 5.25 | 5.08 | 94.1 | 41.8 | 34.76 | 8.73 |
| April | 24.10 | 8.94 | 7.51 | 96.1 | 38.9 | 36.98 | 9.06 |

breed and libido on semen production and quality in boars, although such interactions appear to exist. All of these possible influences indicate a real need for some directed research into the impact of season and genotype and on sperm production and the expression of libido in A I boars.

The objective of the current study is to evaluate libido (sex drive) and examine the quality of ejaculates collected from Yorkshire and Landrace boars taking into account the potential effects of season and breed over a test period of one year.

## MATERIAL AND METHODS

Project location was Alcorn State University, Swine Development Center, Church Hill, in Southwest Mississippi. Two sexually mature boars (one from each breed, Yorkshire and Landrace) were trained to mount a dummy and ejaculate. Boars were housed in 3x3 m stalls in a rectangular building with dwarf walls and open sides. The climatic data for the semen collection period (May 2004 to April 2005) is presented in Table 1. Semen collection was done via Glove hand Technique. Collection frequency was once a week (Tuesday – Yorkshire and Thursday – Landrace boars). Upon collection, standard laboratory tests (described by Buhr, 1998) were utilized to evaluate volume of ejaculate, Raw Motility (RM) and Forward Progressive Motility of sperm cells (FPM). Briefly, a libido score was assigned to each boar during semen collection. Libido values ranged from zero to four, with zero indicating minimum and four representing maximum sex drive (Table 2). Subjective libido scores were used, rather the objective scores (i.e., time to mount, time to ejaculate, time to erection, etc.), to rank libido intensity. The authors felt that, in the interest of safety, certain restraints placed around the collection pen would alter strict objective measurements.

The project was designed as a 2x4 factorial arrangement with two genotypes (Yorkshire and Landrace) and four seasons (spring, summer, fall and winter). Data were analyzed by STATISTIX 7 package[6], using descriptive statistics, general AOV/AOCV

Table 2: Libido scoring criteria for A I Boars.

| Score | Libido level |
|---|---|
| 0 | No sexual interest and unable to collect |
| 1 | Little sexual interest and slow to achieve erection and ejaculation (> 5min). |
| 2 | Moderate sexual interest, erection and ejaculation within <5 min. |
| 3 | Greater sexual interest, erection and ejaculation within 3 minutes. |
| 4 | Intense sexual interest, immediate erection and ejaculation. |

procedures. Season and genotype and interaction between season and genotype were defined sources of variation. Comparisons of any differences of means of all parameters were made by the LSD method, at a rejection level of $p<0.05$.

## RESULTS

Results for each semen variable observed for all boars in spring, summer, fall and winter seasons are displayed in Table 3. Effects of breed, season and the interaction of breed and season for semen are presented in Table 4. Breed of boar and season of semen collection significantly influenced the ejaculate volume ($p<0.01$). Yorkshire boar showed overall superiority in quantity of semen produced compared to the Landrace boar (201.0±105.0,321.7±118,414.2±122.0,4.02.6±111.0, vs. 102.0±76, 155.6±98.0, 172.0±116.0, 114.3±90.0; $p<0.01$). Both the percentage of motile sperm cells and raw motility estimates were not significantly affected by season of collection ($p>0.05$). However, breed of boar significantly affected both the proportion of motile sperm cells and the raw motility estimates of sperm cells in the ejaculate ($p<0.01$).

Although the Landrace boar appears to express lower libido scores, mean libido scores did not differ significantly between boars (3.50±0.20, 3.44±0.36, 3.56±0.16, 3.48±0.44 vs. 3.38±0.22, 3.13±0.18, 3.09±0.21, 3.19±0.21; pvs. 144.42±100.0 mls; $p<0.01$). 3.49±0.29 vs. 3.19±0.20; $p>0.05$) for Yorkshire and Landrace boars in spring, summer, fall and winter, respectively. As

Table 3: Breed and seasonal variations in semen quality traits (Means±S.D.).

| Breed | Yorkshire | | | | Landrace | | | |
|---|---|---|---|---|---|---|---|---|
| Season | Spring | Summer | Fall | Winter | Spring | Summer | Fall | Winter |
| Parameter | | | | | | | | |
| Volume (ml.) | 201.0±105 | 321.7±118 | 414.2±1224 | 402.6±111 | 102.0±76 | 155.6±98 | 172.0±116 | 114.3±90 |
| Progressive | | | | | | | | |
| Motility (%) | 77.5±31.3 | 86.3±26.2 | 78.2±38.0 | 97.0±1 | 65.2±45.0 | 78.5±34.0 | 71.7±22.0 | 63.7±49 |
| Raw motility(1-3) | 2.50±1.2 | 2.70±0.8 | 2.40±1.5 | 2.90±0.01 | 1.80±1.3 | 2.20±1.2 | 2.10±1.3 | 1.90±1.5 |
| Libido score (0-4) | 3.50±0.20 | 3.44±0.36 | 3.56±0.16 | 3.48±0.44 | 3.38±0.22 | 3.13±0.18 | 3.09±0.21 | 3.19±.21 |

Table 4: Breed and seasonal variations in semen quality traits (p-values)*

| | Season | Breed | Season x Breed |
|---|---|---|---|
| Volume (ml.) | 0.0018 | 0.00001 | 0.0556 |
| Progressive motility (%) | 0.8278 | 0.0241 | 0.6022 |
| Raw motility (1-3) | 0.7819 | 0.0082 | 0.6898 |
| Libido scores (0 – 4) | 0.0883 | 0.0882 | 0.1003 |

*Significant if $p<0.05$

expected, the proportion of motile sperm cells was highly correlated with estimates of gross or raw motility (r = 0.99), also, volume of ejaculate showed moderate correlation (r = 0.44) with libido.

## DISCUSSION

There is no question that high temperature can damage sperm production (volume, sperm concentration and sperm morphology) in animals like the pig that has a scrotum located anterior to anal region and cannot sweat. There exists a paucity of information in literature regarding the precise mechanism through which various climatic factors can impact semen quality and conception rates in the pig. Anderson *et al*[7]. observed that pigs are sensitive to season, independent of the temperature. Day length is more important than light intensity (within reasonable limits) and is driven by the nature of the modern pig's ancestor, the European wild boar. Consistent with the data generated by current study is the observed genotype differences in semen quality, with Landrace boars having more motile and more normal sperm in the hot season than Duroc or York boars[8]. Flowers[9] reported semen from Large White boars under temperate conditions to be of best quality in the fall, followed by spring, winter and summer. In the humid tropics of Nigeria, Egbunike and Steinbach[10] and Egbunike and Dede[11] found semen quality from Large White boars, indigenous breeds and their crosses to best in rainy season and poorest in dry season. In contrast, investigations by Dede[12] on Large White failed to reveal any seasonal influence on ejaculate quality.

Because data from the current investigation failed to show any detrimental effects of season of collection on semen quality measured by the proportion of motile sperm cells harvested from both Yorkshire and Landrace boars in Church Hill A.I. Stud. Therefore, we recommended that semen could be collected from any of boar in southwest Mississippi or any place with comparable climatic data, at all seasons (spring, fall, summer and winter) without deterioration of any of the semen quality parameters measured.

Differences in libido and mating behavior have been reported between breeds and strains of swine, as well as differences in the duration of ejaculation. Present data suggests that compared to the Landrace boar, the Yorkshire boar appears to express higher. It is not clear whether the increased libido in Yorkshire boars was due to an increase in sex drive or simply to an abundance of energy. Factors such as physical fatigue and external stimuli may play major roles in determining levels of sexual interest in many species. Lane *et al*[13]. reported increased mounting activity individually penned bulls when compared with group penned bull, but attributed this increased activity to the excitement of the bulls coming out of their pens rather than to increased libido due to rearing environment. Present studies do not imply that as a breed, Landrace boars have lower libido, but that they appear to be less –sexually aggressive boars. Anecdotal evidence suggest breed differences in circulating testosterone of AI boars, however, the administration of exogenous testosterone to improve libido has been generally unsuccessful and has been shown to affect spermatogenesis adversely[14]. Perhaps the monitoring of testosterone levels of different breeds AI boars would yield some answers.

In this study, Yorkshire boar showed overall superiority in quantity of semen produced compared to the Landrace boar. A boar is typically selected for inclusion in an AI semen production unit based on his genetic potential to produce piglets of excellent growth and conformation and perhaps to produce female offspring with good mothering traits. It is also becoming evident that he could be and arguably should be, selected for his semen traits, although many relevant aspects of this are poorly understood. Boars selected for 10-11 generations on large scrotal circumference produced more sperm than boars randomly selected for the same period[4]. These boars also had more efficient testes, producing more sperm per gram of testes than did the controls' testes and the bottom line is that the boars produced between 4 to 14 billion more sperm per ejaculate when collected three times per week.

## CONCLUSIONS

AI in pigs is now regularly used around the world. The advantage for small-scale pig breeders is that it avoids the costs and inconvenience of keeping a boar. It also allows small-scale pig farmers to use boars with better genetic potential than they could afford to buy. There are obvious advantages making this technology easily accessible in developing countries because AI offers a better control of certain infectious diseases. For the development of prospective fertility testing programs for AI boars, the ability to identify subfertile or low libido boars accurately and quickly is essential. Clearly, there are many questions concerning current reproductive performance testing of A. I. Boars, but it would appear that the combination of libido test scores and routine semen quality evaluation used in the current investigation might prove to be one way to accomplish this task.

## ACKNOWLEDGEMENTS

Research was supported by USDA-ARS. The authors acknowledge the secretarial support of Ms. Malone of the Swine Development Center and the technical support of Church Hill Swine Research and Development Farm Crew.

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