HIGH TEMPERATURES AROUND OESTRUS DECREASE REPRODUCTIVE PERFORMANCE IN THE GILT.

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SUMMARY

Twenty gilts were used to study the effect on reproductive performance of high ambient temperatures before oestrus. Fourteen gilts were exposed to 32°C for 7h and 38OC for 17h for five daysfrom d17 of the oestrous cycle(where d0 is the first day of oestrus). Six gilts were maintained at 20°C as controls.

Mean concentrations of progesterone, oestradiol and LH were not affected by high temperature. The interval between the pre-oestrous peak of oestradiol and the onset of oestrus was extended in the treated gilts (Ps 0.05). A similar response was observed between the pre-ovulatory surge of LH and the onset of oestrus. Increases in time between the peak of oestradiol and the onset of oestrus were associated with decreases in the duration of oestrus(r= -0.63,P6 op > Fewer heated gilts displayed oestrus for more than 24h (8/14 vs 6/6 X^2 =0.696, P,(0.10). The onset of oestrus and ovulation rate were not affected by high temperature.

Pregnancy rate and embryo mortality were 71% and 15% in the control group and 42% and 42% in the heated group thirty days after mating.

Key words: high temperatures, gilts, oestrus, embryo mortality

INTRODUCTION

In the field, the characteristics of summer infertility in the female pig are often inconsistent and diverse ranging from decreased. oestrous activity, pregnancy rate, embryo survival and litter size to increased ovulation without oestrus, returns to oestrus, extended oestrous cycles and intervals from weaning to mating.

Gilts exposed to high temperatures during the regression of corpora lutea exhibited delays in the onset of oestrus but there was no decrease in the duration of oestrus(Pett 1988). However, when oestrous sows were subjected to high temperatures, the length of oestrus was shortened by half a day and oestrogenic activity in the oviduct was decreased(Steinbach 1976). Similarly, Robinson and van Niekerk(1978)observed lower sexual behaviour in female pigs in summer compared with winter.

Ewes heat treated at different times before oestrus exhibited varied responses ranging from a delayed onset of oestrus to an absence or shortening of the duration of oestrus, depending on the timing and duration of heat treatment (Sawyer 1977).

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Shortening the period of oestrus by heat stress suggests a temperature response mediated through the hypothalamic-pituitary-gonad axis resulting in a lowered secretion of oestrogen(Haynes and Howles 1981).

This experiment was conducted to test the hypothesis that high ambient temperatures before oestrus disrupt the normal increase in oestradiol. The resultant decrease in oestradiol concentration mayshorten oestrous length and decrease pregnancy rate.

MATERIALS AND METHODS

Twenty Large White X Landrace gilts of similar age(196±14d),bodyweight (102±4Kg)and sexual maturity(first oestrus) were fitted with indwelling venous catheters.

Gilts were allocated at random into a control group (n=6)and a treatment group(n=14). The treatment group were introduced to the hot room(32°C for 7h and 38°C for 17h,at 55%RH with 12h light and 12h dark)on d17 of the third oestrous cycle. On d22 they were removed from the hot room and placed in the control room which was maintained at 20°C. All animals received 2.0Kg/d of a dry sow ration which contained 18.2% crude protein 13.4MJ of digestible energy/Kg and a mineral and vitamin supplement. Feed intake and rectal temperature were recorded daily.

Blood samples were collected every 12h from d13 of the oestrous cycle, increasing to every 4 hours from d17 and continued until 48h after the first detection of oestrus. Samples were analysed for progesterone(P), oestradiol(E2) and luteinising hormone(LH).

Gilts were checked every 6 hours for oestrus beginning on d18. All gilts were mated at the first detection of oestrus and again 12 hours later. Ovarian activity and ovulation rate were measured by laparoscopic examination seven days after mating. Thirty days after mating all animals were slaughtered, ovaries sectioned and corpora lutea counted.

RESULTS

High temperatures did not affect the plasma concentration of E2, P or LH. In most gilts the decline in P associated with luteolysis was completed by d17.

Timing of the peak of E2 and the pre-ovulatory surge of LH was similar for all gilts. Maximum E2 (DME) occured on 19.2±0.5d in the control gilts and 19.6±0.4d in the treated gilts.

High' temperatures extended the interval between DME and the onset of. oestrus(24.6±2.7h vs 14.8±4h,$P \leq 0.05$). (Fig. 1). Large intervals between DME and the onset of oestrus were associated with shorter periods‘ of oestrus($r = -0.63, P \leq 0.01$) .

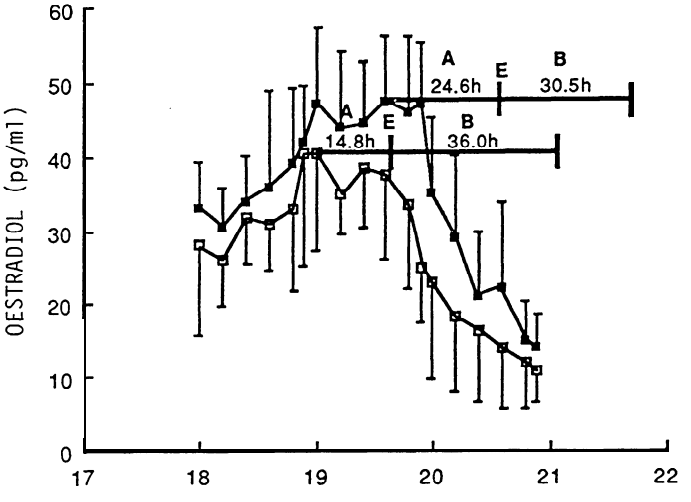

Fig. 1 Mean plasma concentrations of E2 in heated (■) and control gilts (□). A indicates the time (h) between maximum E2 (DME) and onset of oestrus (E) and B indicates the duration of oestrus.

The reproductive performance of the gilts is summarised in Table 1.

Table 1 The effect of high ambient temperatures on reproductive performance in the gilt (mean and standard error)

	Heated	Control
Number of animals	14	6
Duration of oestrus (h)	30.5±5.0	36.0±3.4
Ovulation rate	12.6 0.7	13.1 0.8
Length of oestrous cycle (d)	20.5 0.4	19.8 0.4
Pregnancy rate at 30 Days (%)	42.2	71.2
Number live embryos at 30 Days	7.8 1.2[a]	10.5 0.6[b]
Embryo mortality (%) *	42.0 14.1[a]	14.6 4.0[b]

a, values within rows followed by different superscript differ significantly ($P \leq 0.05$)
value does include non-pregnant animals, assuming all foetuses lost.

High temperatures had no significant effect on ovulation rate, oestrous cycle length, onset of oestrus or average length of oestrus. Two gilts in the treatment group did not exhibit oestrus. By 30 days after mating pregnancy rate decreased 30% in the heated animals. Embryo mortality was higher ($P \leq 0.05$) in the treatment gilts compared to the control gilts and the number of live embryos per litter was decreased ($P \leq 0.01$).

Increased rectal temperatures were associated with decreased lengths of oestrus ($r = -0.57, P \leq 0.02$). In gilts maintained at high temperatures rectal temperature increased 1.4°C($P \leq 0.01$) and feed intake decreased 0.8Kg/d($P \leq 0.001$)

DISCUSSION

Exposing gilts to hot conditions before oestrus does not interfere with the increase or basal concentration of E2. However, the interval between DME and the onset of oestrus was extended by high ambient temperatures. High temperatures appeared to block the stimulatory cue from increased concentrations of oestradiol for oestrous behaviour. A delayed onset of oestrus in relation to the peak of oestradiol was associated with a shorter length of oestrus.

For the normal expression of oestrous behaviour, declining concentrations of P must be followed by increasing concentrations of E2. Neither P nor E2 concentrations were directly affected by high temperatures after d17. Consequently, the effect of heating at oestrus may act directly on the neural centres responsible for behaviour, given the close association between thermoregulation and other biological processes in the hypothalamus.

Extending the interval between the pre-oestrous rise of oestradiol or the pre-ovulatory surge of LH and the onset of oestrus may adversely affect pregnancy rate and embryo survival. Abnormally long intervals disrupt the timing of insemination for maximum conception and optimum litter size (Claus and Weiler 1985). Where oestrus is delayed, insemination can occur during a period of rising P and may result in an increased incidence of polyspermy (Hughes and Varley 1980). When polyspermic fertilisation occurs embryo survival beyond early cleavage stages is remote and implantation unlikely.

During the oestrous cycle in the gilt there appears to be a differential sensitivity to heat stress. For example, there is a critical period around oestrus where high temperatures can completely inhibit the expression of oestrous behaviour, reduce the duration of the oestrous period and subsequently decrease pregnancy rate and embryo survival.

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