# Seasonal Variation in Swine Semen Quality

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Several studies on the effect of climatological conditions on the reproductive performance of the bull and the ram have been conducted, but there has been relatively little research performed to substantiate fertility patterns in boars. Such studies have been oriented primarily toward the function of sperm production in relation to environments with high temperatures. For pork producers in areas where extremely low temperatures prevail for considerable periods of time, research conducted in high temperature environments is of limited practical application.

## Review of Literature

A review of the literature reveals only a limited amount of research concerned with the seasonal variation in the reproductive function of male animals, and disappointingly few of these articles pertain to the boar. The data that have been compiled for all species indicate definite differences in semen quality as a result of exposure to elevated environmental temperatures.

Several species have been used to determine physiologic responses to various temperatures. Artificial environments were studied by Simpson and Rice (1957). They placed three rams in a room maintained at 90°F for a period of one week to evaluate testis response. Semen characteristics were compared to those of three control rams maintained in an unheated barn during January. Semen volume remained unchanged, but during the fourth week of collection motility dropped to 22 per cent and the number of abnormal cells rose to 51.1 per cent in rams maintained at elevated temperatures. The semen characteristics of the control group remained normal throughout the trial.

An air-conditioned chamber was used by Dutt and Bush (1955) to study the effect of reduced temperature on the fertility of rams. The reproductive performance of males maintained in a temperature environment that varied only from 45°F to 48° F was measured. These males were compared to control males in a similar chamber where the average daily maximum temperature was 88.7°F. Semen evaluations revealed significantly ($P < 0.01$) less deterioration, as measured by the per cent motile and abnormal spermatozoa, for the cooled rams during the trial period.

In an experiment conducted to evaluate influences of both temperature and nutritional intake on reproductive performance of boars, Stevermer **et al.** (1961) noted some seasonal variation in semen production as the long term study progressed. Volume per ejaculate increased in five of the six boars during the cool fall months. Both spermatozoa concentration and total number of spermatozoa per ejaculate were highest during the warm months of June through August.

Swierstra (1970) observed the effect of low ambient temperatures on reproduction by housing one group of 14 boars in a temperature controlled chamber (17°C) and another group of 14 boars in outside pens where temperatures ranged from −30°C to 0°C. The extremely low temperatures did not interfere with testicular development, sperm production, or semen quality. Daily sperm production was $16.5 \times 10^9$ for the boars maintained at 17°C and $18.6 \times 10^9$ for the low temperature boars ($P < 0.05$).

The purpose of this study was to examine the variation in swine semen quality and to determine when the semen quality values were lowest during the breeding period. Conclusions were used to resolve what effects the extreme North Dakota temperatures had upon sperm production and potential fertility in boars maintained in extremely low ambient temperature conditions.

## Experimental Procedure

Semen samples were obtained from eight normal fertile boars maintained at the North Dakota State University Animal Science Department swine unit. The boars ranged in age from one to four

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years, and consisted of Durocs and Chester Whites. The boars were housed the year around in individual enclosed sheds with feed and water located at the end of outside runways opposite the shelter. A 15 per cent protein ration consisting of ground barley and soybean oil meal was fed.

For semen collection, each boar was brought into a heated farrowing barn where a sow was restrained. Each boar was allowed to mount this same sow at 10-day intervals for collection purposes. The hand grasp technique was used to elicit ejaculation in the boars. Collections were made in a 500 ml. glass beaker covered with cheesecloth to strain out foreign particles and the gelatinous portion of the seminal plasma.

The semen was examined immediately after collection in the same building where collection occurred. The strained volume of semen was noted and recorded at each collection. A glass rod was used to obtain a small portion of semen from the sample which was placed on a warmed slide. This was examined under the microscope at a magnification of 100X to ascertain the motility of the semen. A rating scale of 0 to 5 was used to determine motility. The color of the sample was noted on a scale of one to five. The direct cell count method was used to determine the concentration of the sample. The per cent abnormal sperm was determined by a staining procedure and counting the entire field (430X). A sperm was classified as abnormal if at any time it deviated from a normal-looking sperm.

A record was kept of the outside temperature at the time of collection and the day prior to the collection. The relationship of low ambient temperatures to swine semen quantity and quality was tested by correlation analysis.

## Results and Discussion

During the course of this study, 247 collections were taken from eight boars of two breeds (Durocs and Chester Whites), 128 from Chester Whites and 119 from Durocs.

Slight differences within the various semen characteristics did exist between boars and between breeds. The mean ejaculated volume was greater in the Chester White boars than the Duroc boars, ranging from a mean of 203.1 ml to 388.0 ml of strained semen. Mean volumes for the Durocs ranged from 136.8 ml to 232.7 ml. The larger volume from the Chester Whites may be attributed partially to the observed exhibition of greater libido prior to collection. This could likely cause greater amounts of seminal plasma in the ejaculate. This was supported by the fact that in most collections the Durocs had a lower volume but exhibited a higher concentration of sperm per ml. of semen. The sperm concentration per ml. in the Durocs also was more constant between boars, ranging in value from 26.5 x $10^7$ to 34.5 x $10^7$, while the Chester Whites ranged from a low of 23.3 x $10^7$ to a high of 37.9 x $10^7$.

Motility estimates were scaled from zero to five with a value of five representing the greatest amount of motility. Only one Chester White boar had an average motility value of less than four, while all of the Durocs' motility scores were 4.1 or less. All boars had good motility, but the Chester Whites as a breed had higher overall motility.

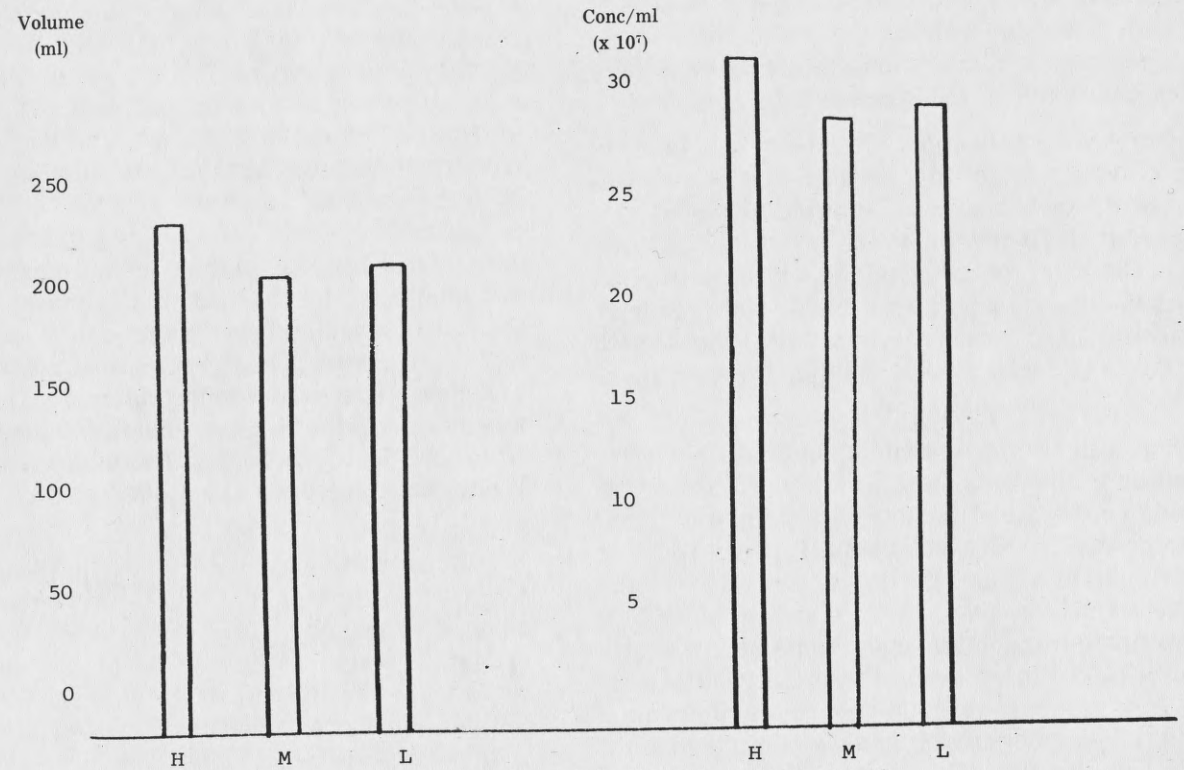
Abnormal sperm were determined to be any sperm that deviated from the normal appearance whether the deviation occurred in the acrosome cap, head, midpiece or tail. The Chester Whites appeared to be superior in this semen characteristic with the exception of one Duroc boar who had a mean of only 6.8 per cent abnormalities. The Chester Whites had a lower percentage of abnormalities as a breed, varying from 5.7 per cent to 7.2 per cent. Abnormalities for the Durocs ranged from 6.8 to 15.9 per cent. All the boars collected had a relatively low percentage of abnormalities.

Data from all collections were classified into three groups based on temperature at the time of collection, the first group having temperatures greater than or equal to 32°F, the second group having temperatures from 0 to 32°F, and the third group having temperatures less than 0°F (Table 1).

**Table 1. The Influence of Temperature at Various Times of Collection of Swine Semen Characteristics.**

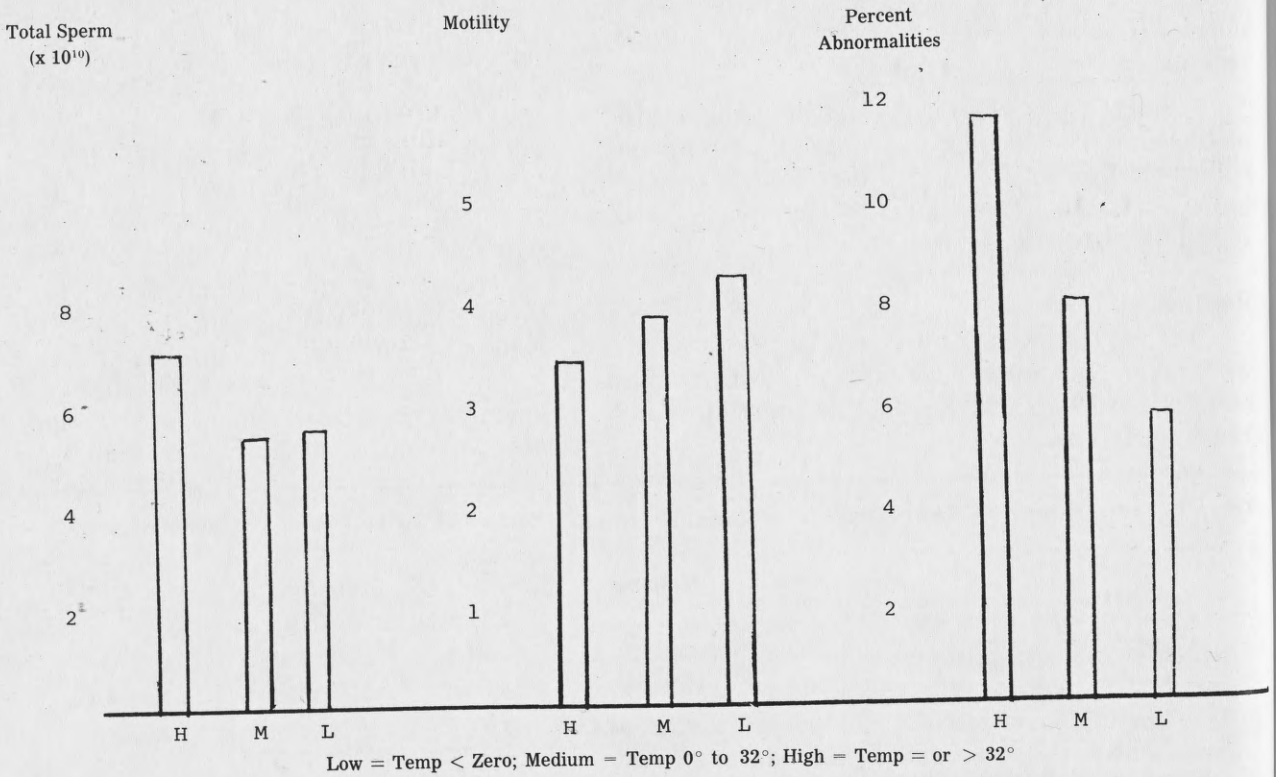
| Temperature | Observations | Color Score | Volume (ml) | Motility Score | Con/ml (x $10^7$) | Percent Abnormal | Total sperm/ ejaculate (x $10^{10}$) |
|---|---|---|---|---|---|---|---|
| High* | 94 | 3.7±1.1 | 240.0±101.0 | 3.7±1.1 | 31.6±14.9 | 10.9±8.4 | 7.2±3.6 |
| Medium* | 84 | 4.0±0.9 | 217.7± 88.9 | 3.9±1.0 | 27.9±10.8 | 8.0±5.4 | 5.7±2.5 |
| Low* | 69 | 4.1±0.0 | 219.7± 94.4 | 4.1±0.8 | 28.8±12.2 | 5.9±3.7 | 6.0±2.8 |

*High — (Temperatures equal to or greater than 32 degrees)
*Medium — (Temperatures O degrees to 32 degrees)
*Low — (Temperatures less than 0 degrees)




Low = Temp < Zero; Medium = Temp 0° to 32°; High = Temp = or > 32°

**Figure 1. Comparison of semen characteristics from all boars at three temperature level groups.**




Low = Temp < Zero; Medium = Temp 0° to 32°; High = Temp = or > 32°

**Figure 2. Comparison of semen characteristics from all boars at three temperature level groups.**

The concentration and total sperm increased only slightly from the medium to low temperature groups with values of 27.9 x $10^7$ to 28.8 x $10^7$ and 4.7 x $10^{10}$ to 6.0 x $10^{10}$, respectively (Figure 1). These changes are not statistically significant and probably are due to chance alone.

Since volume and concentration did not seem to be adversely affected by decreased temperature, the quality of the semen including motility and per cent abnormalities would be the next logical issue. Motility score increased from 3.7 at high temperatures to 3.9 at medium and 4.1 at low temperatures. This suggests a trend toward greater motility as temperatures drop (Figure 2).

The per cent abnormalities in the low temperature group were almost half those found in the high temperature group. The abnormalities declined steadily from 10.9 to 8.0 to 5.9 per cent for high, medium and low temperature groups, respectively. It would then appear that as ambient temperatures decline, the quality of the semen tends to increase as indicated by values noted for motility and per cent abnormalities.

The low temperature was recorded for each day collections were made. These temperatures were correlated with the data collected on the semen characteristics. The correlation coefficients between low daily temperatures and semen characteristics for the three temperature groups of high, medium, and low were recorded (Table 2).

**Table 2. Correlation of low temperature with semen characteristics.**

| Temperature | Observations | Volume | Motility | Concentration | Percent Abnormalities | Total Sperm |
|---|---|---|---|---|---|---|
| High* | 94 | 0.12 | −0.25[1] | −0.24[1] | 0.22[1] | −0.13 |
| Medium* | 84 | 0.10 | −0.08 | −0.02 | 0.18 | 0.05 |
| Low* | 64 | 0.10 | 0.06 | −0.20 | −0.05 | −0.06 |

*High - Temperature equal to or above 32 degrees F.
Medium - Temperature between 0 degrees F and 32 degrees F.
Low - Temperature 0 degrees F or lower.
[1](P is less than 0.05)

Only three correlation coefficients were statistically significant. These were in the group where temperatures were equal to or greater than 32°F. These express a negative relationship in that as temperatures rise, the motility and concentration tend to decrease. Also, the per cent abnormalities increased as temperatures increased. There were no significant correlations between the medium and low temperature groups indicating that variations in temperatures below 32°F do not affect semen quantity or quality.

## Summary and Conclusions

Semen samples were collected from eight mature boars. Certain semen characteristics and temperature at the time of collection were recorded. Small differences in certain semen characteristics did exist between boars as well as between breeds. The Chester White boars excelled the Durocs in most semen qualities, although both were adequate as far as reproductive performance was concerned. Semen volume in the Chester White boars ranged from 203.6 to 388.0 ml of strained semen. The Durocs ejaculated considerably less, ranging from 136.8 to 232.7 ml of strained semen. The Durocs has an average of 10.6 per cent abnormalities, while the Chester Whites averaged 6.6 per cent. However, the Durocs' sperm concentration per ml. was greater.

Data from the collections were grouped according to temperature at the time of collection. These were correlated with the low temperature recorded on day of collection. Three correlation coefficients were statistically significant ($P < .05$) indicating some relationship exists between semen quality and ambient temperature. Concentration per ml. and total sperm per ejaculate tend to increase as temperatures decline. It was observed that low ambient temperatures do not interfere with sperm production or semen quality in the temperature ranges observed in this study. In contrast, high ambient temperatures are known to reduce sperm motility and increase abnormalities.

If the semen characteristics examined in this study are valid criteria of a boar's fertilizing capacity, then under practical management conditions, a cold environment should not damage the male's contribution to conception rate and litter size potential.

## References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