RESEARCH COMMUNICATION

Seasonal infertility in Kenyan pig breeding units

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ABSTRACT

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Reproductive performance of 12 Kenyan pig breeding units (56–299 sows per unit) of similar feeding, genetics and health status were evaluated from October 2003 to October 2004 during hot and cooler periods.

Sows during cooler months of the year (April to October, average temperature between 08:00 and 17:00: 25.2 $\pm$ 2.2 °C) had shorter ($P < 0.01$) weaning to service intervals (7.9 $\pm$ 2.2 days vs 12.7 $\pm$ 2.7 days, respectively), less ($P < 0.01$) regular returns to service (5.7 $\pm$ 1.9 % vs 9.9 $\pm$ 1.9 %, respectively), higher ($P < 0.01$) farrowing rates (80.1 $\pm$ 4.4 % vs 70.8 $\pm$ 3.8 %, respectively), and larger born (10.0 $\pm$ 1.1 vs 9.1 $\pm$ 1.7, $P < 0.05$) and weaned litter sizes (9.2 $\pm$ 1.2 vs 8.0 $\pm$ 1.3, $P < 0.05$) compared with the time periods of high ambient temperature (November to March, between 08:00 and 17:00: 37.2 $\pm$ 3.3 °C).

It was concluded that a high ambient temperature is a risk factor for reproductive performance in pig breeding units.

Keywords: Infertility, pigs, reproduction, season

INTRODUCTION

Seasonal infertility in domestic pigs has been recognized for many years in a number of countries, including Australia (Love 1981), USA (Hurtgen & Leman 1980; Britt, Szarek & Levis 1983), UK (Kornegay & Thomas 1983; Peters & Pitt 2003) and Hungary (Bilkei 1995). The severity varied between countries but, in general, the hotter countries experienced more severe effects.

High ambient temperatures can potentially have multiple influences on the sow (Britt *et al.* 1983). The term "seasonal infertility" includes prolonged weaning to oestrus intervals, increased number of abortions and stillbirths, reduced farrowing rates, and smaller born and weaned litter sizes (Bilkei 1995). Conception losses are the highest when sows are heat-stressed around the time of conception and nidation, and are manifested as regular returns to oestrus if all the embryos are killed, or to smaller litter sizes if embryonic mortality is limited (Edwards, Omtvedt, Turman & Stephens 1968; Bray, Sharpe & Basset 1994). Elevated ambient temperature has a similar detrimental effect on the boar, resulting in a decrease of both the motility and quantity of sperm and an increase in the proportion of abnormal sperm cells (Wetteman, Wells & Johnson 1979), which negatively influences fertility. Lower parity sows suffer seasonal delay in post-weaning return to oestrus than higher parity sows (Bilkei 1995).

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Some studies have demonstrated that elevated temperatures significantly decrease ovulation rate (Tegue, Roller & Grifo 1968; Bilkei 1995), while other studies revealed no such effect (Tomkins, Heidenreich & Stob 1967; Edwards *et al*. 1968). Tomkins *et al.* (1967), and Bilkei (1995) observed increased embryonic mortality when sows were exposed to high ambient temperature within 3 weeks post mating, but found no effect of high temperature on the litter during middle and late pregnancy.

Due to different evaluation periods, feeding, housing, management, climatic and genetic differences, it is notoriously difficult and even controversial to compare published reproductive data on seasonally related reproductive problems from different authors and continents in different seasons (Wrathall 1982; Bilkei 1995).

This study compares the seasonal reproductive performance of sows in the same geographic area, with similar feeding, management, vaccination programme and genetics, but with highly different ambient temperatures during different times of the year.

MATERIALS AND METHODS

In this study the seasonal infertility and reproductive performance of sows in Kenya were compared. Twelve pig breeding units (56–299 sows per herd) of similar feeding, genetics and health status was evaluated from October 2003 to October 2004. The sows in all units were F1 or F2 genetic lines of Landrace x Large White, mated to Duroc or Landrace boars. The units received medical and management advice from the same veterinary consulting group. The sows in every unit were vaccinated against parvovirus infection, erysipelas, leptospirosis, *Clostridium perfringens* C*,* and *Escherichia coli*.

The sows were mated at their first postweaning oestrus, and were moved after positive pregnancy diagnosis into individual crates. On the 110th day of pregnancy they were moved into farrowing crates in which they have spend their whole lactation period of 4 weeks (28.1 $\pm$ 2.4 days).

The herds had similar pressure by pathogens in that they were subclinically infected with *Actinobacillus pleuropneumoniae*, toxin producing *Pasteurella multocida* and *Mycoplasma hyopneumoniae*. In these herds enterotoxigenic *Escherichia coli* (ETEC, presenting pilus types: F4, F5, F41, 987P, F18, respectively) and verotoxigenic *E. coli* (VETEC) having pilus F18, heat-labile toxin (LT) and/or heat-stable toxins (STa, STb) were repeatedly found by ''Fimbrex kit'' (Weybridge UK) or by PCR technique in weaned pigs that died.

The sows were fed similarly (Table 1 [Edwards 1994]):

- During gestation the feed was restricted to 24–28 megajoul (MJ) digestive energy (DE) per day, depending on age and body condition.
- During lactation and from weaning to artificial insemination (AI) the feed was offered ad libitum.
- Higher than usual lysine concentrations during lactation (1.2 %) and during “flushing” from weaning to AI (1.4 %) was part of the reproductive management of these units.

The sows were identified according to the year of birth by placing identical plastic ear tags of different colour into each ear in case one tag was lost. The reproductive management (postweaning “flushing”, double mating, ultrasonic pregnancy diagnosis, vaccinations, mange and worm control, heat monitoring, rodent control) was identical in all units.

The sows were evaluated in two groups. The groups were defined by the time of their first oestrus post weaning being during a time period between April to October (average temperature between 08:00 and 17:00 was 25.2 $\pm$ 2.2 °C for Group 1) and during November to March (average temperature between 08:00 and 17:00 was 37.2 $\pm$ 3.3 °C for Group 2).

TABLE 1 Diet composition for breeding sows in different production periods. No antibiotics were added

Production period	MJ DE per kg[a]	Crude protein	Lysine	Phosphorus
		%	%	%
Gestation	12.2	12.5	0.65	0.4
Lactation	13	18	1.2	0.6
Wean—AI[b]	14.2	18	1.4	0.6

[a] MJ DE megajoul digestible energy
[b] AI artificial insemination

Reproductive records were collected from individual sow cards and regularly mailed to our office. Weaning to service intervals, regular returns to service (Days 18–25 and 37–44 post service), farrowing rates, born litter sizes and weaned litter sizes were evaluated.

Statistical analysis

Reproductive performance measures were described using descriptive statistics including frequency distributions. General linear model (GLM, Statistical Analytical System [SAS], 1988, Cary, North Carolina, USA) procedures were used to measure litter sizes. Variances of the means were compared by F-ratio testing and proportional data were compared using χ^2. The month of weaning was included in the statistical model to investigate the effect of season. The statistical model included covariates for lactation length, fixed effects of herd, group, herd by group interaction, parity and genetic type. The herd was included to account for the normal variation between herds due to facilities, nutrition and management differences. The group effect was fitted to account for variation due to climate and weather. A herd-by-group interaction was fitted to remove variation due to the interaction of each specific herd with season or weather. In addition, a parity effect was included to account for variation due to differing maturity level of sows, and sow genetics effect (F1 or F2) was fitted to remove variation due to the maternal heterosis. Differences in age at weaning were measured by the predicted difference statement (PDIFF) (SAS 1988).

RESULTS

Sows in the group of the colder months of the year had shorter (P<0.01) weaning to service intervals (7.9±2.2 days vs 12.7±2.7 days, respectively), less (P<0.01) regular returns to service (5.7±1.9% vs 9.9±1.9%, respectively), higher (P<0.01) farrowing rates (80.1±4.4% vs 70.8±3.8%, respectively), and larger born (10.0±1.1 vs 9.1±1.7, P<0.05) and weaned litter sizes (9.2±1.2 vs 8.0±1.3, P<0.05) compared with the period of high ambient temperature (Fig. 1).

DISCUSSION

The present results show significant differences in seasonal infertility between hot and cooler ambient temperature periods. Owing to the fact that production determinants such as genetics, nutritional, climatic, managerial, health, geographic area and vaccination were nearly identical, and the main difference was the ambient temperature, it is considered that this must have been the major cause for the different seasonal production levels in these units.

The exposure of females to high ambient temperatures (>35 °C) within 3 weeks of mating is associated with decreased conception rates (Bilkei 1995). It has been stated that the inability of a sow to acclimatize to temperature stress is manifested as a return to oestrus if all the litter is lost, or as a too small litter size if embryonic mortality is limited (Edwards *et al.* 1968; Bray *et al.* 1994). A decrease in farrowing rate is one of the most consistent effects of seasonal infertility reported in the literature (Hurtgen & Leman 1980; Love 1981; MLC 1993; Bray *et al.* 1994; Xue, Dial, Marsh & Davies 1994; Bilkei 1995; MLC 1997; Peters & Pitt 2003) and is often manifested by return to service. Consistent with the present study, Peters & Pitt (2003) found that sows served during hot times of the year showed a significantly higher regular return rate than during the colder months of the year.

Peters & Pitt (2003) examined 70 000 breeding records collected in East Anglia over a 6-year period in order to determine if seasonal patterns existed. Consistent with the results of the present study, they found that there was a highly significant correlation between the number of live piglets born per litter and ambient temperature. In contrast to the present results, however, they found no significant seasonal effects on weaning to oestrus intervals between

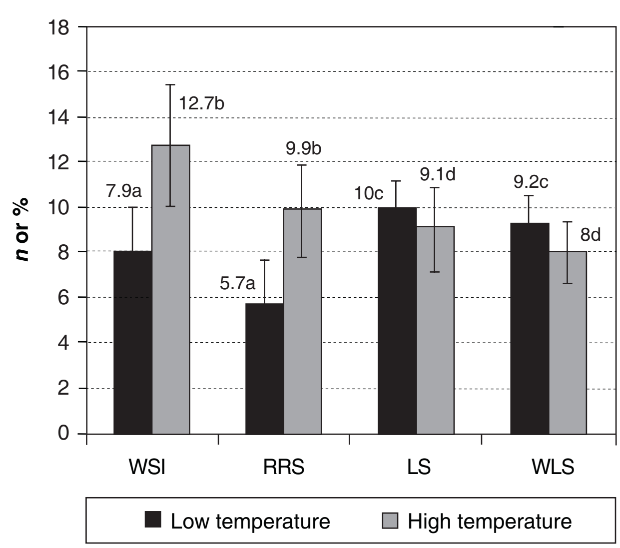

FIG. 1 The effects of season on the sows reproductive performance in Kenyan pig breeding units

sows whose piglets were weaned during hot weather periods.

In the present study the seasonal decrease in litter size is consistent with that reported in a number of studies (Xue *et al.* 1994; Bilkei 1995; Karg & Bilkei 2002; Peters & Pitt 2003), but contrasts that of an earlier report (Love 1981). The unfavourable working conditions during the hot weather periods might have influenced the labourers' morale, resulting in less intensive care (Bilkei 1995).

In addition, genetic patterns might have influenced the present results. The European wild pig (*Sus scrofus*) has strong seasonal reproductive patterns. Its mating activity peaks in late autumn to early winter with the birth of litters in spring and, although the litters are weaned in summer, mating ceases between June and September in the northern hemisphere. It seems likely that the modern domestic pig retains such sensitivity to season (Bilkei 1995).

The mechanisms controlling seasonal breeding activity for sheep are well described. Seasonality in sheep is determined by the changing photoperiod, with decreasing day length in early autumn being the reason for onset of breeding activity. The effects of the changing photoperiod on gonadotropin secretion are mediated by changes in melatonin secretion from the pineal gland. While there is evidence that changes in gonadotropin production in pigs are similar to this model (Britt *et al.* 1983), there are no reliable data on melatonin production in pigs.

Both photoperiod and ambient temperature change with the season and influence weaning-to-service intervals through direct effects on the hypothalmo-hypophyseal-ovarian axis (Britt *et al.* 1983). Kornegay & Thomas (1983) showed that sows maintained in cooled buildings after weaning returned to oestrus more quickly than those housed in naturally ventilated buildings. Preliminary studies with gonadotropins and GnRH suggest that hormonal treatments may potentially be an effective solution for preventing summer infertility (Bilkei 1995).

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