Reproductive performance of two sow lines under arid climatic conditions

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Abstract

Data (n = 4836) from a pig company in Namibia recorded over the period 2002 – 2007 were analysed to: (i) compare performance of two sow lines for the age at first farrowing (AFF), number born alive (NBA), life total born (LTB), weaning-to-conception interval (WCI), farrowing index (FI) and; (ii) estimate preweaning piglet mortality, non-productive sow days (NPSD) and replacement rates in two sow lines. The mating scheme involved a within herd grandparent programme where line A was the grandparent stock and line C the parent stock. NBA and WCI were analyzed as repeated measures traits. The least square means (d) for AFF were 363.3 ± 3.1 and 353.6 ± 2.4 for A and C, respectively. The NBA increased from first to fifth parity and then declined, but females served during the summer months of October – December (mean monthly temperature = 24.5 °C) had smaller litter sizes, compared to those in other seasons. Sows weaning piglets in the cold months of May – September (mean monthly temperature = 15.4 °C) had the shortest WCI. LTB increased by 10.9 ± .1 piglets per unit increase in parity at culling. The FI was 2.4 for both lines. The preweaning piglet mortality was 10.7% for A and 14% for C. The NPSD was 76 d in A and 52 d in C; replacement rate was 50.5% in A and 42.1% in C. Component traits of reproduction indicate depressed performance during the summer period. Management efforts should be directed at further mitigation of heat stress in breeding pigs and reduction of preweaning piglet mortality in line C.

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Introduction

Commercial pig production involves use of replacement females from within the herd or purchased females from multiplier herds. In Namibia, sow and boar lines imported from TOPIGS South Africa are used, but to the best of our knowledge have not been assessed for their reproductive performance under commercial production units in arid conditions, where diurnal fluctuations in temperature can be considerable, ranging from as low as 0 °C during winter to a maximum of 38 °C in summer. Moreover, to optimize performance in a given environment, in a grandparent programme requires comparison of productivity measures for animals at different levels of hierarchy.

Reproductive performance is a key trait in the profitability of a pig farm. The productivity of an individual sow depends on her reproductive performance, which is determined by a number of component traits like number born alive (NBA), weaning-to-conception interval (WCI) and conception rate (Stein *et al.*, 1990). The variation in these component traits is influenced by both genetic background of the sow (reviewed by Rothschild & Bidanel, 1998) and environmental factors like management and season. There is also significant interaction between genotype of the sow and environmental factors. In addition to optimal reproductive efficiency, longevity is also critical in commercial herds (Koketsu, 2007). Sow longevity has been assessed as the mean parity of culled females (Lucia *et al.*, 1999), parity of farrowed sows, average herd parity, female death rate, culling rate and lifetime pigs weaned per culled female (Stein *et al.*, 1990).

The objectives of this study were to: i) compare the performance of two sow lines based on age at first farrowing (AFF), NBA, life total born (LTB), WCI, farrowing index (FI); ii) estimate the preweaning piglet mortality, non-productive sow days (NPSD) and replacement rates in two sow lines.

Materials and Methods

Data (n = 4836) for the period 2002 – 2007 were obtained from a commercial pig farm in Namibia which utilizes two sow lines designated A and C and three boar lines B, D and E; animals in lines A, B, D, E were sourced from the TOPIGS nucleus herd in South Africa. The mating scheme at the pig farm involved a

within herd grandparent programme, where purchased line A females were mated to line B boars to generate F_1 females (line C), which were then mated to line D or E boars generating slaughter progeny.

In the analysis, parities 10 onwards were pooled into one class because of a limited number of observations; and season was classified as October – December (hot and dry), January – March (hot and wet), April – June (warm and dry) and July – September (cold and dry). Monthly averages for rainfall (mm), temperature (°C) and relative humidity (%) collected from a nearby weather station for the period 1987 – 2003 for the four seasons above were: (6.0, 24.5, 37.0); (40.5, 26.3, 46.5); (6.9, 17.2, 48.1); and (8, 15.5, 42.6), respectively. NBA, WCI and farrowing intervals (FRI) were analyzed as repeated measures traits using Proc Mixed (SAS, 1996); AFF and LTB were analysed using Proc GLM (SAS, 1996). The farrowing index was obtained as 365 divided by the farrowing interval.

The annual replacement rate was computed as the reciprocal of the length of productive life. The length of productive life of a sow was estimated as the difference between the date of culling and date at first farrowing, divided by 365.25 (Tarres *et al.*, 2004); only sows which had both a culling and first farrowing date were considered.

Life total born (LTB) was defined as the sum of the number of piglets born alive over a sow's lifetime and was obtained only on those sows with a culling date. Non-productive sow days (NPSD) were defined as the average number of days in the year in which sows were neither pregnant nor lactating; these include the period from weaning to conception and days lost when gestation was interrupted by abortion, death or culling (Wilson *et al.*, 1986). The NPSD was computed from number of litters per sow per year (LPSPY) and average weaning age (AWA) as follows:

NPSD = 365 – LPSPY (AWA +114)

Results and Discussion

Line, year and month of birth influenced (P <0.001) AFF (Table 1). The least square mean (d) was 363.3 ± 3.1 for line A and 353.6 ± 2.4 for line C. Birth season of the sow, year of service, parity, service season and service season x parity interaction influenced (P <0.05) NBA. Although NBA steadily rose, plateauing at the fourth to fifth parity across all seasons and then declining (Figure 1), matings during summer resulted in the smallest litter sizes. High summer temperatures result in lowered fertility in both sows and boars hence the reduced litter sizes. Tummaruk *et al.* (2001) found the same interactions and attributed them to differences in physiological response of primiparous compared to multiparous sows.

Parity, year of farrowing, farrowing season and month of weaning influenced (P <0.05) WCI (Table 1). The least square means declined from 6.8 ± .3 d in primiparous sows to 5.6 ± .3 d in third parity sows and then increased in latter parities, peaking at 8 ± .4 d in fifth parity sows. The WCI was lowest for sows weaning their piglets from May to July, which are typically the coldest months (Table 1) in a year in Namibia, with lower temperatures and non-negative influences on intake, hence permitting early postpartum recovery of sows and a quick return to oestrus. In their review, Prunier *et al.* (1996) concluded that oestrus after weaning is delayed in primiparous sows during summer which was attributed partly to the effect of the elevated temperatures on reduced appetite and undernutrition-derived inhibition of LH secretion. Barb *et al.* (1991) reported that chronic exposure to high ambient temperatures (>25 °C) delayed the occurrence of oestrus after weaning in primiparous females, but it had limited influence in second parity sows (Schoenherr *et al.*, 1989). Although modern production units such as on this farm have cooling facilities, it may be difficult to keep temperatures within the thermal neutral zone because of high power costs; indeed the best cooled pens on the farm were those housing recently weaned piglets so as to optimize intake and growth rate. To reduce stress, particularly in primiparous sows, other supplementary strategies like increasing energy content of the diet (e.g. by including oils and fats) and frequent wetting of floors should be adopted (Holness, 2005).

Birth year of sow and the parity at culling influenced (P <0.05) LTB. LTB increased by 10.9 ± .1 piglets per unit increase in parity at culling. Parity, year and month in which the previous farrowing took place influenced (P <0.001) FRI. The shortest intervals corresponded to farrowings in the winter months of July – September. The farrowing index for both lines was 2.4.

Estimated preweaning piglet mortality was 10.7% for A and 14% for C; higher mortality rates in parent compared to grand parent stock have been observed in the swine industry and are attributed to inadequate attention to preweaning survival traits in selection indices (2008, S. Nemaire, Pers. Comm.).

Table 1 Seasonal influence on least square means (± s.e.) for age at first farrowing (AFF), weaning-to-conception interval (WCI) and farrowing interval (FRI)

Month*	Mean Temperature (°C)	Number of sows**	AFF¶ (d)	WCI (d)	FRI (d)
January	27.3	482	$361.5^{c} \pm 3.2$ (139)	$7.5^{a} \pm .4$	$154.6^{a} \pm .8$
February	26.6	377	$353.3^{b} \pm 3.5$ (78)	$8.0^{a} \pm .5$	$153.7^{ac} \pm .8$
March	25.1	441	$341.3^{a} \pm 3.3$ (143)	$8.0^{a} \pm .5$	$153.1^{acd} \pm .8$
April	21.4	403	$359.5^{bc} \pm 3.4$ (144)	$7.5^{a} \pm .5$	$152.8^{acd} \pm .7$
May	17.3	468	$362.2^{c} \pm 3.4$ (139)	$4.8^{b} \pm .5$	$151.9^{bc} \pm .8$
June	13.1	364	$363.2^{c} \pm 6.2$ (18)	$4.9^{b} \pm .5$	$151.0^{b} \pm .7$
July	12.9	399	$376.6^{d} \pm 6.7$ (15)	$4.6^{b} \pm .5$	$149.7^{b} \pm .7$
August	14.9	338	$356.2^{bc} \pm 5.1$ (32)	$7.7^{a} \pm .5$	$147.9^{be} \pm .7$
September	18.8	399	$361.9^{bc} \pm 6.3$ (19)	$6.8^{a} \pm .5$	$148.7^{be} \pm .7$
October	22.3	380	$356.8^{bc} \pm 6.8$ (16)	$6.8^{a} \pm .5$	$149.3^{b} \pm .8$
November	24.6	355	$352.2^{bc} \pm 7.3$ (18)	$7.0^{a} \pm .5$	$151.3^{bd} \pm .7$
December	26.8	423	$356.5^{bc} \pm 5.6$ (37)	$7.4^{a} \pm .5$	$150.6^{b} \pm .6$

a, b, c, d, e Column means with different superscripts differ significantly (P <0.05).
* Month of birth for AFF; weaning month for WCI; farrowing month for FRI.
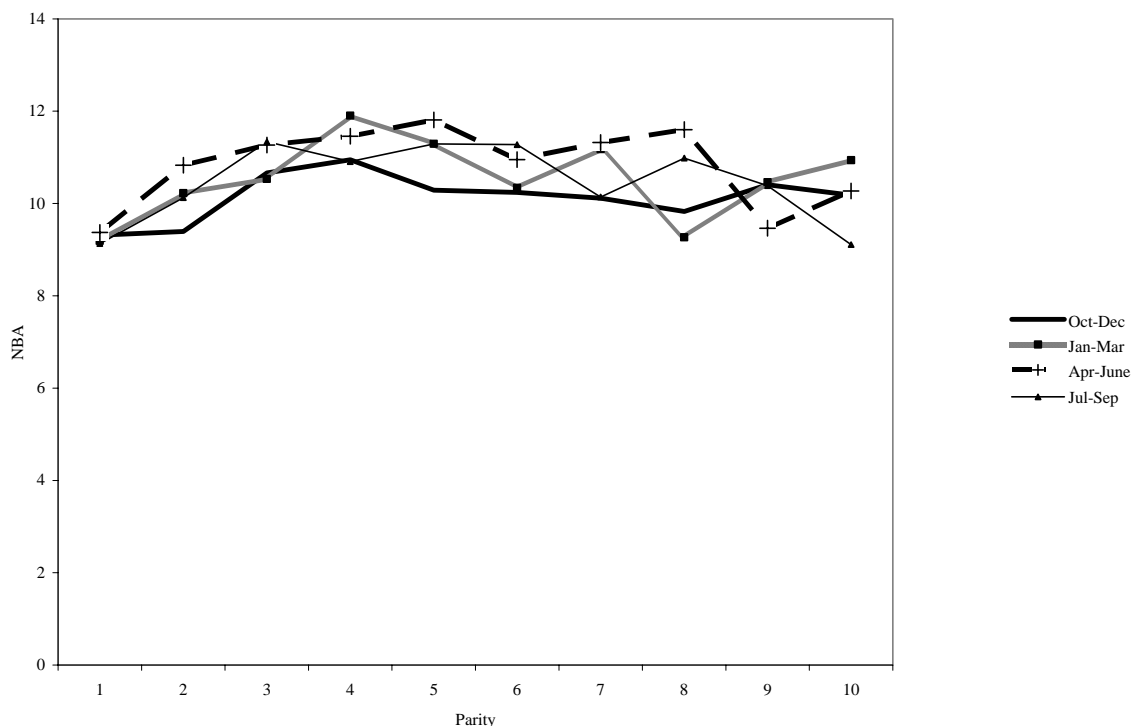** Number of sows is with respect to WCI and FRI. ¶ Number of sows in brackets.

Figure 1 NBA *versus* parity for sows serviced in different seasons.

The estimated NPSD was 78 d in line A and 54 d in line C. Koketsu *et al.* (2005) reported non-productive days that included information from both gilts and sows of 63.4 d in ordinary and 42.3 d in high performing herds in Japan. The higher NPSD in line A is reflected in the higher replacement rate in that line compared to line C. Stein *et al.* (1990) reported a negative correlation between herd age and wasted days and advised that productivity could be improved by reducing the proportion of gilts, which necessitated a

reduction in the culling rate. Other measures that can be used to reduce NPSD include increasing the percentage of multiple matings during oestrus (Xue *et al.,* 1998).

The replacement rate was 50.3% in line A and 41.8% in line C; in the US commercial pig herds, replacement rate was approximately 50% and the average herd parity of culled sows was 3.1 to 3.7 parities (Stalder *et al*., 2003). The mean parity of culled sows was 5.1 and 6.3 for lines A and C, respectively, but the analysis did not account for censoring of records. Using a dynamic simulation model, Rodriguez-Zas *et al.* (2006) found that sow cost and salvage value were key economic considerations in determining optimum parity to replace sows. Although high performing herds implemented a strict culling policy (Koketsu, 2007) as reflected in the decline in proportion of re-serviced females and an increase in culling rates over time compared to low performing herds, the culling rate was 41.2%, which is similar to that in line C. Management practices that reduce infertility, deaths, abortions, lameness and sow deaths are called for to reduce the number of replacement gilts that a herd will need, particularly in line A which is externally sourced. In general, the obtained results for components of reproduction fit in well with the theoretical expectation of better performance of line C compared to A, due to higher heterosis levels.

Conclusion

All the assessed reproductive components suggest depressed performance during the summer months. To reduce heat stress, particular attention should be paid to altering feeding practices, management and cooling of pens for breeding animals particularly, gilts and primiparous sows during the summer months. Although line A constitutes a smaller part of the entire herd, improved management is called for to reduce wastage and hence replacement costs. This wastage is reflected in higher NPSD, poorer reproductive performance and lower age at culling. Herd productivity could be improved by lowering non-productive sow days by reducing the culling rate and increasing the percentage of multiple matings during oestrus; attention also needs to be paid to reduction of preweaning piglet mortality, particularly in line C.

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