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EFFECT OF GROUP SIZE ON BREEDING VALUE ACCURACY IN GILTS

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ABSTRACT

The objective of this paper was to analyze the effect of group size on accuracy of breeding value for fattening traits in gilts. The analysis included data from maternal genotypes, which are used in prediction of breeding value. Gilts belonged to four genotypes: Slovenian Landrace – line 11, Slovenian Large White, hybrid 12, and hybrid 21. Contemporary group represented gilts of the same genotype, which were measured at the owner on the same day. In Slovenian Landrace – line 11 one seventh of all gilts were tested in groups with one or two gilts. Less than one fifth of gilts were tested in group with 10 or more. Maximum group size was 38. Group size in Slovenian Large White is smaller due to smaller population. One fifth of all gilts were tested in groups with one or two animals. More than half gilts were tested in groups with three to ten measured gilts. Maximum group size was 12 gilts. In both breeds, proportion of untested animals was around 4%. Size of contemporary group affects the accuracy of the estimated breeding value: accuracy is higher in larger groups and consequently, smaller groups have lower accuracy predictions. Contemporary group have to include at least ten gilts per genotype and similar age. It is important to measure all gilts, including those for which we preliminary assume they will not be selected, because they contribute to accurate PBV. Because only purebred animals accumulate genetic progress, they must get more emphasis.

Key words: pigs / gilts / group size / breeding value / accuracy / fattening traits

1 INTRODUCTION

Selection response depends on selection intensity and accuracy of breeding value. Aggregate value in gilts includes days on test, backfat thickness, litter size, weaning to estrus interval, teats number, and longevity. Gilts field test is performed from birth to body weight around 100 kg (Kovač and Malovrh, 2010). It is important to collect data on all gilts in group, because the prediction of breeding values in too small group is inaccurate.

Accuracy of prediction is defined as a correlation between the true breeding value (BV) of animal (which is not known) and its prediction (PBV; Falconer and Mackay, 1996). In dairy cattle evaluations, the accuracy of prediction is usually expressed in terms of reliability, which is the squared correlation between true and predicting breeding value (Mrode, 1996). PBV with low accuracy values can vary as more information become available. Accuracy of PBV depends on heritability, quality and quantity of data, and pedigree. Traits with high heritability can be predicted more accurately than traits with low heritability (Stalder, 1999). Performance test and data collection have to be carried out under constant conditions (Bates, 1999) so that differences observed between individuals reflect their differences in genetic merit and less non-genetic factors. Within owner, constant conditions have to be established to reduce environmental impact in the herd, so that genetic potential is more expressed.

The size and structure of contemporary group affect the accuracy of PBV and the selection intensity (Kovač *et al.*, 2004). Appropriate contemporary group on farm

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consists from at least ten gilts of same genotype and similar age. Bates (1999) recommended that gilts in contemporary group have to be of the same genotype, from single owner, from at least six different litters and at least three sires. Range in age of the animal cannot be greater than seven days. In breeding program SloHibrid (Kovač and Malovrh, 2010), simplified criteria have been defined, where only the size of group was expressed.

Owner can contribute to higher accuracy of PBV in several ways. First of all, he/she must be very strict in his work. Owners should provide a sufficient number of tested animals per genotype in group housed under same conditions. Gilts cannot be mixed with fatteners, group of gilts during test cannot be reduced, mixed or sold, and gilt can be served only after the end of field test. One of the factors of unbiased PBV is also test of the entire group of gilts that completed the test regardless to subjective judgment. If gilts are culled before end of test, PBV was bias (Appel *et al.*, 1998). Numbers of measured sibs did not affect accuracy of PBV for fattening traits in gilts (Malovrh *et al.*, 2012).

The objective of this paper was to investigate the effect of group size on accuracy of PBV for days on test and backfat thickness in gilts.

2 MATERIAL AND METHODS

The analysis included data from maternal genotypes, which are used in prediction of breeding value. Gilts belonged to four genotypes: Slovenian Landrace – line 11, Slovenian Large White, hybrid 12 and hybrid 21. Contemporary group represented gilts of the same genotype, which were measured at the owner on the same test day (Kovač *et al.*, 2004). At the end of test, animals were weighed and backfat thickness was measured.

Breeding values for days on test and backfat thickness were predicted with two trait animal model (Gorjanc *et al.*, 2004). Statistical model for days on test included season and genotype as class effects, while owner, common litter environment and direct additive genetic effect were random effects. Model for backfat thickness also included body weight nested within genotype using linear regression.

Accuracy (eq. 1) was calculated from additive genetic variance (σ_a^2) and prediction error variance (PEV, Mrode, 1996). PBV for days on test and backfat thickness and theirs PEV were predicted with PEST package (Groeneveld *et al.*, 1990).

$$r = \sqrt{1 - \frac{PEV}{\sigma_a^2}} \qquad (1)$$

3 RESULTS AND DISCUSSION

Distributions of contemporary group size are shown only for purebred animals of both maternal breeds. Group size (darker columns) and number of gilts (brighter columns) are presented in figure 1 and 2. First column presents selected gilts, which have not been tested, where gilts selected in production level were included, while unmarked animals with unknown pedigree were not included.

Group size distribution for Slovenian Landrace – line 11 is shown in Figure 1. Proportion of untested gilts

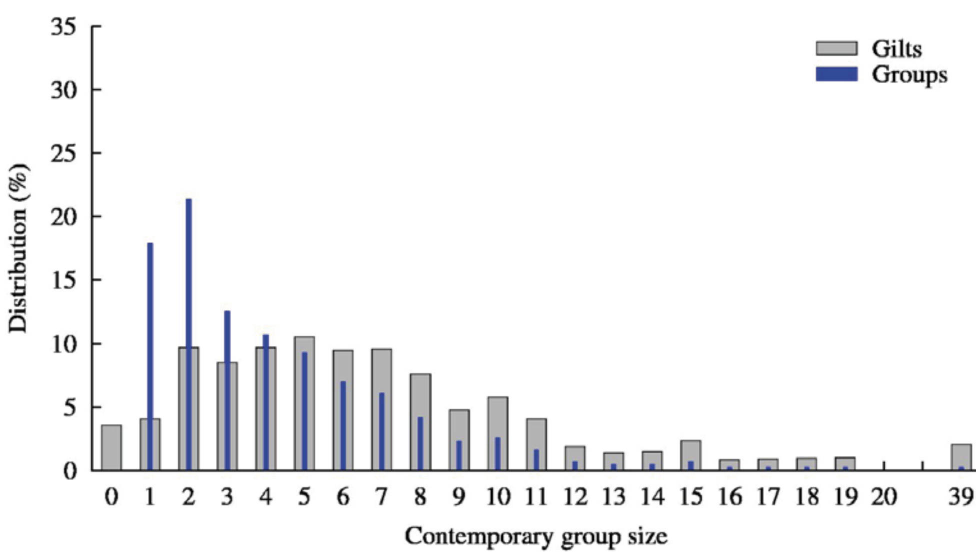

Figure 1: *Distribution of contemporary groups for Slovenian Landrace – line 11*

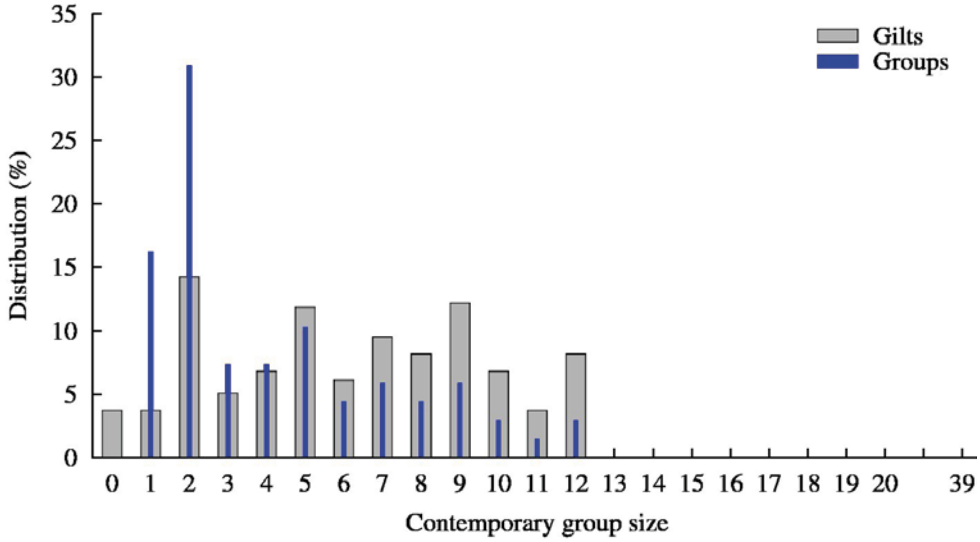

Figure 2: *Distribution of contemporary groups for Slovenian Large White*

represented 4% from all gilts. One seventh of all gilts were tested in groups with one or two gilts. Less than one fifth of gilts were tested in group with 10 or more. Maximum group size was 39. Proportion of groups with more than 10 gilts was also small. Contemporary groups were larger than ten in less than 8%. In most cases, only two purebred gilts were tested in group. In over 38%, groups with only one or two gilts were tested.

Group size in Slovenian Large White is smaller due to smaller population. One fifth of gilts were tested in groups with one or two animals (Figure 2). More than half gilts were tested in groups with three to ten measured gilts. Maximum group size was 12. Almost half of groups included one or two animals. Group size was larger than ten in 7%. In this case 18% of gilts were tested in groups of this size. Like in Slovenian Landrace – line 11, proportion of untested animals was around 4%.

Size of groups is an issue, since contemporary group consist of only one or two animals (Figure 1, 2). In contemporary group at least ten animals per genotype have to be tested (Kovač *et al.*, 2005), while 20 gilts in group is better (Gadd, 2003). However effect is correctly estimated if there are at least 30 measurements on level. Smaller herds can reach larger group with weaning synchronization, planed mating, and increasing of productivity. In small herds, sufficient number of animals can also be obtain with selection on two to three weeks, while the larger farms select weekly (Gorjanc *et al.*, 2004).

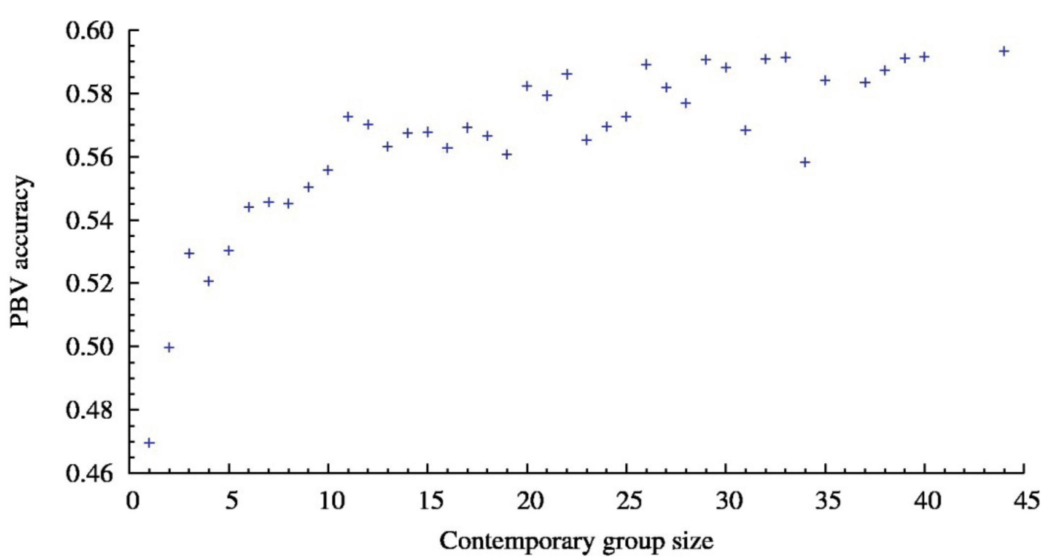

Figure 3: *Correlation between contemporary group size and PBV accuracy for days on test*

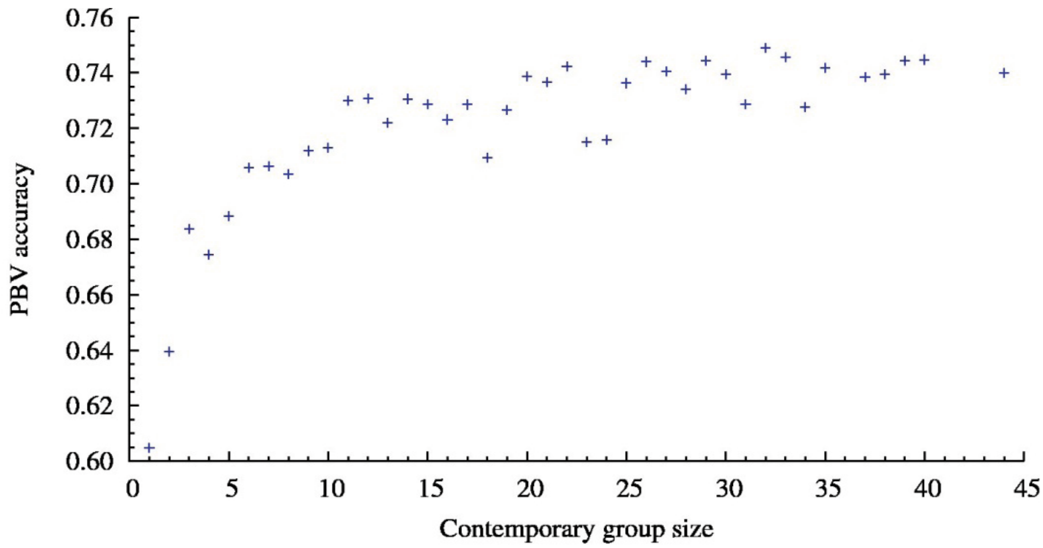

Figure 4: *Correlation between contemporary group size and PBV accuracy for backfat thickness*

Gilts are housed in group during field test to establish social environment. Groups must be separate by genotype, because animals have different requirements. Crossbred gilts grow faster and are more vital. If crossbred and purebred gilts are mixed in the same group, purebred are lower on social rang, therefore they are less productive. Gilts are not housed under the same conditions in spite of the fact they are in the same pen. Crossbred gilts express more competitive behavior then purebred. Purebred gilts under that condition are often target of culling before end of field test.

Group size affects accuracy of PBV: accuracy is higher in larger groups and lower in smaller groups (Figure 3, 4). PBV accuracy for days on test increased from 0.47 to 0.59 (Figure 3). Groups with 10 to 20 gilts reached plateau at accuracy 0.56, while in larger groups accuracy of PBV increased on 0.58. Accuracy for backfat thickness is higher, due to higher heritability. Heritability for backfat thickness was 0.28, while heritability for test on days was lower (0.08). PBV accuracy for backfat thickness varied from 0.60 to 0.70 (Figure 4). Accuracy was 0.72 for groups with ten to twenty, in larger groups accuracy was around 0.73.

PBV is more accurate in larger groups (Figure 3, 4). In statistical analysis environmental effects are better estimated if contemporary groups are larger. In this way phenotypical traits are released from ungenetic component, so accuracy of PBV is higher. Accuracy also depends on technology of test (data quality) and quantity of data. Technological irregularities cannot be repaired with measurements, superficially measuring cannot be improved with analysis. Accuracy of PBV is also higher when more information on relatives become avaliable (Bates, 1999). On contrary results from Malovrh *et al.* (2012) showed that numbers of measured sibs did not affect accuracy of PBV for fattening traits in gilts.

4 CONCLUSION

Accuracy of PBV increased with number of animals tested in contemporary group. Analysis showed necessity to increase group size. It is important to measure all gilts, including those which we preliminary assume they will not be selected, because they contribute to accurate PBV. Prior culling of animals reduces variability and PBV is less accurate. For genetic improvement more animals have to be measured, because selection and genetic response depends from ratio between tested and selected animals.

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