Effect of boar genotype on reproductive performance of the local sows of Zimbabwe

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Abstract

The effect of boar genotype on the reproductive performance of local sows was investigated. Large White (LW) and local Mukota boars were mated to 20 sows over 3 parities and the performance of the sows and litters were compared up to weaning. Data on the gestation length, number of piglets born alive (NBA), the number of piglets born dead (NBD), number weaned and the sex ratio were recorded. The weights of the piglets were recorded within 16 hours of birth and also at weaning. No creep feeding of the piglets was done and weaning was done at 35 days of age.

There were no differences in the number of services per conception and the NBD. Litter size at birth, NBA and the number of piglets that were weaned were higher in sows mated to LW boars than to indigenous boars.
These findings indicate that imported boars can be used under smallholder pig production systems as they complement traits of both the local and imported breeds.

*Key words: Crossbred pigs, local Mukota pigs, reproductive performance, Zimbabwe.*

**Introduction**

Smallholder pig production constitutes over 50% of the total pig population in Zimbabwe and the majority of the pigs used are the local genotypes (Central Statistical Office 2000). The local pigs, generally known as Mukota, are predominantly black and are much smaller than the imported genotypes, such as the Large White (LW). Large White pigs are the most common imported pigs in commercial pig production, due to their superior fertility and growth rates. Although the local Mukota pigs have slow growth rates, they are adapted to survive under harsh environmental conditions, which are experienced in smallholder farming areas. Keeping of local pigs that are adapted to the smallholder environments is appropriate for the farmers because they can be fed on fibrous feeds, such as maize cobs (Kanengoni et al 2002; Ndindana et al 2002). Local pigs have also been reported to reproduce under low planes of nutrition (Holness 1972). Use of local pigs also contributes to conservation of the local gene pool, at the same time promoting the utilisation of their valuable genes (Scherf 1990; Ly 2000). The lack of sufficient characterisation of the local genotypes, however, makes it difficult to use them in pig improvement schemes. Most of the research has been focussed on the imported genotypes, which, apparently, cannot be sustained under smallholder conditions. The high nutrient requirements and the need for intensive management systems for imported genotypes make them unsuitable for resource-poor rural farmers. It is widely believed that crossing local and imported genotypes improves fertility through exploiting heterosis (Lekule et al 1990; Pathiraja 1986). Mashatise (2002) has
observed that there are a significant number of smallholder farmers who have interest in keeping imported and crossbred pigs. It is, therefore, important to determine the effects of using imported boars, in comparison with local boars, on fertility when mated to local sows. More importantly, there is need to evaluate the survivability of the Mukota and crossbred piglets raised under smallholder farming conditions, particularly up to weaning, beyond which mortalities are negligible. A comparative study was, therefore, conducted to compare the effect of breed of boar on the reproductive performance of pure Mukota sows and their litters.

Materials and Methods

Study site

The trial was conducted at the University of Zimbabwe Farm, about 10 km to the north-west of Harare, the capital city of Zimbabwe. The area is located about 1300 metres above sea level and is situated at 18ºN and 30ºE. Annual rainfall averages 760mm. The trial was conducted between April 1999 and March 2000 over three parities.

Animals

Three purebred LW boars were bought from the Pig Industry Board situated about 20 km to the north east of Harare. It has the mandate for the central testing of pigs in Zimbabwe. The boars were selected on the basis of their growth rate and feed conversion ratio. They were about two years old at the start of the experiment. Four local boars were used in this trial. They were about four years old and were bought from Mutoko Communal Area, nearly 250 km to the north east of Harare. Twenty sows were used as the dam lines. Similar to the boars, all their phenotypic features resembled the pure local genotype. The averaged number of
teats was 12 (ranging from eight to 14). The breeding pigs were unrelated, and showed the typical characteristics of the local Mukota pig genotype (Holness 1972). One of the breeding sows was obtained from Mvuma (about 300 km to the south of Harare) and the remainder were bought from Mutoko. Mating was done in a way that avoided or reduced inbreeding.

**Housing and feeding management**

The management and feeding conditions of the herd were different from those in which the local genotype is commonly reared. This is largely because the local pigs have been kept at the farm not only to enable their characterisation but also its preservation. Boars and sows were housed separately, in multi-purpose pens. The boars were penned singly. The sows were kept three in a pen. All the pens had concrete floors and the size of each pen was about 9 m$^2$. The pens had roofs that extended the whole pen length and were well ventilated. Sow houses had no creep areas, farrowing crates and infrared lamps. All pens were cleaned daily.

All the dry sows were fed on a high fibre diet with the ingredient composition shown in Table 1. Boars were maintained on 2 kg/day of the same diet as for sows. Lactating sows were fed on 2 kg of commercial brood sow meal a day and an allowance of 0.5 kg for each piglet that it was nursing. No creep feeding of the piglets was practised. Feeding was done twice daily, at 06:30 and 15:00 hours. Drinking water was supplied to all the animals through low-pressure nipple drinkers.

<table>
<thead>
<tr>
<th>Ingredient composition</th>
<th>g/kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maize</td>
<td>559.5</td>
</tr>
<tr>
<td>Soyabean meal</td>
<td>160</td>
</tr>
</tbody>
</table>
Maize cobs 250
Mineral/vitamin premix 3.5
Monocalcium phosphate 12.0
Limestone 15.0

Chemical composition

Crude protein 160
Neutral detergent fibre 410
Metabolisable energy (MJ ME/kg) 9.6

Oestrus detection, mating and farrowing

Checking for signs of heat in sows was done daily. Homosexual behaviour, swollen vulva and the standing reflex were the major signs used in heat detection. One of the boars was allowed to stroll along the sow pens as an aid to heat detection and to stimulate ovulation. When a sow was detected to be on heat, it was removed from its pen and put in the boar’s pen for mating. Subsequent matings were allowed 12, 24 and 36 hours later to ensure successful mating. Heat detection was repeated 21 days later on the mated sows and sows that did not show signs of heat were presumed pregnant. Mating was occasionally aided. Seven days before the expected date of farrowing, each sow was put in its own pen and closely monitored. Grass bedding was provided in each pen. To mimic smallholder farming conditions, no infrared lamps were provided.

Data capture
Data from 432 piglets were collected over three parities. Date of mating and expected date of farrowing for each sow were recorded. Piglets were given an iron injection three to five days after farrowing. The number of piglets born, number born alive (NBA), number born dead (NBD), litter weights and the sex of the piglets were recorded for each breed. On the second day, eye-teeth of the piglets were removed and the piglets were ear-notched, weighed and recorded. Navels were dipped in iodine to prevent bacterial infection. After 35 days of age, the dam was separated from her progeny, and the piglets were weighed.

**Statistical analyses**

The effects of boar genotype on the number of services per conception, gestation length, birth weight, NBA, NBD and litter size at weaning were compared using the generalised linear model procedures of SAS (1996). The model used was:

\[ Y_{ijkl} = \mu + B_i + P_j + S_k + (B \times P)_{ij} + (B \times S)_{ik} + E_{ijkl}; \]

Where: \( Y_{ijkl} \) = response variable (litter size, birth weight, weaning weight)

\( \mu \) = overall mean response

\( B_i \) = fixed effect of genotype of boar

\( P_j \) = fixed effect of parity

\( S_k \) = fixed effect of sex of piglet

\( (B \times P)_{ij} \) = genotype × parity interaction

\( (B \times S)_{ik} \) = genotype × sex interaction

\( E_{ijkl} \) = residual error

Birth weight was incorporated as a covariate in the model for weaning weight.

The sex ratios of the piglets per genotype were compared using the \( \chi^2 \)-test using the PROC FREQ procedure of SAS (1996).

**Results**

**Colour of the piglets**
Piglets from the local pigs were predominantly black in colour, although about one percent of them had white and grey strips along the length of the body. The F₁ crosses were largely white, with black patches over the body, mainly on the ears, eye-lids, nose fore-head and the loin.

**Effect of genotype on the sex ratio of the piglets**

The relationship between genotype of the piglet and the sex ratio is shown in Table 2. There were a higher proportion (P<0.05) of males among the crossbred pigs than in the local genotype. Conversely, the Mukota boars produced proportionately more females (P<0.05) than their LW counterparts.

<table>
<thead>
<tr>
<th>Breed</th>
<th>N</th>
<th>Females</th>
<th>Males</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crossbreed</td>
<td>175</td>
<td>40.4</td>
<td>59.6</td>
<td>*</td>
</tr>
<tr>
<td>Mukota</td>
<td>257</td>
<td>56.6</td>
<td>43.4</td>
<td>*</td>
</tr>
</tbody>
</table>

* P<0.05

**Effects of genotype on reproductive performance**

No culling was done on the basis of repeat breeding. There was no effect of parity on the number of services per conception, litter size, NBA, NBD and the number of piglets that were weaned (P>0.05). Table 3 shows that the number of services per conception and NBD were similar (P>0.05) between the sows that were mated to the LW and those mated to the local Mukota boars. The gestation period, however, was longer (P<0.05) in the sows that were fertilised by LW boars, as compared to their local counterparts. Litter size at birth, NBA and the number of piglets that were weaned were higher in crossbred than in local pigs (P<0.05).
Table 3. Effect of genotype of boar mated with Mukota sows on reproductive parameters

<table>
<thead>
<tr>
<th>Trait</th>
<th>LW</th>
<th>Mukota</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>33</td>
<td>42</td>
<td></td>
</tr>
<tr>
<td>Services per conception</td>
<td>1.7 ± 0.36</td>
<td>1.7 ± 0.30</td>
<td>NS</td>
</tr>
<tr>
<td>Gestation length (days)</td>
<td>118 ± 1.14</td>
<td>113 ± 0.94</td>
<td>*</td>
</tr>
<tr>
<td>Total number born</td>
<td>9.4 ± 1.20</td>
<td>7.3 ± 0.93</td>
<td>*</td>
</tr>
<tr>
<td>Number born alive</td>
<td>8.9 ± 1.13</td>
<td>6.9 ± 0.87</td>
<td>*</td>
</tr>
<tr>
<td>Number born dead</td>
<td>0.3 ± 0.05</td>
<td>0.2 ± 0.93</td>
<td>NS</td>
</tr>
<tr>
<td>Number weaned</td>
<td>8.4 ± 1.22</td>
<td>6.6 ± 1.54</td>
<td>*</td>
</tr>
</tbody>
</table>

* P<0.05; NS = non significant (P>0.05)
Values are least square means ± standard error

Effect of genotype on piglet birth and weaning weight

The effect of parity on birth weight of the Mukota and LW × Mukota piglets is shown in Table 4. The LW × Mukota piglets had a higher birth weight than Mukota piglets (P<0.05). There was no significant difference (P>0.05) in birth weight between male and female piglets within each genotype. There was an increase in birth weight with parity in both genotypes (P<0.05). Piglet birth weight
had a significant effect on weaning weight (P<0.05). A higher birth weight led to a higher weaning weight. Crossbred piglets had higher weaning weights than Mukota piglets (P<0.05). Sex of piglets had no influence (P>0.05) on weaning weight. Weaning weight decreased with an increase in parity (P<0.05). The weaning weight was 5.86 and 4.17 kg for the crossbred and Mukota pigs, respectively.

**Table 4.** Effect of genotype and parity on birth weight and weaning weight in Mukota (n = 33) and LW × Mukota (n = 42) pigs

<table>
<thead>
<tr>
<th>Parity</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birth weight (kg)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mukota</td>
<td>0.89 ± 0.036</td>
<td>0.98 ± 0.035</td>
<td>1.03 ± 0.041</td>
<td>0.97&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>0.036&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.035&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.041&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>Crossbreed</td>
<td>1.23 ± 0.073</td>
<td>1.26 ± 0.053</td>
<td>1.33 ± 0.043</td>
<td>1.27&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>0.073</td>
<td>0.053</td>
<td>0.043</td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>1.06</td>
<td>1.12</td>
<td>1.18</td>
<td></td>
</tr>
</tbody>
</table>

| Weaning weight (kg) |      |      |      |      |
| Mukota | 5.21 ± 0.459 | 3.97 ± 0.494 | 3.33 ± 0.569 | 4.17<sup>a</sup> |
|         | 0.459 | 0.494 | 0.569 |      |
| Crossbreed | 6.61 ± 0.501 | 6.40 ± 0.430 | 4.56 ± 0.453 | 5.86<sup>b</sup> |
|         | 0.501 | 0.430 | 0.453 |      |
| Mean    | 5.91 | 5.19 | 3.95 |      |

<sup>a,b,c</sup> Mean values for each trait with different superscript letters, were different (P<0.05).

* Values are least square means ± standard error
Discussion

The predominantly black pigmentation of the local Mukota pigs implies that they do not suffer from sunburn as much as their crossbred counterparts. Since many communal areas in sub-Saharan Africa are situated in very hot environments, the high temperatures make it difficult to keep the imported pigs under extensive conditions. The colour patterns of the piglets also depict some form of incomplete dominance of the white colour of the imported genotype (Van Vleck et al 1987). The observation that the Mukota boars gave a higher proportion of females than their LW counterparts was surprising. It would have been expected that the proportion of males to females be 1:1 (Van Vleck et al 1987). Although it is not clear why the sex ratios were different, similar observations were reported for pigs that are indigenous to Nigeria (Adebambo 1986).

The gestation period observed in this study agrees with Holness (1972), who reported gestation lengths of 113 to 138 days for Mukota sows. The longer gestation periods observed in the sows carrying crossbred pigs, however, contradicts with Adebambo (1986), who argued that gestation length is negatively associated with the birth weight of the piglets. Our observations, however, agree with Singh et al (1990), who reported that local sows that had been mated to LW boars had longer gestation periods than those mated to local boars.

Litter size has low heritability (Rico et al 2000) and crossbreeding has been found to improve it (Adebambo 1986). The low litter size observed in the local sows mated to local boars agrees with Pandey et al (1996). These authors argued that low litter size in local sows might be due to a higher embryonic or foetal mortality resulting from small body size of the piglets. This could suggest that the higher litter size in sows mated to LW boars might be due to reduced embryonic death or foetal mortality in crossbred piglets due to increased prenatal weight gain. It is also possible that LW boars had better fertilization capacity
(Pandey et al 1996). The higher litter size and NBA in sows mated to LW boars indicates that crossbred pigs can be used in smallholder pig production systems to increase reproductive efficiency. The similarity in the NBD observed in this study could also indicate that pre-natal mortality, which is, largely, a maternal trait (Whittemore 1993) was similar for both breeds. The superior weaning weights of the crossbred pigs could also mean that the total litter weight at weaning was higher for the crossbred pigs. Such findings could support the argument that crossbred pigs can be utilised under smallholder farming systems.

Since all the dams were of the local Mukota genotype, any differences that were detected were attributed to the breed of the boar. The higher weights of pigs born of LW sires at birth indicate the superiority of the imported blood on litter weight, as also reported by Pathiraja (1986). The white colour of the crossbred pigs, however, could put them at a disadvantage compared to the black local pigs, particularly when raised under extensive systems. The large birth weights of the crossbreds could also mean that crossbreeding should be exercised on fairly bigger indigenous sows, if problems of difficulty in farrowing are to be minimised (Gordon 1997). The problem of dystocia was, however, not found during this trial.

Piglet birth weight increases with crossbreeding (Dzama et al 1999). The average birth weight of the crossbred pigs was higher than for the Mukota. The average birth weight of LW pigs in Zimbabwe is 1.44 kg (Dzama et al 1999). Gilts produce piglets of low birth weights because they are still physiologically immature and hence have to partition nutrients between their own nutrient requirements and those of the foetuses.

Pigs were weaned at 35 days of age. Such a weaning age could also be used in smallholder areas in order to reduce the number of lost days of production. Most smallholder farmers wean their pigs naturally, i.e., after about 56 to 60 days (Scherf 1990). The higher weaning weights of the crossbred pigs were, however, not unexpected. The higher weaning weights for the crossbreds indicate the phenomenon of heterosis (Van Vleck et al 1987). More importantly, differences in
the weaning weights were detected when no creep feeding was used. Such observations indicate that crossbred pigs can be used under resource-poor smallholder farming systems. In addition, a number of reports (e.g. Chimonyo et al 2001; Kanengoni et al 2002) have shown that the crossbred pigs have enhanced capacities to digest and utilise fibrous diets. The other implication of these findings is that the Mukota sows can produce enough milk to support fast growing piglets. Thus the low weaning weights of the Mukota pigs cannot be attributed to inadequate supply of milk, but reflects their inherent characteristic of slow growth rates. The slow growing Mukota pigs can, therefore, be used where the farmers do not have the objective of attaining fast growth rates, such as in some rural areas, where the pigs are mainly kept to provide meat for household consumption. It is also possible that the high weaning weights of crossbred pigs could also have been a reflection of their higher birth weights (Whittemore 1993).

The number of piglets weaned at 35 days of age was positively correlated to the litter size and weight at birth. The heavier piglets of the crossbred were better able to compete for milk because they were thriftier and hence had higher chances of surviving up to weaning. The mean number of piglets weaned in the crossbreds, 6.9, was lower than 8.4 obtained in the imported LW and Landrace genotypes (Dzama et al 1999). This suggests that crossing LW and the Mukota does not increase litter size substantially. The higher weaning weight in the crossbred piglets was also attributed to the higher birth weight of the piglets. Heavier piglets at birth had significantly higher weaning weights, which was expected because piglet birth weight is genetically highly correlated to other subsequent weight traits. Piglets of higher birth weights consume more milk per suckle than their lighter littermates and this could be the major reason why heavier piglets outgain lighter ones (Dzama et al 1999). The low weaning weights could also have been due to poor milk production qualities of the Mukota pigs that were used as dam lines. Higher birth weights and
weaning weights imply that the chances of survival of the piglets to maturity are enhanced.

Conclusions

Although the sample size used in this study was relatively small, it has highlighted the role and importance of crossbreeding in the reproductive performance of local pigs. The chances of survival to weaning age were higher in the crossbred piglets than in the Mukota piglets. The reproductive capacity of the Mukota sows was improved by using LW pigs as sire lines. There is, therefore, a need to design appropriate crossbreeding programmes and strategies that do not lead to the erosion of the local genotypes. The performance of the F$_2$ generation, reciprocal crosses and the genetic parameters from the different lines also need investigation.

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