The Prolificacy of Crossbred Gilts Depending on the Selection Differentials at Generations of Purebred Mothers

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Summary

To find how the average expression of prolificacy of crossbred daughters depended on the magnitudes of selection differential obtained in generations of purebred hyperprolific mothers the research was undertaken using the data collected at the piggery OPG Goran Jančo in Punitovci, Croatia, during 2016. Assumed heterosis effect was 0.382 piglet/litter and calculated h² was 0.0927. The number of piglets born in the 1st litter of purebred mothers averaged 12.333. Since at the same time two maternal generations were overlapping, the selection criteria had to be different: for “younger” generation above or under 10.273, for “elder” one above or under 15.571 piglets/litter. With the selection differential for two maternal generations together +2.381 the mean number of piglets born in the 1st litters of crossbred daughters was expected to be 13.625 and observed average was 13.650, above the mean found out in the crossbred daughters’ population 13.404. With the selection differential -1.515 expected average of the trait was 13.264 vs. observed mean 13.222, both values under the crossbred daughters’ population average of 13.404 piglet/litter. Differences between the magnitudes of expected and observed means were explained by the magnitudes of realised heritability: h² = 0.1033 or h² = 0.1201.

Keywords: prolificacy, crossbred gilts, purebred mothers

Introduction

It was reported that hyperprolific Large White sows bore 1.4 piglets alive per litter more than customary Large White females after 20 years of breeding in order that the swine prolificacy to be improved in France (Bidanel, Grumau and Legault, 1994).

Realized and realizable improvement of prolificacy in the herd of swine breed exotic for Chinees (Swedish Landraces) was exposed to the participants of the closed Conference of the British Pig Breeders’ Round Table at the Wye College on the 4th April 1991, when the experts and the breeding companies at many places tried to improve the expression of prolificacy using Chinese hyperprolific breeds of swine, especially Meishan.

At the 8th WCGALP in Belo Horizonte, Brazil, Sviben, Jiang Zhihua and Veronika Pavlovski (2006) published the results of elaboration of data on the sows’ prolificacy, the piglets’ livability and the losses of piglets till weaning through 20 generations of Swedish Landraces used at the pig farm in Nova Topola, Bosnia and Herzegovina, where the primiparous sows to be selected had to farrow the number of piglets above average and to have above average the number of piglets alive at the weaning. The means were: at the
generation 0 (1970) 8.925 ± 0.314 born piglets and 6.602 ± 0.303 weaners, at the generation 19 (1989) 9.726 ± 0.123 born piglets and 8.000 ± 0.116 weaned piglets. It should be said that at the pig farm in Nova Topola during 1970 31,617 piglets were born and 23,037 of them weaned from 3,314 litters but in 1989 118,895 piglets were born and 94,654 weaners produced from 11,319 litters. The application of quantitative genetics to increase the sows prolificacy and to decrease the piglets’ losses till weaning resulted with positive phenotypic trend concerning the number of piglets born per litter and negative phenotypic trend respecting the number of piglets lost per litter till weaning in the farm intending to increase the volume of production and its economic efficiency.

During the last decade of 20th century annual betterment of 0.1-0.3 piglets per litter was achieved in some pig populations and further improvement was expected from the increasing use of hyperprolific swine for crossbreeding (Rothschild and Bidanel, 1998).

An average heterosis effect of +0.24 piglet per litter was estimated by Rothschild and Bidanel (1998).

Mean litter size of hyperprolific purebred as well as crossbred sows increased up to 15 piglets born per litter (Castellas, Ibáñez-eseriche and Nogurea, 2007).

Sviben (2013) reported that in 2007, since achievements of breeding work during decades had been reviewed, the mean of 11.58 weaners/litter could be probable attained at a piggery instead of 8 weaned piglets taken possible earlier on. The first pig farm using hybrid hyperprolific swine in Croatia, in Bratina from 2007 till 2011 achieved the mean of 11.54 weaned piglets per litter and 27.57 weaners/sow/year but 32.81% less production volume and economic efficiency than it could be expected with sows neither hyperprolific nor hybrid (13,632 instead of expected 20,288 weaners annually, 94.67 piglets per farrowing pen a year instead of expected 140.9).

At reconstructed piggery in Gradec, Croatia, using hyperprolific hybrid sows, which in years 2010-2012 gave on an average 11.661 weaners per litter, the volume and economic efficiency of production were presented with the means of 53,219 weaned piglets annually and 84.87 weaners per farrowing pen a year. According to the Sviben’s report (2014) 26% higher number of farrowing pens and 39-42% higher number of piglets weaned per litter did not result with 29-79% higher production volume. The economic efficiency of production was diminished 18.47-19.63% comparing to the state before the reconstruction, when using neither hyperprolific nor hybrid sows it was attained in years 1986-1991 104.1 and in years 1992-1999 105.6 weaned piglets per farrowing pen a year.

Recently it was observed that in more farms the means of born piglets per litter were not improved steadily from year to year. Therefore the research were undertaken to find out how the average expression of prolificacy of crossbred daughters depended on the magnitudes of selection differential obtained in the generations of hyperprolific mothers. We do hope the results of this work will help the buyers at asking for gilts needful for the sows’ replacement and the breeding companies also to satisfy the buyers’ expectations.

**Material and methods**

The data collected at the pig farm in OPG Goran Jančo in Punitovci, Croatia, where during 2016 the first litters of 47 crossbred gilts originated from 18 purebred Large White sows and 2 French Landrace boars were registered, made the material in this research. Eleven mothers were born from 27th July 2013 till 17th October 2014 and gave 22 daughters born form 5th March 2015 till 13th January 2016 at the mothers’ age of 551.7 days on an average, covered at the mean age of 251.9 days and-after the pregnancy of 113.7 days – farrowed at the age of
365.6 days on an average. Seven mothers were born from 23rd December 2011 till 23rd December 2012 and had 25 daughters born from 30th December 2014 till 23rd December 2015 at the mothers’ mean age of 1152.6 days, covered at the average age of 254.1 and-after the gravidity of 114.0 days – farrowed at the age of 368.1 days on an average. So the population of crossbred daughters farrowing during one calendar year consisted of gilts originated from purebred sows being at the selection younger (having 1-4 litters) or from purebred sows being at the selection elder (having 4-8 litters), i.e. from two maternal generations. Mean numbers of piglets born in the first litters (X̅ – Serdar, 1957) were calculated for all mothers (AM) and for mothers belonging to “younger” generation (X̅AMY) or to “elder” generation (X̅AME). On the same way the expression of prolificacy in the first litters of crossbred daughters (X̅CD) was established.

It was necessary to assume average number of piglets born in the 1st litters of purebred daughters.

It was taken that possible magnitude of heterosis effect (HE) was 2.93% of the progeny of all parents as it was established by Bosnić (1978) who found out HE of 0.288 piglets per litter after the mating Large White sows with Swedish Landrace boars.

Mean number of piglets born in the first litters of purebred daughters (X̅PD) was got multiplying X̅CD times 0.9715.

The magnitude of heterosis effect was calculated as the difference X̅CD-X̅PD.

The heritability (h²) was found out by doubling the intrasire regression of daughters on the mothers (Lush, 1963).

The expression of prolificacy observed in the 1st litters of crossbred daughters originated from mothers selected in the upward direction (X̅CDSM-) or in the downward direction (X̅CDM+) was compared to the mean expected according to the equation: X̅CDSM = X̅AM + (X̅PD - X̅AM) + (X̅SM - X̅AM) · h² + HE.

Mothers selected in the upward direction were purebred sows having in the first litters piglets more than X̅AMY or more than X̅AME.

Mothers selected in the downward direction were purebred sows bearing in their first litters less than it was X̅AMY or less than X̅AME.

The mean observed in litters of daughters of selected mothers were diminished for the sum of X̅PD + HE the actual selection effect to be find.

The magnitude of realised selection effect (SEr) was used realized heritability (h²r) to be find out as the ratio SEr/SD (Falconer, 1964).

**Results and discussion**

The calculations resulted as it follows: X̅AM = 12.333, X̅CD = 13.404, X̅PD = 13.022, HE = 0.382, h² = 0.0927, X̅AMY = 10.273, X̅AME = 15.571, SD = +2.381 or SD = -1.515, X̅CDSM- = 13.625 vs. X̅CDSM+ = 13.650 or X̅CDSM+ = 13.264 vs. X̅CDSM = 13.222, SEr = +0.246 or SEr = -0.182, h²r = 0.1033 or 0.1201.

During one calendar year in the population of crossbred daughters there were data on progeny of two overlapping purebred maternal generations. It was justified to put the selection criteria differently according to the expression of trait at each generation separately, respecting one of general principle “that the intensity of selection actually practiced is to be measured in terms of the difference between the average of those saved for parents and the generation in which they were born” (p. 149 in Animal Breeding Plans by Lush, 1963).

The magnitude of heritability calculated and realised were close to the mean for total number of born piglets (0.0927, 0.1033 and 0.1201 vs. 0.11 on p. 323 of The Genetics of the...
Pig by Rothschild and Bidanel, 1988).

Assumed magnitude of heterosis effect of 0.382 piglet per litter differed from the average of 0.24 piglet a litter presented by Rothschild and Bidanel (1998) and from 0.288 found out by Bosnić (1978). It can be explained by equal percent of heterosis and higher level of the expression of prolificacy in 2016 versus the expression of trait a half of the century ago.

The means of trait observed in litters of crossbred daughters originated from purebred mothers selected in the upward direction as well as in the downward selection were very close to expected averages (13.650 vs. 13.625; 13.222 vs. 13.264). The calculations confirmed the statement that “crossbreeding combined with selection would be expected to result in improvement equal to the sum of the expected improvements shown for selection and for crossbreeding” (p. 275 in Introduction to Livestock Production by Durham, 1962).

Differences between the magnitudes of means expected and observed in the crossbred daughters’ population were explained by the magnitudes of realised heritability: $h^2_r = 0.1033$ or $h^2_r = 0.1201$.

“Animal breeding is a business” – it has been written by Jay L. Lush in the preface of his book “Animal breeding Plans” (1963). The results of this research proved that the expression of the trait, in the case the prolificacy of crossbred daughters, depended on the magnitudes of selection differentials obtained in the generations of purebred hyperprolific mothers. The buyers of gilts for the sows’ replacement in smaller and in large farms should ask for information on the selection intensity attained in the maternal generation of offered animals.

The difference between observed mean of the number of piglets born in litters of the sows’ maternal generations and assumed average of the trait in litters of purebred daughters (12.333 vs. 13.022) remained unclear. It will be necessary to consider environmental influences and the epistasis.

**Conclusion**

Crossbred gilts express the prolificacy on an average depending on the difference between the mean of the trait in litters of selected hyperprolific mothers and the average expression of prolificacy in the sows’ maternal generations. The buyers of gilts for the sows’ replacement should ask for information on the selection intensity applied in the sows’ maternal generations of offered animals. The breeding companies should satisfy the buyers’ requirements. Theoretical explanations recognized a half of the century ago still remain the basis of procedures applying during the pig breeding at high level of production and the production on large scale.

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