Effects of Heat Stress at Various Stages of Pregnancy on Sow Productivity*

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Effects of high ambient temperatures on the reproductive performance of first-litter gilts was studied at various stages of pregnancy. One environmental chamber was maintained at 74°F continuously while the other chamber was elevated to 100° F for 17 hours and then lowered to 90° F for the remaining 7 hours during each 24-hour period.

Of the 28 gilts subjected to heat stress during the first month after breeding, 9 returned to estrus. This was opposed to none returning among the control gilts. The heat-stressed group had fewer live embryos when slaughtered 30-days postbreeding and embryo length tended to be somewhat reduced but these differences were not significant. The average ovulation rate for the 47 gilts slaughtered 30-days postbreeding was 14.77. It appeared that embryos were more susceptible to heat stress during the period of implantation than immediately following breeding.

The adverse effects of heat stress were more pronounced in late pregnancy than in mid pregnancy in this study. The gilts subjected to the heat chamber in late pregnancy farrowed an average of 6.0 live pigs per litter compared to 10.4 for those subjected to the control chamber. Pig birth weights tended to be lower for gilts subjected to heat stress during late pregnancy also, but these differences were not significant.

Productivity of control chamber gilts and those maintained outside full term were comparable indicating that the physical stress of confining gilts to the chambers was not a factor. Based on these data, heat stress tends to cause most adverse effects in early pregnancy and in late pregnancy with gilts being fairly resistant during mid pregnancy.

Introduction

Many swine producers in the southern part of the United States have gone to confinement feeding, and because of their investment it is essential that these facilities be operated at full capacity year round. This makes it necessary for sow herds to farrow year round and reproduce uniformly during all seasons of the year.

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Previous observations made at this station and by many swine producers indicate that sows farrowed in late summer have smaller litters and lighter weaning weights than those farrowed during the cooler months.

This study was initiated to gain more information concerning the possible effects of high ambient temperatures on the reproductive performance of gilts during early, mid, and late pregnancy.

Materials and Methods

Two groups of 63 breeding-age gilts were allotted to one of 9 environmental treatments giving 14 gilts per treatment as outlined in Table 1. Gilts were allotted to treatment at time of breeding after each had been observed through at least two normal estrous cycles prior to breeding. The first replication consisted of 63 crossbred gilts mated to Hampshire boars in August and September of 1968, while the second group was made up of 63 Hampshire gilts mated to Hampshire boars in February and March of 1969.

The two environmental control chambers at the Ft. Reno Livestock Research Station previously described by Edwards, *et al.* (1968) were used in this study. The control chamber was maintained at 74° F continuously while the hot chamber was kept at two temperatures: 100° F for 17 hours (4 p.m. to 9 a.m.) and 90° F for 7 hours (9 a.m. to 4 p.m.). Humidity was not controlled in these chambers but normally ranged from 40 to 50 percent in the hot chamber and from 58 to 62 percent in the control chamber. Artificial light was used in the chambers but the photo period was not strictly controlled.

Rectal temperatures were recorded for all gilts twice daily during the period of confinement in the chambers. One reading was taken at

Table 1. Description Of Treatments

Treatment Number	No. Gilts allotted	Chamber	Period of Confinement	Disposal of sow
1	14	Hot	0- 8 days postbreeding	Slaughte
2	14	Control	0- 8 days postbreeding	Slaughte
3	14	Hot	8- 16 days postbreeding	Slaughte
4	14	Control	8- 16 days postbreeding	Slaughte
5	14	Hot	53- 61 days postbreeding	Farrow
6	14	Control	53- 61 days postbreeding	Farrow
7	14	Hot	102-110 days postbreeding	Farrow
8	14	Control	102-110 days postbreeding	Farrow
9	14	Outside Control	0-109 days postbreeding	Farrow

4 p.m. before the heat was elevated in order to approximate the minimum body temperature for those subjected to heat stress. The second rectal temperature was taken at 8 p.m., or four hours after increasing the heat, in order to estimate the maximum body temperature. Temperatures were obtained on gilts in the control chamber at the same times as those obtained in the hot chamber.

The 56 gilts used to evaluate temperature stress during early gestation (treatments 1 through 4) were slaughtered at 30 to 36 days postbreeding and intact reproductive tracts were recovered. These tracts were examined by dissection noting numbers of live embryos, numbers of hemorrhagic or partially decomposed embryos, and numbers of corpora lutea. Also, crown-rump measurements were made on viable embryos while still enclosed in the amnionic sac.

All gilts were maintained in outside pasture lots except during periods of chamber confinement. These lots were equipped with shelters, shades and sprinkler systems depending on weather conditions. All gilts were fed in individual feeding stalls and maintained on the same ration at approximately the same level of intake.

Results and Discussion

Average rectal temperatures from gilts confined to chambers are given in Figures 1, 2, 3 and 4. It can be seen from these graphs that body temperatures of control chamber gilts were quite similar for those evaluated during all phases of gestation, but were slightly lower than the 102.5° F reported as being the normal for swine. Maximum body temperatures were considerably higher than normal for the hot chamber gilts at all times. A certain degree of adaptation to this environment was evidenced by the tendency toward reduced rectal temperatures during the latter days of confinement. This trend was even more pronounced for the minimum body temperatures. Except for those subjected to the hot chamber in late pregnancy, the 4 p.m. temperatures for those in the hot chamber and those in the control chamber were not significantly different after 6 days of exposure. This acclimation was not evident for gilts subjected to heat stress in late pregnancy.

The data collected from the reproductive tracts of the gilts subjected to heat stress in early gestation are summarized in Table 2. All gilts placed in the control chambers after breeding were pregnant at 30 days, while 9 of the 28 gilts (32 percent) subjected to high temperatures during this time returned to estrus. These gilts settled when re-bred indicating that they were normal.

Ovulation rates, as determined by the average number of corpora lutea obtained when gilts were slaughtered 30 days postbreeding, was

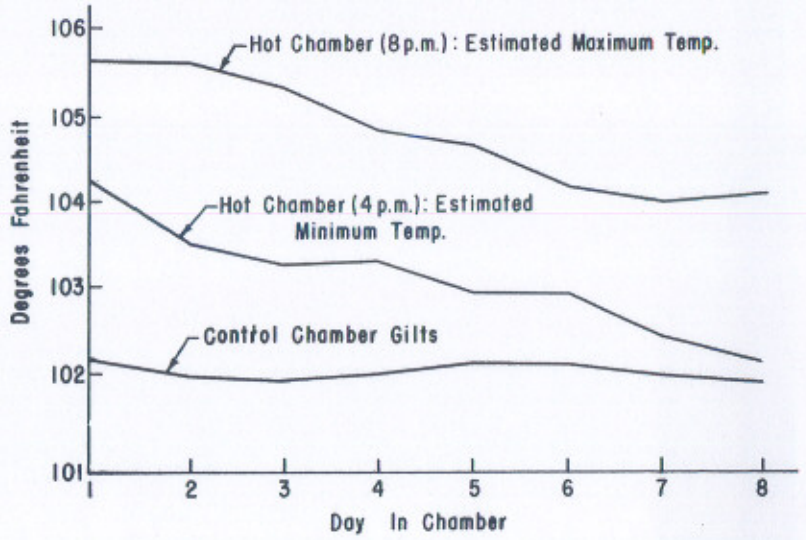

Figure 1. Avg. rectal temperatures of gilts subjected to chambers immediately after breding (0 - 8 days).

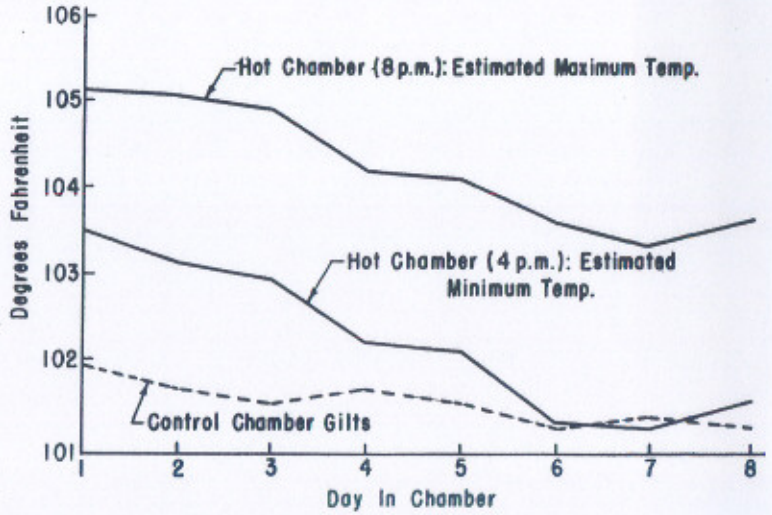

Figure 2. Avg. rectal temperatures of gilts subjected to chambers 8 t 16 days postbreeding.

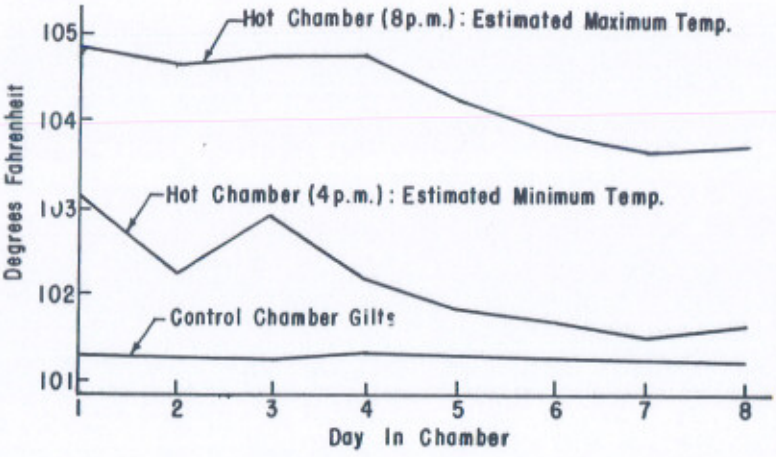

Figure 3. Avg. rectal temperatures of gilts subjected to chambers during mid pregnancy (53-61 days postbreeding).

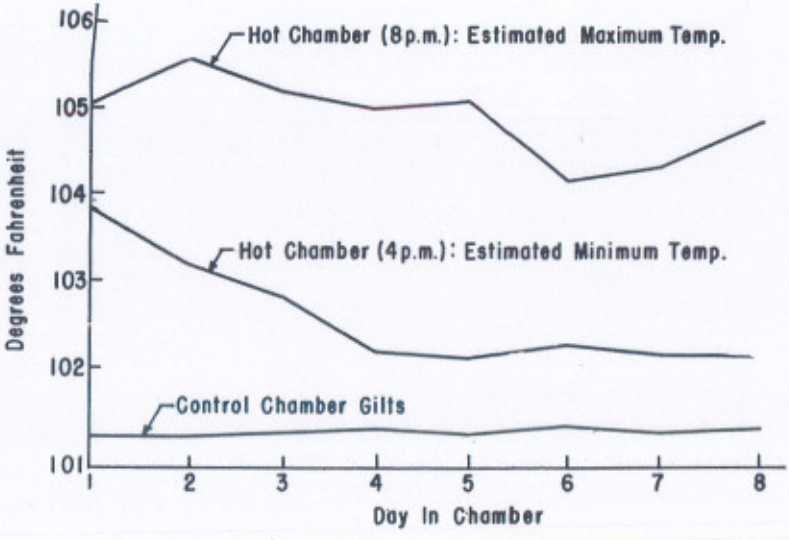

Figure 4. Avg. rectal temperatures of gilts subjected to chambers during late pregnancy (102-110 days postbreeding).

14.8 ova per gilt. Since by chance the ovulation rates were not evenly distributed among the early gestation treatments, the number of live embryos per gilt was adjusted by holding the number of corpora lutea constant in order to make the treatment comparisons valid. The control chamber gilts had more viable embryos per gilt than the heat stressed gilts during both periods of investigation. Exposure to the hot chamber from the 8th to 16th day postbreeding had a more adverse effect on embryo survival than subjecting them to heat stress immediately following breeding. Embryo lengths were adjusted to a constant age and were found not to be significantly different between treatments, although the embryos from the heat stressed gilts tended to be somewhat shorter than those from the control gilts.

Gilts placed in the chambers during mid and late pregnancy, along with those kept outside full term, were allowed to farrow and data

Table 2. Influence Of High Ambient Temperatures During Early Pregnancy

Item	Period of Postbreeding Confinement			
	0-8 days		8-16 days	
	Hot Chamber	Control Chamber	Hot Chamber	Control Chamber
No. gilts allotted	14	14	14	14
No. pregnant at 30 days	8	14	11	14
No. corpora lutea/gilt[1]	14.8	13.4	17.1	15.1
No. viable embryos/gilt[1,2]	11.4	13.0	6.9	12.8
Embryo length, mm.[3]	32.1	34.0	31.8	32.5

[1]Differences between treatments significant at 1% level
[2]Number of viable embryos holding number of corpora lutea constant
[3]Embryo length holding age of embryo constant

Table 3. Influence Of High Ambient Temperatures At Mid And Late Pregnancy And Productivity Of Outside Controls

Item	Period of Postbreednig Confinement				
	53-61 days		102-110 days		
	Hot Chamber	Control Chamber	Hot Chamber[2]	Control Chamber	Outside Control
Farrowing Records:					
No. live pigs/litter[1]	10.3	10.8	6.0	10.4	10.7
No. dead pigs/litter[1]	0.7	2.2	5.2	0.4	1.0
Avg. pig wt., lb.	2.8	2.8	2.7	3.0	2.8
Avg. litter wt., lb.[1]	28.4	29.4	19.0	29.9	29.8
21-day Records:					
No. pigs/litter[1]	9.2	9.4	4.3	9.2	8.6
Avg. pig wt., lb.	11.3	11.6	11.2	12.2	11.4
Avg. litter wt., lb.[1]	103.2	107.2	64.3	111.9	98.8

[1]Differences between treatments significant at 1% level
[2]Does not include two gilts that died while in confinement

from these treatments are presented in Table 3. Productivity for gilts subjected to both chambers during mid pregnancy were comparable to those maintained outside full term indicating that gilts were relatively resistant to heat stress in mid pregnancy.

Pronounced adverse effects of high ambient temperatures were noted during late pregnancy. Gilts subjected to the hot chamber at this time farrowed fewer live pigs and more stillborn pigs and there was a tendancy for the pigs to be lighter at birth but the differences in birth weight were not significant. Large differences in litter birth weights and litter 21-day weights were obtained. Using the average ovulation of 14.8 based on all gilts slaughtered in this study as a measure of the potential litter size, the control gilts farrowed 70.9 percent live pigs of potential compared to 69.5 percent for those subjected to heat stress in mid pregnancy and 40.5 percent for those subjected to heat stress in late pregnancy.

Literature Cited

Edwards, Ronnie, I. T. Omtvedt, E. J. Turman, D. R. Rule, D. F. Stephens and G. W. A. Mahoney, 1968. Reproductive performance of gilts following exposure to heat stress prior to breeding and in early gestation. Oklahoma Agr. Exp. Sta. Bull. MP 80:97.

A Study of Seasonal Changes in Boar Semen

Jerry A. Lawrence, E. J. Turman, Travis Rich, Allen Sharp and J. C. Hillier

Story in Brief

Changes in the semen characteristics of eight boars housed in pens containing three types of shelters and collected three times a week were studied over a seven month period, July, 1965 to January, 1966.

There were no consistent differences in motility associated with any season. The quantitative values of volume and total sperm per ejaculate were higher during cool weather, However, semen quality, as measured by the percent abnormal sperm, was lower during this period. The reason