IJAAAR 9 (1&2): 113-119, 2013 *International Journal of Applied Agricultural and Apicultural Research*

Evaluation of Some Litter Traits and Heritability Estimates of Nigerian Indigenous Pigs

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Abstract

Cumulative litter records of 1494 progeny from 257 litters produced by 30 sires and 87 sows of Nigerian indigenous pigs (NIP) from the Swine Unit of Obafemi Awolowo University Teaching and Research Farm for a period of fourteen years (1977-1990) were used for this study. Data were analysed with the use of SAS (1997), litter trait means and their heritability were estimated with the use of variance component analysis. Results showed that, mean birth weight and weaning weight were 0.93 ± 0.02 kg, and 4.03 ± 0.55 kg respectively, and the litter weights at birth and weaning were 5.44 ± 0.12 kg and 23.39 ± 0.55 kg. The mean litter sizes at birth and at weaning were 5.82 ± 0.11 and 5.53 ± 0.11 respectively. The heritability estimates were 0.00 ± 0.04 for litter size at weaning and 0.37 ± 0.12 for weaning weight. Others were 0.36 ± 0.09, 0.29 ± 0.07, 0.24 ± 0.07 and 0.27 ± 0.07 for birth weight, litter birth weight, litter size at birth and litter weaning weight respectively. It was concluded that individual selection may be appropriate for genetic improvement of birth weight and weaning weight while family selection may be effective for litter birth weight, litter size at birth and litter weaning weight for the NIP.

Key words: Litter traits, heritability estimates, Nigerian Indigenous Pigs, Sows

Introduction

Information on the reproductive performance and heritability estimates of livestock, pigs inclusive, are prerequisites for genetic improvement of animal genetic resources. The trend in pig breeding and production in Nigeria and other developing countries in the tropics depends on the use of exotic breeds which are mostly developed in temperate regions where they are designed for high level of management. Several studies (Adebambo, 1981; Adebambo and Onakade, 1983; Adebambo, 1986; Oseni, 2005 and Aladi *et al*., 2008) have reported efforts to improve the genetic potentials of the Nigerian indigenous pig (NIP) population through crossbreeding with different exotic breeds but these are not sustainable in South-western Nigeria.

Balogun (1981) reported that pigs possess several advantages over other livestock species. They have higher prolificacy than cattle, sheep and goat, and are capable of producing 4 to 5 litters with an average of seven piglets per litter in two years. They mate early and have shorter generation interval than red meat animals. Some authors have reported some advantages of NIP over the exotics. Ilori (1974) indicated that the NIP required a much lower dietary protein level for their production, while Fetuga *et al*. (1976) noted that the NIP had fewer losses from birth to weaning when kept under intensive system backed up with adequate nutrition. Adebambo and Dettmers (1979) reported a high degree of persistence in milk production in NIP compared with some exotic breeds which had higher peaks but lower persistence. Adebambo (1986) reported that the NIP litters were superior in pre-weaning viability, while Pathiraja and Oyedipe (1990) noted that the NIP are very precocious with ability to thrive on low-quality diets in stressful environments.

Pathiraja and Oyedipe (1990) observed a steady decline in the indigenous pig population and suggested conservation of the germplasm of this valuable genetic resource. Adeola and Omitogun (2012) noted that NIP are threatened with a loss of their genetic diversity through unsustainable farming practices in Nigeria. The same authors also noted that the genetic resources of this pig population must be conserved since it could form the basis for genetic improvement to produce improved breeds that are adapted to local conditions of the south-western Nigeria. Presently, the NIP are still unselected. They appear in all sorts of colours with long and pointed snouts. They are smaller animals in comparison to the exotic breeds and they possess erect ears.

Adequate information on litter performance and genetic parameter estimates of the NIP are essential in developing breeding programmes for this pig population. Improvement of the reproductive efficiency of this population will increase their population and thereby increase the range of alternatives of protein sources for the people that eat pork. Dalton (1987) listed heritability, selection differential and generation interval as the three factors that control genetic gain in a trait. The author classified heritability into three on a scale of 0.0 to 1.0. It is low or weak when the value ranges from 0.0 to 0.1, medium or intermediate if between 0.1 and 0.3 and high or strong when the value is above 0.3. Limited information is available on studies on NIP compared to several reports on the exotic breeds and their crosses in Nigeria. Therefore, this study was designed to evaluate litter performance at birth and at weaning of the NIP and obtain heritability estimates to determine selection methods for the genetic improvement of these reproductive traits.

Methodology

Data were collected on 1494 progeny records from 257 litter records produced by 30 sires and 87 sows on litter size and on body weight at birth and at weaning of NIP. The data were obtained from the record books of the NIP at the swine unit of the Obafemi Awolowo University Teaching and Research Farm, Ile-Ife for a period of fourteen years.

Herd management: The swine herds in the study study were maintained at an altitude of 240 m above sea level. Ile-Ife, located at $7^0 28^1$ N and $4^0 23^1$ E ecologically typifies the hot humid tropical forest. The management was intensive; animals were grouped into pens according to sex, age and physiological condition. Feeding was done twice daily with piglet and adult rations depending on their ages. Laboratory feed analysis was not available, although periodic feeding with cassava peels and pawpaw parts was reported. The piglets were creep-fed in addition to access to milk from their dams. Normal daily routine management included cleaning of the pens and removal of left-over feed and water. The control of ectoparasites was done by dipping adult animals in asuntol® solution and endoparasites was controlled by deworming the animals using piperazine® soluble powder at three month-intervals. The boars were introduced to the gilts at 7 to 9 months of age and sows that showed signs of heat 8 weeks post-partum. Gilts and sows were monitored throughout gestation and farrowing.

Data collection

Litter traits data collected were those routinely taken at the piggery unit of the Obafemi Awolowo University Teaching and Research Farm, Ile-Ife. They included birth weight (BWT) which was the individual birth weight that was usually taken within 24 hours of delivery, litter birth weight (LBW), i.e. a summation of individual birth weights in a litter while litter size at birth (LSB) was taken as the total number of piglets delivered at each farrowing per sow. Weaning weights (WWT), individual weights of piglets in each litter, were recorded against their birth weight. Litter weaning weight (LWW) was taken as the sum of the individual weaning weights in each litter while the litter size at weaning (LSW) was the number of piglets that remained alive at weaning, sows which lost all piglets before weaning were removed from the data. Sex ratio at birth was reported as the ratio of males to females piglets recorded within 24 hours after farrowing.

Data Analysis

Data were edited using PROC SORT and PROC FREQ of SAS (1997) and records that were outliers were not included in the data for heritability estimation in order to eliminate biases. Data for each trait except for sex ratio at birth were analyzed to evaluate means and standard errors. The statistical model used was

$Y_{ijk} = \mu + \alpha_i + \beta_{ij} + e_{ijk}$

Where Y_{ijk} = the observation from the kth progeny of the jth dam mated to ith sire

μ = the common mean

α_i = effect of the ith sire, (ith sire =1, 2, 3………..30th sire)

β_{ij} = effect of the jth dam mated to the ith sire

e_{ijk} = random error associated with each observation and genetic deviations attributed to individuals assumed to be normally distributed, with a mean of zero and a common variance. Unbalanced design using offspring from each sow measured to generate the data. Analysis of variance was carried out in which the phenotypic variance was partitioned into observational components attributable to difference between the progeny of different sires (the between sire components, σ^2_S) and to differences between individual offspring of the same sow (or within – progeny components σ^2_W).

Heritability from the sire component of variance was computed as

$$h_S^2 = \frac{4\sigma_S^2}{\sigma_S^2 + \sigma_W^2}$$

using varicomp subroutine of SAS (1997).

h_S^2 = heritability from Sire component of variance

σ_S^2 = Sire component of variance

σ_W^2 =Within individual component of variance

Standard error of mean was calculated with the approximate method:

S.E. (h_S^2) $= \sqrt[4]{\frac{2(n_.-1)(1-t)^2\ (1+(K_1 - 1)t)^2}{K_1^2\,(n_.-S)(S-1)}}$

(Swiger *et al*., 1964)

n. = total number of progeny

s = total number of Sires

$k_1 = \frac{1}{s-1}\left(n. - \frac{\sum n_i^2}{n.}\right)$

$t = \frac{\sigma_S^2}{\sigma_S^2 + \sigma^2_W}$ Becker (1984).

Results and Discussion

The mean birth weight of 0.93 ± 0.02 kg (Table 1) was higher than 0.8 kg reported by Aladi *et al*. (2008),) but compares favourably with the values of 0.92 and 0.93 kg that were reported for NIP by Ilori (1974) and Adeoye (2002) respectively. However, Chiboka (1981) reported a higher value of 1.13 ± 0.01 kg. The mean weaning weight of 4.03 ± 0.55 kg observed in this study was lower than 5.87 reported by Adebambo (1986). The mean litter birth weight of 5.44 ± 0.12 kg can be compared to 5.22 kg reported by Adeoye (2002), but higher than the value of 5.0 kg reported by Adebambo (1981). The value falls within the range of 2.99 - 8.17 kg reported by Sunday (1997).

A mean of 23.39 ± 0.55 kg for litter weaning weight in this report was lower than 32.46 ± 2.50 kg reported by Oseni (2005) but slightly higher than 21.30 kg reported by Adebambo (1981). Mean litter size at birth of 5.82 ± 0.11 was close to the estimated values of 6.01 and 6.00 reported by Adeoye (2002) and Sunday (1997) respectively. However, it was lower than 6.50 ± 0.09 reported by Oseni (2005), but higher than a mean of 4.6 reported by Chiboka (1981). Mean value for litter size at weaning in this study was 5.53 ± 0.11 kg; a close value to a mean of 6.3 reported by Adebambo (1986). The wide variability between the minimum and the maximum values in all the litter traits (Table 1), depicts the unselected nature of this population and this indicates the possibility of improving the genetic potentials of the litter traits of NIP sows through appropriate selection and mating methods without crossing with the exotic breeds. The sex ratio of male: female is 1:1.02, and this was close to the expected ratio of 1:1.

Table 1: The means of litter traits of Nigerian Indigenous Sows

Traits	n	Means ± standard error	Min	Max
Birth weight (Kg)	1494	0.93±0.02	0.30	1.50
Weaning weight (Kg)	1494	4.03±0.55	1.80	7.50
Litter birth weight (Kg)	257	5.44±0.12	1.50	12.10
Litter weaning weight (Kg)	257	23.39±0.55	2.70	42.60
Litter size at birth	257	5. 82±0.11	2.00	11.00
Litter size at Weaning	257	5.53±0.11	2.00	8.00

Sex ratio male: female 1:1.02

Table 2 shows that heritability estimates of birth weight and weaning weight in this study were moderately high, 0.36 ± 0.09 and 0.37±0.12 respectively. The values of h^2 of weaning weight in this study was lower than 0.53 reported by Ehiobu and Kyado

(2000) but higher than 0.18 reported by Young *et al*. (1978). The h^2 value for litter size at birth (0.24±0.07) was higher than 0.15 reported by Dalton (1987) in the temperate region. Warwick and Legates (1990) indicated a range of 0.1 to 0.2 for h^2 estimate for litter weight at weaning which is lower than 0.27± 0.07 that was observed in this study. Litter birth weight and litter weaning weight were 0.29 ± 0.07 and 0.27± 0.07 respectively; an indication of a moderate genetic influence on these traits. Litter size at weaning had a low heritability estimate (0.00±0.04) which was lower than 0.07 reported by Dalton (1987) which could have been due to sampling errors or vagaries of the environment. The differences in the estimates might have been as a result of differences in breeds and the environmental factors under which the animals were kept. Lowly-heritable traits, such as those associated with reproductive efficiency, are better improved by using outbreeding mating systems. Heritability estimates of the litter traits in this study ranged between low and medium to high.

Table 2: Heritability estimates (h^2) and standard errors (S.E) for litter traits in the Nigerian Indigenous sows

Traits	h^2 ± S.E.
Birth weight	0.36±0.09
Weaning weight	0.37±0.12
Litter birth weight	0.29±0.07
Litter size at birth	0.24±0.07
Litter weaning weight	0.27±0.07
Litter size at weaning	0.00±0.04

Conclusion

Large variability in reproductive traits among individual sows in the NIP indicates that there are opportunities for genetic improvement of litter traits in this pig population. Hence, appropriate selection and mating methods within this population should be employed for genetic conservation of this pig population.

Individual selection may be appropriate for genetic improvement of birth weight and weaning weight while family selection may be effective for litter birth weight, litter size at birth and litter weaning weight for the NIP.

Acknowledgement

The authors gratefully acknowledge the cooperation of Mr. J.A. Adedeji and other members of staff of piggery Unit of Obafemi Awolowo University Teaching and Research Farm Ile-Ife, Nigeria for their cooperation in the use of the data for this study.

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