Short Communication

EFFECT OF INBREEDING ON THE LITTER TRAITS OF LARGE WHITE YORKSHIRE SOWS

M. Vasundara Devi* and M.R. Jayashankar
Department of Animal Genetics and Breeding, Veterinary College, Hebbal - 560 024, Bangalore,

Received : 16.05.2014 Accepted : 22.06.2014

ABSTRACT

Data relating to 130 sows, 19 boars from 400 farrowings spread over a period from 1984 to 1992 were utilized to study genetic and non-genetic effects in variation of litter size and weight at birth and at weaning. The overall mean litter size at birth (LSB) was 6.83 ± 0.13 piglets. The effects of period, season of farrowings and inbreeding on litter size at birth were not significant (P>0.05). The overall least squares mean of litter size at weaning (LWW) was 4.83 ± 0.12 and was significantly (Pd<0.05) affected by inbreeding. Litter weight at birth (LWB) had a least square mean of 7.81 ± 1.16 kg and it was significantly (Pd<0.05) affected by period of farrowing. The mean LWB of non-inbred sows was 8.22 ± 0.19 kg and that of inbred sows was 7.41 ± 0.29 kg. The overall least squares mean for litter weight at weaning (LWW) was 39.36 ± 1.25 kg and inbreeding of sow exerted significant effect on LWW. The LWB and LWW were significantly affected by period of farrowing. The litter size at birth and at weaning and litter weight at birth and at weaning was not significantly affected by season of birth. The heritability estimates of litter size at birth and litter size at weaning were 0.096 ± 0.09 and 0.816 ± 0.27 respectively. The corresponding heritability values for LWB and LWW were 0.41 ± 0.18 and 0.53 ± 0.21 respectively.

Key words:- Large White Yorkshire, litter traits, inbreeding.

Large White Yorkshire is one of the important exotic breeds, which has performed better and thrived well in all zones of Karnataka. Hence, they are exclusively used both in pure breeding or upgrading of local pigs. However, breeding with lesser number of animals within a closed farm leads to mating between closely related animals resulting in un-intentional inbreeding. Earlier studies using inbred lines of pigs have demonstrated several adverse effects of enforced homozygosity on performance. Inbred sows have been reported to shed lesser number of ova and higher embryonic mortality, than out-bred counter parts. The present study was undertaken to investigate the level of inbreeding in a population of sows maintained in the UAS

* Corresponding author Email : mvdpriya@gmail.com
piggery farm was a closed small population of pigs maintained which may result in unintentional inbreeding and its effect on their performance with respect to litter size at birth (LSB-born alive) and litter size at weaning (LSW) and litter weight at birth (LWB) and litter weight at weaning (LWW).

Data on Large White Yorkshire sows maintained at swine unit, Department of Animal Genetics and breeding, Veterinary College, University of Agricultural Sciences, Bangalore were utilized for the present study. The pedigree information on 127 sows were collected to estimate inbreeding coefficient. The performance data on 130 sows, 19 boars and 2209 piglets from 400 farrowings, spread over a period of nine years from 1984 to 1992 were compiled and classified into season-wise based on meteorological parameters viz., Summer (March to June), Monsoon (July to October) and Winter (November to February); and period-wise at three years: Interval viz., Period-I (1984-86), Period-II (1987-89) and Period-III (1990-92). Further, the data were classified based on the pedigree records of sows into two groups as inbred and non-inbred sows in order to study the effect of inbreeding on litter traits.

Least squares analysis of variance for disproportionate/unequal subclass frequencies as suggested by Harvey (1987) was followed to detect the significant source of non-genetic variation. The following fixed effect model was used for analysis,

\[ Y_{ijkl} = \mu + B_i + S_j + P_k + E_{ijkl} \]

Where,

- \( \mu \) = Population mean when equal subclass frequencies existed among the groups
- \( B_i \) = Fixed effect of the \( i \)-th breeding group \((I = 1,2)\)
- \( S_j \) = Fixed effect of \( j \)-th season of farrowing \((j = 1,2,3)\)
- \( P_k \) = Fixed effect of \( k \)-th period of farrowing \((k = 1,2,3)\)
- \( E_{ijkl} \) = Random error associated with \( Y_{ijkl} \) and assumed to be normally and independently distributed with mean zero and unit variance \((\sigma^2)\)

The least squares means of different factors were subjected to LSD test (Snedecor and Cochran, 1967) where ever the effects were found to be significant \((P<0.05)\).

Inbreeding coefficients of breeding sows was computed as per Lush’s modified Wright’s method (Emik and Terril, 1949). Rate of inbreeding per generation in sows was estimated as per Lush’s method (1962).

The records were adjusted for significant effect of non-genetic factors before being used to estimate heritability apart from considering only those boars that had at least five litters. Heritability was estimated by paternal half-sib correlation method as outlined by Becker (1975) and standard error of heritability was estimated as per Swiger et al (1964).

The least squares means for litter size at birth and weaning, litter weight at birth and weaning are presented in Table 1. While rate of inbreeding (\( \bar{\Delta}F \)) in Table 2 and heritability \((h^2)\) estimates along with standard error of litter traits are presented in Table 3.
Mean litter size and litter weight: The overall least square means obtained for litter size at birth was 6.83 ± 0.13 piglets. This value is close to the value reported by Nagaraja et al (1992) in Large White Yorkshire pig. The mean computed for litter size at weaning was 4.83 ± 0.12 piglets. The present estimate was in close conformity with those reported by Rai and Desai (1985) and Nagaraja et al. (1992) in Large White Yorkshire pigs.

The mean litter weight at birth was 7.81 ± 0.16 kg in the present study which is in close agreement with the reports of Rai and Desai (1985) in Large White Yorkshire and Arun Pradeep et al (2004) in different breeds of pigs. The mean computed for litter weight at weaning was 39.36 ± 1.25 kg and was close to the values of Arun Pradeep et al (2004) reported for different breeds of pigs.

Effect of inbreeding: Based on the pedigree records of 127 sows considered, 34 sows were found to be inbred, whose inbreeding coefficient estimated spread from 0.047 to 0.290, with an average inbreeding coefficient of 0.135.

The mean litter size at birth of non-inbred sows was 7.13 ± 0.15 piglets as compared to 6.53 ± 0.24 piglets in inbred sows. There was a non-significant (P>0.05) difference between the inbred and non-inbred groups in litter size at birth. This finding is in agreement with the reports of Paneerselvam et al. (1991).

The mean litter size at weaning for non-inbred sows was 5.28 ± 0.15 piglets and that of inbred sows was 4.38 ± 0.22 piglets. The difference observed between the breeding groups was significant (P<0.05). Similar results were reported by Paneerselvam et al (1991) in Large White Yorkshire pigs. The present study indicated that even a low to medium level of inbreeding of sows would reduce litter size at weaning significantly.

The mean LWB of non-inbred sows was 8.22 ± 0.19 kg and that of inbred sows was 7.41 ± 0.29 kg. However, the mean differences was statistically non-significant (P>0.05). Paneerselvam et al (1991) also observed non-significant influence of inbred group on LWB. The mean LWW of non-inbred sows was 43.73 ± 1.59 kg and that of inbred was 34.99 ± 1.96 kg. The difference between inbred and non-inbred groups was significant (P<0.05). Similar effect was reported by Siler (1974) in Large white Yorkshire sows.

Effect of period of farrowing: The litter size at birth was not significantly affected by period of farrowing. Similarly non-significant effect of year of birth on litter size at birth in Large White Yorkshire pigs was reported by Chabbra et al (1990). The period of farrowing significantly influenced litter size at weaning and it was lowest for those farrowed during period-II (4.43 ± 0.23 piglets). Mishra et al. (1990) also reported similar significant effect of period of farrowing on litter size at weaning in Large White Yorkshire pigs. The possible reason for this effect might be due to variation in environmental conditions.

The LWB and LWW were significantly affected by period of farrowing. The significant effect of year of farrowing on LWB and LWW was also reported by Mishra et al. (1990). The possible reasons for the significant effect may be attributed to environmental conditions during the respective periods of birth(farrowing) in case of LWB, LWW is a composite trait which is influenced by litter size at birth, mothering ability of sow.
and inherited potentialities of piglets for rate of gain in weight in addition to management factors.

**Effect of season of farrowing:** The litter size and litter weight at birth and also at weaning were not significantly affected by season of birth. This finding was in agreement with the reports of Chabbra et al (1990) in Large White Yorkshire pigs. Singh et al. (1990) reported significant effect of season of birth on litter size at birth and weaning also on litter weight at birth and weaning in different breeds of pig.

**Inbreeding coefficient:** Out of 127 sows considered, 34 sows were found to be inbred, whose inbreeding coefficient estimated ranged from 0.047 to 0.290, with an average inbreeding coefficient of 0.135, and was in close proximity with those of Siler (1974) and Raghunandan et al (1981). The highest level of inbreeding (0.203 to 0.290) was observed for three sows only.

**Rate of inbreeding:** The estimated rate of inbreeding (Table 2) was in the range of 0.0241 to 0.036 among four generations and was lower than those reported by Okamato and Chiobra (1982).

The present study indicates that mild inbreeding may not be detrimental and will not affect performance of sows, drastically.

**Heritability:** The heritability estimated for litter size at birth was 0.096±0.09. This value is comparable with the reports of Walker et al (1982) in Large White Yorkshire pigs. The heritability value of 0.816±0.27 obtained for litter size at weaning was closer to the reports of Chabbra et al (1990) in Large White Yorkshire pigs.(Table 3)

The h² estimate of 0.41±0.18 for LWB, is higher than the reports of Park and Kim (1987) in Yorkshire pigs. The estimate of heritability of 0.53 ± 0.21 for LWW is higher than that reported by Chabbra et al (1990) in Yorkshire pigs. The present study reveals ample scope for improvement of this trait in the herd through mass selection and improved management during pre weaning period.

The present study indicated that low to moderate level of inbreeding of breeding sows significantly decreased litter size and litter weight at weaning. Litter size at weaning and litter weight at weaning were found to be highly heritable and the selection for any one trait would bring about improvement in other trait, simultaneously.
Table 1: Least square means for litter size and litter weight at birth and at weaning

<table>
<thead>
<tr>
<th>Classification</th>
<th>Litter size at birth</th>
<th>Litter weight</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N at birth µ ± SE</td>
<td>N at weaning µ ± SE</td>
</tr>
<tr>
<td>Overall</td>
<td>400 6.83 ± 0.13</td>
<td>363 4.83 ± 0.12</td>
</tr>
<tr>
<td>Breeding group</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-inbred</td>
<td>293 7.13 ± 0.15</td>
<td>266 5.28 ± 0.15</td>
</tr>
<tr>
<td>In bred</td>
<td>107 6.53 ± 0.24</td>
<td>99 4.38 ± 0.22</td>
</tr>
<tr>
<td>Period</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Period-I</td>
<td>120 6.92 ± 0.23</td>
<td>108 5.38 ± 0.23</td>
</tr>
<tr>
<td>Period-II</td>
<td>126 6.56 ± 0.25</td>
<td>114 4.43 ± 0.23</td>
</tr>
<tr>
<td>Period-III</td>
<td>154 7.00 ± 0.20</td>
<td>143 4.67 ± 0.19</td>
</tr>
<tr>
<td>Season</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Summer</td>
<td>129 6.85 ± 0.22</td>
<td>116 5.14 ± 0.23</td>
</tr>
<tr>
<td>Monsoon</td>
<td>129 6.93 ± 0.23</td>
<td>118 4.58 ± 0.21</td>
</tr>
<tr>
<td>Winter</td>
<td>142 6.70 ± 0.22</td>
<td>131 4.76 ± 0.21</td>
</tr>
</tbody>
</table>

Means bearing same superscript with in a subgroup are not significantly different from each other

* (P≤0.05).

NS- non-significant
Table 2: Rate of inbreeding (AF) in different generations

<table>
<thead>
<tr>
<th>Generation</th>
<th>Number of breeding males</th>
<th>Number of breeding females</th>
<th>Rate of inbreeding (AF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generation - I</td>
<td>4</td>
<td>24</td>
<td>0.0364</td>
</tr>
<tr>
<td>Generation – II</td>
<td>5</td>
<td>37</td>
<td>0.0283</td>
</tr>
<tr>
<td>Generation – III</td>
<td>6</td>
<td>38</td>
<td>0.0241</td>
</tr>
<tr>
<td>Generation - IV</td>
<td>4</td>
<td>30</td>
<td>0.0354</td>
</tr>
</tbody>
</table>

Table 3: Heritability estimates of litter size at birth and weaning along with standard error and k

<table>
<thead>
<tr>
<th></th>
<th>Df</th>
<th>Litter size</th>
<th>Litter weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>At Birth</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>K</td>
<td>-</td>
<td>20.00</td>
<td>20.00</td>
</tr>
<tr>
<td>h² ± SE</td>
<td>-</td>
<td>0.09±0.09</td>
<td>0.41 ± 0.18</td>
</tr>
<tr>
<td>At Weaning</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>K</td>
<td>-</td>
<td>18.00</td>
<td>18.00</td>
</tr>
<tr>
<td>h² ± SE</td>
<td>-</td>
<td>0.81±0.27</td>
<td>0.53 ± 0.21</td>
</tr>
</tbody>
</table>

REFERENCE


