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ESTIMATION OF DIRECT RESPONSE TO TRUNCATION SELECTION OF LITTER SIZE IN LARGEWHITE FLOCK OF SWINE IN MIDWESTERN NIGERIA.

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Target Audience: Breeder, swine farmers, genetists.

ABSTRACT

Data obtained from the swine records kept between 1982 and 1992 at the Nigerian Institute for Oil Palm Research (NIFOR) were analysed to estimate response to truncation selection by selecting sows with average litter size of 5 and above. Traits analysed were litter size (LITSZ), birth weight (BWT), weaning weight (WWT) and farrowing interval (FRINT). Average value of 6.27 to 6.52(no); 1.44 to 1.46(kg); 5.31 to 5.38(kg) and 217.00 to 242.81(days) and 6.78 to 6.97(no); 1.30(kg); 5.24 to 5.28(kg) and 232.00 to 251.43(days) were obtained for LITSZ, BWT, WWT and FRINT before and after selection respectively. Heritability estimate of 0.13±0.13; 0.25±0.12; 0.15± 0.01 and 0,11± 0.12 were obtained for LITSZ, BWT, WWT and FRINT respectively. Correlation coefficient among the traits was low and not significant with reproduction (FRINT) and LITSZ being negatively correlated. LITSZ, WWT and FRINT showed positive response to selection while BWT had negative response. Selection of sows for increased litter size at first parity was as good as using average performance at 1st and 2nd and 1st, 2nd and 3rd parities.

Key words: Response, truncation selection, litter size, swine

DESCRIPTION OF PROBLEM

Research efforts in swine improvement must be geared towards increased litter size, growth rate, better mothering ability and adaptation to harsh weather conditions. Such improvement must be based on successful and articulated breeding and selection strategies. Presently well-adapted exotic breeds of swine are used in commercial production in the tropical rainforest zone of Nigeria. One of such exotic breed is the large white, which has been in use in the Nigerian Institute for Oil Palm Research (NIFOR) for quite some time. Although, swine production was not part of the institute mandate, the institute has accumulated a lot of data that could serve for research purpose.

Over the years, the swine population in the institute has not been subjected to any deliberate selection for improved productivity as there are no studies to attest to it. Selection is the basic tool used both by nature and by man to change the attributes of animals. In any livestock improvement, the first difficulty and sometimes the greatest, is the decision of selection criteria that could hold for reasonable period of years (sustainability). A reason for initiating selection is to evaluate the genetic responses. Hudson and Kennedy 1985 (1) and (2) reported a considerable improvement in litter size, weight and backfat thickness. Correlated responses among productive and reproductive traits have also been reported (3, 4, 5). A change in performance of swine was observed with persistent direct selection. The response to selection per generation for traits depend not only on the heritability but also on the applied selection pressure (6).

Therefore, in order to make use of possible genetic variance in litter size in the swine flock at NIFOR, it has become necessary to obtain the estimate of response to selection and the relationship that exist between litter size and other traits. It is the objective of this study to estimate the direct response to truncation selection for litter size in Large White breed of swine population at NIFOR reared between 1981 and 1992.

MATERIALS AND METHODS

The animals from which the data used for this study were obtained from the swine population kept at the swine unit of the Nigerian Institute for Oil Palm Research (NIFOR). The Institute is located approximately 29 kilometers north west of Benin City in the tropical rainforest zone of Nigeria. It has an average annual rainfall, temperature and relative humidity of 2421mm, 28.5°C and 73.5% respectively. Detailed description, management and housing of the animals had earlier been reported (7) Data for the study were obtained from the offspring of 115 sows and 12 boars. The data obtained consist of 503 records of litter size at birth (LITSZ), 414 records of birth weight (BWT), 390 records of weaning weight (WWT) and farrowing dates from which 404 records of farrowing interval (FRINT) was computed from difference between two successive farrowing. Preliminary analysis was done to obtain average litter size of sows for each parity. Selection criterion of litter size at birth of five or greater than was used. The choice of five corresponded to a selection intensity of 80 percent of the sows. Sows were selected using average litter size at three stages. Stage 1 was at parity one. Stage 2 used the average litter size of sows at parity one and two; while in stage 3 average litter size at parity 1, 2 and 3 was used. Performance of sows selected was grouped into two. Group one constituted the performance of the sows at selection while group two constituted performance of all subsequent farrowings combined. Trends in sow's successive farrowings were also analysed.

The data were subjected to least squares analysis and response to selection was estimated using the procedure (8) expressed simply as

$$R = h^2 \times SD$$

Where

R = response to selection

h^2 = heritability of the trait

SD = apparent selection differential.

The heritability estimate was estimated with variance components. Henderson method 1 (9) mixed model methodology was adapted for the estimation of variance components. The model assumed was

$$Y_{ijklm} = \mu + X_i + Y_j + N_k + S_l + E_{ijklm}$$

Where

Y_{ijklm} = the observation on the m^{th} offspring of the i^{th} sex born in the j^{th} year and in the k^{th} season of the l^{th} sire

μ = unknown constant common to all records in the herd and fixed.

X_i = the fixed effect of the $_i^{th}$ sex.

Y_j = the fixed effect of the j^{th} year of birth

N_k = the fixed effect of the k^{th} season

S_l = the random sire effect common to all records of the l^{th} sire, the expected value of which was zero with variance $ó_s^2$.

E_{ijklm} = a random error effect associated with each observation with an expected value of zero and variance $ó_s^2$ Sire and error terms were assumed to be mutually independent.

Apparent selection differential was calculated as the mean phenotypic performance of the selected sows minus mean performance of the population. The relationship between the traits was also determined.

RESULTS AND DISCUSSION

The performance of sows before and after selection at the different time of selection is presented in Table 1. Also presented in the table are the heritability estimates, apparent selection differential and estimate of response to selection. The performance of the sows before selection showed insignificant difference in the value obtained for litter size, birth weight and weaning weight. A more pronounced difference in absolute value was observed only in farrowing interval. On the other hand variation existed in the mean litter size of the selected sows. The average litter size of sows after selection was greater than those obtained before selection. The slight increase in litter size may have accounted for the lower birth weight of piglets. This however agreed with earlier report that as litter size increases birth weight tend to be smaller (10, 11). The reduction in birth weight was not commensurate with the increase in litter size. A 6.70% increase in litter size resulted in 10.30% reduction in birth weight. Such reduction was far more than the 0.01kg reported for an additional increase in litter size (10).

The reduction in weaning weight cannot be attributed to a direct effect of litter size, though litter size has been reported to have a reduced effect on weaning weight (11). In this study this was not the case as several other factors like level of feeding, quality of feed and management practices may have therefore contributed to the reduced weaning weight than litter size. The increase in farrowing interval can be said to be environmentally influenced as no link can be established between litter size and farrowing interval.

Table 1. Sows Performance before and after Selection, Heritability estimate, apparent Selection differential and Response to Truncation Selection for the different traits

	Traits			
Stages of selection	LITSZ(no)	BWT(kg)	WWT(kg)	FRINT(days)
Before Selection				
1	6.52±0.47	1.46±0.02	5.38±0.25	242.89±29.20
2	6.27±0.54	1.45±0.02	5.31±0.27	220.96±27.74
3	6.45±0.56	1.44±0.02	5.32±0.26	217.24±27.23
H^2	0.13±0.13	0,25±0.12	0.15±0.01	0.11±0.12
After Selection				
1	6,78±0.14	1,30±0.01	5.28±0.05	251.43±5.89
2	6.97±0.15	1.30±0.01	5.24±0.06	250.09±6.01
3	6.80±0.018	1.30±0.01	5.24±0.07	232.56±6.68
Selection Differential				
1	0.26	-0.16	0.10	8.54
2	0.70	-0.15	0.07	29.13
3	0.35	-0.14	0.08	15.32
Response				
1	0.034	-0.040	0.015	0.939
2	0.091	-0.038	0.011	3.204
3	0.046	-0.035	0.012	1.685

1= selection on litter size at parity 1, 2 = selection on average litter size at parity 1 and 2., 3 =selection on average litter size at parity 1, 2 and 3., LITSZ= Litter size, BWT = birth weight, WWT = weaning weight and FRINT = farrowing interval.

Heritability estimate obtained for the different traits were low. They were midway within reported range of 0 to 39% for litter size, 0 to 31% for birth weight, 3 to 20% for weaning weight and 0 to 15% for farrowing interval (12, 13, 14, 15, 3). Heritability estimates provides information on the extent of progress that might be made in improving a particular trait through selection. Positive response was observed in litter size, weaning weight and farrowing interval although that of farrowing interval was in undesirable direction. Birth weight at all stages of the truncation selection showed negative response probably due to the selection criterion, which has been reported to have an inverse relationship with birth weight (10). Response to selection was highest for selection at the third stage. The very small response obtained in the study can be attributed to the little variation that existed in the traits in the swine flock and the intensity of selection since response is influenced by variation, intensity and heritability. Although, the heritability estimate obtained for these trait were within acceptable range, higher estimates permit more accurate selection (16). Therefore, with the low heritability estimate, marked response cannot be expected. Selection for highly heritable single traits has been found to cause more correlated responses.

The comparative performance of sows at selection and subsequent performance are presented in Table 2. There was significant difference in litter size and birth weight of piglets of sows selected at the first stage.

Table 2: Comparative Performance of Sows at Selection and Subsequent Performance

	Traits			
Stages of Selection	LITSZ(no)	BWT(kg)	WWT(kg)	FRINT(days)
1	7.47^{a}	1.24^{b}	5.22^{a}	-
	6.84^{b}	1.30^{a}	5.27^{a}	246.15
2	7.24^{a}	1.25^{b}	5.04^{a}	285.06^{a}
	6.76^{b}	1.31^{a}	5.29^{a}	240.03^{b}
3	7.41^{a}	1.28^{b}	5.19^{a}	254.24^{a}
	6.61^{b}	1.31^{a}	5.26^{a}	225.69^{b}

Figures on top at each selection stage are for those at selection while those below are for subsequent performance. Figures in the same column with different superscript are significantly different. ($P < 0.05$)

Those selected at stages 2 and 3 only had significant difference in farrowing interval with subsequent farrowings being shorter. Generally, litter size of sows were larger at selection compared with successive performance while weight of piglets tend to be higher in subsequent farrowings thus corroborating the reverse relationship between litter size and weight. The trend in the performance of sows with increasing parity depicted some linearity up to the 4th parity particularly with sows selected at stage one for birth weight and weaning weight (Fig 2 and 3) respectively. Litter size and farrowing interval showed no definite trend (Fig 1 and 4) respectively.

However, sows showed no relative advantage over each other.

Table 3: Correlation coefficients Among the Traits.

	LITSZ	BWT	WWT	FRINT
LITSZ		0.01	0.07	0.10
BWT			0.73	-0.03
WWT				0.04
FRINT				

The correlation coefficients among the traits are presented in Table 3. Traits are interrelated positively, negatively or neutral. Where relationship existed, selection for one trait could bring change in the other (17). The correlation coefficients between the traits range from low to medium (-0.03 to 0.73). The correlation Coefficient between weaning weight and litter size was very low and not significant and that between farrowing interval and birth weight was not only low but also negative thus showing an inverse relationship between reproduction and production. This observation agreed with those of other researchers (11, 14). Since the phenotypic variation in any polygenic character is divided into genetic and environmental components, the obtained correlation value therefore suggest that correlated response among such traits will be insignificant if any. The very low response observed in this study was therefore not surprising. However, the results obtained from these data indicated that selection of sows for increased litter size at stage one was as good as using average performance of sows at stages 2 or 3.

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