

Reproduction Physiology

Recovery of Normal Semen Quality after Heat Stress of Boars¹

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Story in Brief

When six Yorkshire boars were subjected to 94°F ambient temperature, sperm motility was decreased compared to six control boars at 74°F. After heat stressed boars were returned to 74°F, sperm motility did not return to normal values until after about five weeks of cool temperature. The reduction in semen quality was associated with a reduction in fertility. Conception rate was decreased when gilts were bred to heat stressed boars, but embryonic survival was not influenced.

Providing boars with only shade during the summer caused increased respiratory rates and decreased semen quality. If sprinklers were available for boars in addition to shade, respiratory rates and semen quality were similar to those for boars maintained in cool chambers. An additional year of study is necessary to determine possible year differences and to obtain sufficient semen quality and fertility data to evaluate these management methods.

Introduction

Reproductive efficiency is reduced when swine are mated during the summer months. Results of recent studies indicate that breeding problems during the summer months may be the result of heat stress on boars as well as on gilts. Formation of sperm is a continual process, requiring about five or six weeks in most males. If sperm are affected in the formation stages by increased body temperature, the influence may be apparent several weeks later.

The purposes of these experiments were to determine the interval from the end of heat stress to normal sperm production and to evaluate management systems which should reduce heat stress of boars.

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Experimental Design

Experiment 1

Six Yorkshire boars of proven fertility were allotted to each of two temperature controlled chambers. After a three-week adjustment period at 74°F, control boars were maintained at 74°F and heat stressed boars were exposed to 88°F from 5 pm to 9 am, and 94° from 9 am to 5 pm. Feed intake was controlled and boars gained about 0.5 pounds/day. Boars were ejaculated twice weekly and semen quality was evaluated weekly starting three weeks prior to treatment through the sixth week of heat stress.

From day 40 through day 75 of treatment, control and heat stressed boars were mated to a total of 77 gilts. Gilts were slaughtered at day 30±3 of pregnancy and conception rate and the numbers of corpora lutea and normal embryos were determined. After 75 days of heat stress all boars were exposed to 74°F daily for six weeks. Boars were ejaculated twice weekly and semen quality was evaluated weekly.

Experiment 2

Eighteen boars were used in this trial during May through October, 1976. Six boars were housed in a temperature controlled chamber at approximately 70°F. A second group of six boars was kept in outside lots with a shade provided and a third group of six boars was kept in outside lots provided with shade and a water sprinkler from June 1 until September 15. Maximum and minimum ambient temperatures were recorded daily under the shade at 3 pm and respiratory rates were determined three times each week. Sperm motility and morphology were evaluated during the first weeks of June, August and October.

Results

Experiment 1

The quality of the sperm cells was reduced by heat stress. In Figure 1, percent motile sperm from heat stressed boars is compared to that for control boars. During the three weeks prior to heat stress, percent motile sperm was similar in both groups of boars (averaged 80 percent). After two weeks of treatment, motile sperm decreased to 56 percent in stressed boars. During the third to sixth weeks of treatment, only half as many motile sperm were obtained from heat stressed boars as from control boars.

After the five-week breeding period, heat stressed boars had 53 percent motile sperm, whereas control boars had 85 percent (Figure 1). Stressed boars were then exposed to a cool temperature (74°F). Percent motile sperm gradually improved, and after five weeks, percentages of motile sperm were similar for stressed and control boars. Therefore, if sperm are affected in the formation

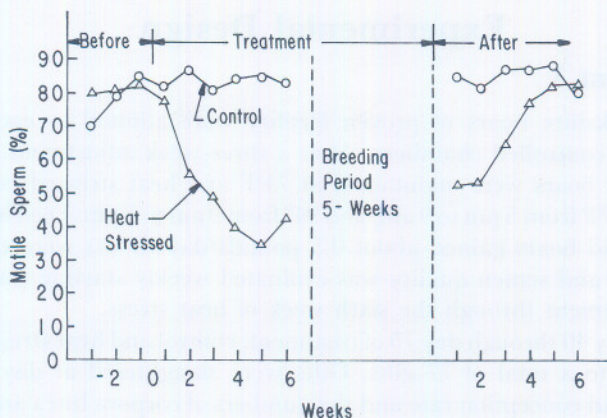


Figure 1. Motility of sperm from control and heat stressed boars before, during and after exposure to elevated ambient temperature.

stages by increased body temperature due to heat stress, the influence is present for up to five weeks later.

Fertility was reduced when gilts were mated to boars after six weeks of heat stress (Table 1). Eighty-two percent of the gilts bred to control boars conceived, but only 59 percent of the gilts bred to heat stressed boars were pregnant. Embryonic survival at 30 days after breeding was similar for gilts bred to control or heat stressed boars. Gilts that were bred to control boars had an average of 10.9 embryos, and gilts bred to heat stressed boars had 10.7 embryos. The reduction in fertility in this study is similar to that which was observed in a previous experiment when gilts were artificially inseminated with semen from heat-stressed boars.

Experiment 2

The temperature in the cool chamber ranged from 55 to 75°F during the trial (Figure 2). Ambient temperature, in El Reno, increased from an average weekly maximum of about 83°F, during the last two weeks of May, to 104°F during the second week of August. Then the maximum temperature decreased gradually to about 79°F during the first week of October.

Table 1. Fertility of gilts bred to control or heat stressed boars

Treatment	No. of boars	No. of gilts bred	Gilts pregnant at 30±3 days after breeding		
			No.	Percent	Embryo survival (percent)
Control	6	37	30	82.3	82.1
Heat Stressed	6	40	25	59.2	82.1

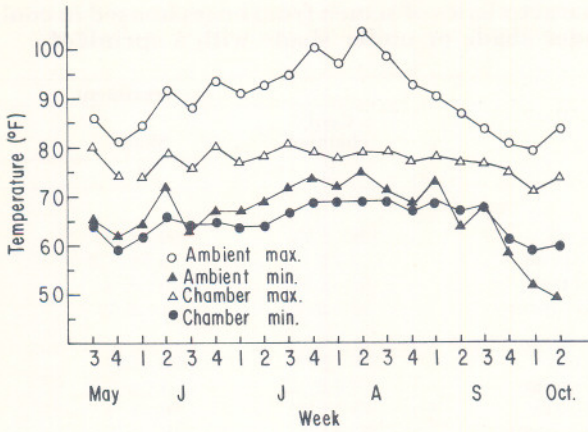


Figure 2. Maximum and minimum ambient and environmental chamber temperatures that boars were exposed to during 1976.

The respiratory rates (RR) of the boars were directly related to the ambient temperature (Figure 3). When boars are exposed to elevated ambient temperature, increased evaporative cooling by the respiratory passages is a major way excess heat is removed from the body. During the last two weeks in May and the first week in June, RR were similar in all boars. As ambient temperature increased, RR increased rapidly in boars provided with only shade, reaching a maximum of 144 breaths per minute in August. During

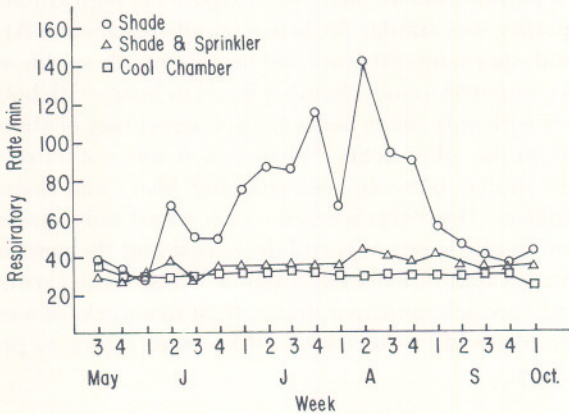


Figure 3. Respiratory rates of boars maintained in cool chambers, under shade or under shade with a sprinkler.

Table 2. Characteristics of semen from boars housed in cool chambers, under shade or under shade with a sprinkler

No. Boars	Treatment		
	Cool chamber	Shade	Shade + sprinkler
	5	6	6
<u>June 1976</u>			
Semen volume (ml)	138 ±39	159 ±15	142 ±41
Motility rate of sperm	3.7± .2	3.5± .2	3.8± .1
Percent motile sperm	67 ± 4	70 ± 4	78 ± 2
Percent abnormal sperm	13 ± 2	11 ± 2	12 ± 2
<u>August 1976</u>			
Semen volume (ml)	126 ±23	129 ±29	181 ±25
Motility rate of sperm	3.3± .2	3.1± .1	3.5± .1
Percent motile sperm	75 ± 4	56 ± 4	76 ± 2
Percent abnormal sperm	8 ± 1	19 ± 2	10 ± 1
<u>October 1976</u>			
Semen volume (ml)	112 ±30	156 ±21	186 ±40
Motility rate of sperm	3.5± .2	2.8± .1	3.5± .1
Percent motile sperm	69 ± 2	55 ± 2	70 ± 3
Percent abnormal sperm	11 ± 2	17 ±1	11 ± 2

August, for boars supplied with sprinklers as well as shade, RR was only slightly greater than that for boars in the cool chamber. These results indicate that boars given only shade were heat stressed, but if sprinklers were supplied the stressful effect of high ambient temperature was greatly reduced.

Similar to previous studies, semen volume was not influenced by heat stress (Table 2). Although boars were not trained for semen collection on a dummy, it was possible to obtain ejacula from 17 of the 18 boars at each of the collection times. In June, before boars were exposed to high ambient temperatures, semen quality was similar for boars on all treatments. At the August evaluation period, sperm motility rate and percent motile sperm were reduced for shade boars compared to cool chamber boars or boars with both shade and sprinklers. Boars with only shade had a greater percentage of abnormal sperm in the ejacula than the other boars. When semen was evaluated in October, quality was still similar between cool chamber boars and boars with both shade and sprinklers. However, when boars received only shade during the summer, percent motile sperm was still decreased and the percent abnormal sperm was increased at the October evaluation. These results are in agreement with Experiment 1, which indicated that at least five weeks of a cool ambient temperature are required for heat stressed boars to return to production of high quality semen.