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EFFECT OF PARITY ON THE REPRODUCTIVE PERFORMANCE OF NIGERIA INDIGENOUS SOWS AND THEIR PROGENY GROWTH PERFORMANCE DURING THE RAINY SEASON

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Abstract:

The effects of parity of dam on the reproductive performance of Nigeria Indigenous (NI) sows and progeny growth performance in a commercial breeding farm in Enugu state, Nigeria was investigated in this study. One hundred (100) apparently healthy third trimester pregnant NI sows were randomly assigned to four (4) treatment groups in a completely randomized design (CRD) of twenty five (25) sows per group according to their reproductive parities as groups I, II, III and IV representing the first (P1), second (P2), third (P3) and fourth (P4) parities respectively. The mean litter size (LS) of P1 piglets (6.00±0.71 Head) was significantly ($P < 0.05$) lower when compared to the mean of P4 (8.50±0.65 Head) but showed no significant ($P > 0.05$) difference when compared to P2 (6.75±0.75 Head) and P3 (7.75±0.75 Head). The mean male LS was highest at P3 and lowest at P1 while there was a progressive increase in the mean female LS reaching top level at P4. The mean birth weight (BW) and mean male BW increased progressively from P1, reaching peak at P3 and then declined at P4 while the mean female BW reached peak at P2, declined at P3 and then increased at P4. The mean weaning weight (WW) and mean male WW were highest at P3 and lowest at P4 while the mean female WW was also highest at P3 (4.18±0.33 kg) but lowest at P1 (3.78±0.27 kg). The mean number of piglets weaned of P1 (5.25±0.63 Head) was significantly ($P < 0.05$) lower than P3 (7.00±0.41 Head), P4 (7.25±0.25 Head) but showed no significant ($P > 0.05$) reduction when compared to P2 (5.50±0.65 Head). The mean number of males weaned was highest at P3 and lowest at P2 which is similar to P4 while the mean number of females weaned was highest at P4 and lowest at P1. It can be concluded from this work that the reproductive performance of NI sows and its progeny growth performance were best at fourth parity (P4) of reproduction and the highest return on investment by swine breeders may be expected at this level of reproduction.

Keywords: Reproduction, Performance, Pigs, Nigeria

Introduction

The continual rise in global food demand coupled with the push for higher quality protein worldwide presents challenges as well as opportunities for livestock producers and food industries

(Henchion *et al.*, 2014; Keating *et al.*, 2014). Representing 37% of total meat consumption worldwide, pork serves as one of the primary sources of animal protein (FAO, 2014). Considering the 34% growth in population expected to occur by the year 2050, our food supply is pressured to increase to meet the predicted demand (United Nations, 2013). With this call for greater food production, swine producers must continually strive for improved productivity. Maximizing sow lifetime productivity is critical for the sustainability and profitability of a sow herd (Stalder *et al.*, 2004); with the objective of having females produce multiple parities while providing adequate nourishment to wean a maximum number of full value pigs with as few non-productive days as possible. When insufficient litters or an inadequate number of full value pigs are weaned per litter, the opportunity for a sow to offset the initial investment and contribute profit to an enterprise is reduced. Based on a variety of reasons, different culling strategies may be utilized on a sow farm to ensure the most productive and genetically current females remain in production. With young females, producers experience increased costs associated with initial purchasing, development and acclimation of new replacement gilts (Stalder *et al.*, 2003), as well as increased opportunity cost due to decreased productivity through the first parity (Lucia *et al.*, 1999). In today's industry, reproductive failure accounts for approximately 35% of females culled from breeding herd and are the primary reason for female removal (Koketsu *et al.*, 1997; Mote *et al.*, 2009). Selecting for reproductive performance, however, is difficult due to the complexity of traits associated with reproductive success and the large influence environmental factors may have (Serenius and Stalder, 2006).

Pig appears to be superior in its reproductive ability when compared to other domestic animal species. This ability is based on the extremely high rate of fertility. Over the past three decades, efficient breeding and management has almost doubled the litter size of the domestic sow breeds (Oliviero, 2019). During the same period, the duration of farrowing (from the first to the last foetus expulsed) has extended remarkably and is now four to five times longer than in the early 1990s (Oliviero *et al.*, 2019). This may have resulted in an increase in farrowing complications such as postpartum dysgalactia syndrome (PDS) (Kaiser *et al.*, 2018a,b), retention of placenta and reduction in subsequent fertility (Bjorkman *et al.*, 2017c; 2018c). Along with this development,

we have seen a constant downward trend in the birth weight of the piglets and a similar trend in colostrum intake, which are connected and are the most important risk factors for piglet mortality (Oliviero *et al.*, 2019). In other hand, there has been a tremendous increase in efficiency of production, which has considerably improved farming economy and related industry in a highly positive way. However, this may have come, at least to some extent, at the expense of animal health and welfare. A large litter may be challenging for the metabolism of the sow such that there may be difficulties in resumption of ovarian cyclicity after weaning, especially in young sows in certain breeds (Oliviero *et al.*, 2013; Peltoniemi *et al.*, 2016; Bjorkman *et al.*, 2018c; Oliviero *et al.*, 2019). Therefore, there appear to be major challenges associated with increasing litter sizes that are evident at farrowing, lactation and after weaning, which are periods when the foundations of the subsequent pregnancy are laid (Algers and Uvnas-Moberg, 2007; Martineau *et al.*, 2012).

To ensure improved efficiency in pig production, growth and reproductive traits are important economic traits which need much attention. According to Patterson *et al.* (2010), sows are capable of raising an average of 30–40 piglets annually, hence the need to study the reproductive performance of sows under different environments. Again, the reproductive performance of breeding sows, according to Rekwot *et al.* (2001), could influence the efficiency of swine production, with high reproductive performance being considered to be of economic significance to the pig industry. Litter size at birth and weaning and birth weight are among the primary parameters used to measure the reproductive performance of female pigs (Yilma, 2017). These important reproductive traits could be influenced by parity, lactation length and nutrition (Clark *et al.*, 1988; Dewey *et al.*, 1992; Koketsu and Dial, 1997; Xue *et al.*, 1997; Koketsu *et al.*, 1999; Tummaruk *et al.*, 2000; Bloemhof *et al.*, 2008). It is therefore important to perform a detailed analysis on how these factors could impact on performance. Reproductive performance (litter size) is supposed to increase as parity increases, reaching the highest levels from parity 3 to 5 (Koketsu *et al.*, 1999; Hughes and Varley, 2003; Hoving *et al.*, 2011). Parity order is associated with physiology, primarily with growth of the organism, and in particular with the development of the reproductive system. Lengthening the production life of sows should be an

important foundation of production because from the 3rd parity sows tend to generate financial profitability in terms of their exploitation (Engblom *et al.*, 2007). Takai and Koketsu (2008) observed that with repeated insemination of sows, higher numbers of piglets were born only in the 1st and 2nd parity, but not in subsequent ones. Milligan *et al.* (2002) indicated that parity influences birth weight and that sows in their first parity have lower birth weight than sows in other parities. Damgaard *et al.* (2003) also reported that high litter size produces reduced birth weight. In pig reproduction, weaning number and weight are important parameters. Birth weight and litter size affect weaning number and weight. With increase in birth weight, there is tendency for high weaning number (Quiniou *et al.*, 2002; Gondret *et al.*, 2005). The identification of the factors affecting reproductive performance in sow is necessary to adequate the operation, techniques and technologies of production systems. Furthermore, knowledge of the indicators of productivity is important as it helps to make better decisions, which means a better return on investment in swine production systems. Besides the foregoing, when the best sows are selected early in life, a greater gain in productivity is expected, because highly heritable traits retain that superiority over their productive lifetime. However, there is paucity of information on the reproductive performance of NI pigs in this country. Therefore this current study was carried out to assess the effect of dam's parity on the reproductive performance of NI sows and their progenies.

Materials and Methods

Experimental Location: This experiment was carried out on sows obtained from Captain commercial breeding pig farms located in Amorji Nike, Enugu East LGA, Enugu State, Nigeria. One hundred (100) apparently healthy NI sows were used for this study. One hundred (100) apparently healthy third trimester pregnant sows (NI) were randomly selected and assigned to four (4) treatment groups in a completely randomized design (CRD) of twenty five (25) sows per group according to their reproductive parities as groups I, II, III and IV representing the first (P1), second (P2), third (P3) and fourth (P4) parities respectively. This study lasted for 2 years. Sows were kept in separate pens from third trimester of pregnancy until farrowing and were maintained in these separate pens throughout lactation with their newborn piglets until weaning at 28 days

postpartum. Sows were fed twice daily while the piglets received udder milk from the lactating sows until the end of lactation. Sows and piglets were provided with clean fresh water *ad libitum* throughout the period of the study. Piglets were identified with tag letters and weighed not later than 12 hours after birth. Two hundred milligram (200 mg) dose of iron dextran was given to the piglets via intramuscular injection 1-7 days postpartum to prevent piglet anaemia (Svoboda and Drabek, 2005). Litter size and the number of piglets weaned were counted manually (heads) while birth and weaning weights (kgs) were obtained using electronic digital scales. Sampling was done between 8.00 hours and 10.00 hours for each day of sample collection.

Statistical Analysis

The data collected were subjected to One Way Analysis of Variance (ANOVA) using SPSS statistical package (version 20.0). Variations in means were separated using Duncan's New Multiple Range Test (Steel and Torrie, 1980). Probability values < 0.05 were considered significant.

Results

The mean litter size (LS) of P1 was significantly ($P < 0.05$) lower when compared to P4 but showed no significant ($P > 0.05$) difference when compared to P2 and P3. The mean male LS was highest at P3 and lowest at P1 while there was a progressive increase in the mean female LS reaching top level at P4. The mean birth weight (BW) and mean male BW increased progressively from P1, reaching peak at P3 and then declined at P4 while the mean female BW reached peak at P2, declined at P3 and then increased at P4. The mean weaning weight (WW) and mean male WW were highest at P3 and lowest at P4 while the mean female WW was also highest at P3 but lowest at P1. The mean number of piglets weaned of P1 was significantly ($P < 0.05$) decreased compared to P3, P4 but showed no significant ($P > 0.05$) reduction when compared to P2. The mean number of males weaned was highest at P3 and lowest at P2 which is similar to P4 while the mean number of females weaned was highest at P4 and lowest at P1.

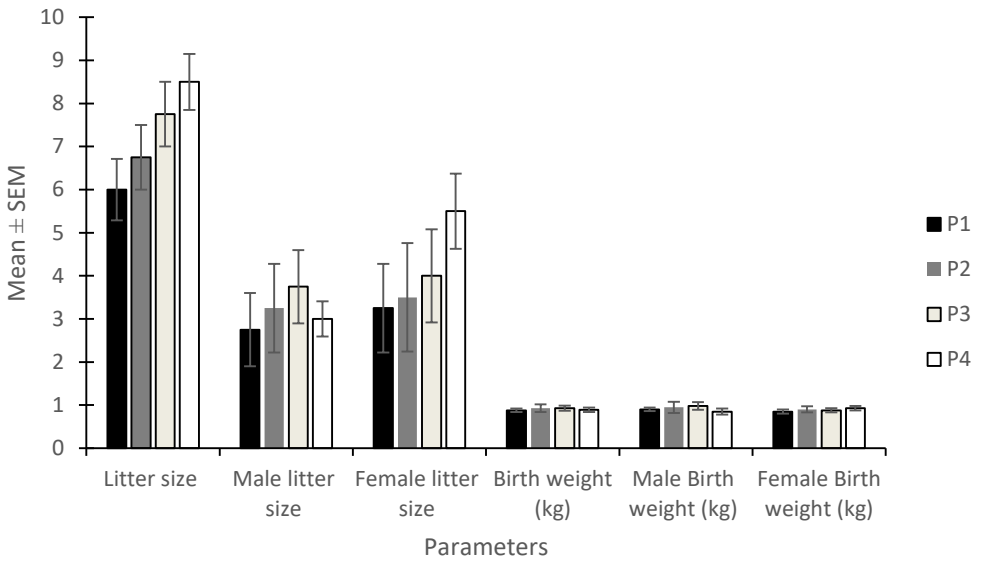

Figure 1: Mean litter performance of sows at different parities of reproduction

Table 1. Mean progeny growth performance at different parities of reproduction

Parameters	P1	P2	P3	P4
Weaning weight (WW) (kg)	3.88±0.23	4.10±0.23	4.33±0.29	3.86±0.36
Male weaning weight (MWW) (kg)	3.98±0.21	4.15±0.29	4.48±0.27	3.93±0.44
Female weaning weight (FWW) (kg)	3.78±0.27	4.05±0.21	4.18±0.33	3.80±0.29
No of pigs weaned (PW)	5.25±0.63[a]	5.50±0.65[ab]	7.00±0.41[bc]	7.25±0.25[c]
No of male pigs weaned (MPW	2.75±0.85	2.50±1.04	3.50±1.04	2.50±0.87
No of female pigs weaned (FPW)	2.50±1.19	3.00±1.41	3.50±0.87	4.75±0.85

[abc]Mean values in the same row with different superscripts are significantly different (P<0.05)

Discussion

The high variability of litter size and weaning number presents an opportunity for genetic improvement of these traits in Nigeria Indigenous breeds of sows. Tables 1 and Figure 1 showed the effect of parity on the reproductive performance of sows and their progeny growth performance respectively. Results obtained from this study showed

significant ($p < 0.05$) influence of parity on most of the reproductive parameters studied, apart from piglet birth and weaning weights. The result of this present study showed a significant influence ($p < 0.05$) of parity on litter size at birth with litter size reaching maximum at fourth parity. Earlier studies by Engblom *et al.* (2007), Hoving *et al.* (2011) and Knecht *et al.* (2015) showed significant influence of parity on reproductive traits, with performance increasing with increasing parity but declining after fourth parity and this trend was observed in this study. Other authors Scholman and Dijkhuizen (1989) and Faust *et al.* (1993) have advocated the use of sows for up to the 5th parity, especially sows with large number of litters should be used over a long period of time. This was because young gilts/sows were most vulnerable to various types of reproductive dysfunctions. Quesnel *et al.* (2008) also found that sows in their first and second parities showed the most homogeneous litters. This might be due to the lower number of piglets born and therefore the increased space for foetal development in the uterus. According to Tummaruk *et al.* (2010) and Suriyasomboon *et al.* (2006), an increased litter size with increasing parity might be due to more follicles released during ovulation and increased uterine capacity as the sows advance in age. There may be also a likelihood of a greater number of fertilized oocytes, resulting in higher number of piglets born at fourth parity seen in this present study. According to Lucia *et al.* (2002) and Van Dijk *et al.* (2005), although the sow's age and parity order affect the reproductive performance, the physiological mechanisms underlying these remains unknown. However our finding was in contrast to Takai and Koketsu (2008) who reported that the performance of sows was best at the first or second parity. Parity of the dam had shown non-significant ($p > 0.05$) effect on the birth weight of NI sows. The piglet's birth weight and weaning weight in this study were moderately higher in the first parity and increased thereafter. This was observed in earlier works by Lucia *et al.* (2002), Van Dijk *et al.* (2005), Engblom *et al.* (2007), Hoving *et al.* (2012) and Knecht *et al.* (2015) that sows in mid parities had higher piglet size and litter birth weight than those in their first and older parities. This could be due to the fact that very young sows are still physiologically immature and hence have to partition nutrients between their own growth requirements and those of the foetuses resulting in lower birth weights (Knecht *et al.*, 2015). In addition, uterine capacity may tend to limit the birth weights of piglets in

young first parity sows as was seen in this study. On the other hand, old sows tend to undergo a physiological deterioration and hence may not fully utilize their feed resources most efficiently in providing nutrition to the foetuses in-utero (Mungate *et al.*, 1999). The values obtained for litter size at birth (7.25) and at weaning (6.25) in this study were lower than the values of 7.30–9.40 (8.35) and 6.60–8.40 (7.50) litter size at birth and at weaning respectively (Ncube *et al.*, 2003), 10.20 and 8.00 litter size at birth and at weaning respectively (MoFA, 2012), 13.30 and 10.20 litter size at birth and at weaning respectively (Hagan and Etim, 2019). The results of the litter size at birth in this study was also lower than the values of 11.00–14.50 (12.75) litter size at birth reported by Knecht *et al.* (2015), Quesnel *et al.* (2008), Huang *et al.* (2003) and 13.92 litter size at birth (Jian *et al.*, 2018) in the temperate regions. The birth weight (0.90 kg) and weaning weight (4.04 kg) obtained in this current research work were lower than the values of 1.40 kg and 7.10 kg birth weight and weaning weight respectively (Hagan and Etim, 2019), 15.27 kg birth weight (Jian *et al.*, 2018). The Weaning weights of P1 piglets on day 21 are decreased compared to progeny derived from P2 or greater dams (Wilson and Johnson, 1980; Wood *et al.*, 1990; Culbertson *et al.*, 1997; Mahan, 1998) and this trend was observed in this study at day 28 postpartum. However, P4 progeny had larger piglet weights throughout lactation (Carney-Hinkle *et al.*, 2012) and this in contrast to our findings. This increase in growth performance at increasing parity may be due to the increased health performance of pigs. The differences in the LS at birth and weaning, birth and weaning weights in our findings compared to works by other authors may be as a result of the differences in the type of breed used for the works, climatic conditions, management (lactation length, plain of nutrition, medication, etc), number of sows or piglets/parities studied, the geographical location where the work was carried out, etc.

Conclusion

In conclusion, it is obvious that dam's parity influenced their performance and that of their progeny growth performance. These observed differences between dams parity could possibly affect the pig's health performance. Furthermore, the result of this

work showed that the reproductive performance of sows and their progeny growth performance were best at fourth (P4) parities of reproduction. The variations in progeny performance suggests that fourth parity sows (mid parity sows) provided their progeny with the necessary requirements needed for greater performance than the younger first, second or third parity sows. Therefore the highest return on investment by swine breeders should be expected at this level (P4) of reproduction. Furthermore, the result of this study is an indication that the NI sows used in this current study needs improvement to meet up with the recent global standard of reproductive performance.

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