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THE EFFECT OF SCOPE OF ANALYZED DATA ON ACCURACY OF SELECTION INDICES FOR EVALUATION OF SOW BREEDING VALUE

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Abstract: Objective of this paper was to establish to what extent the accuracy of constructed selection indices will be changed depending on the scope of analyzed data relating to fertility based on which parameters necessary for construction of selection indices (SI) were established. Fertility results of Swedish Landrace sows obtained on three farms in Republic of Serbia (farms 1, 2 and 3) were analyzed. Parameters necessary for construction of SI were determined by application of different mixed models of the method of Least Squares. For each farm three SI were constructed for evaluation of sow breeding value based on realized fertility in the way that parameters necessary for SI construction were calculated based on fertility results in the first (SI1), first two (SI2) and first three farrowings (SI3). Accuracy of constructed Sis varied within following limits – from low r_{IH} = 0.255 (SI3 for Farm 2) to r_{IH} = 0.405 (SI1 for Farm 3), and only in the case of SI_2 for Farm 2 it was in the category of very low (r_{IH} = 0.231). Introduction into analysis of fertility results realized in the second and third farrowing resulted in decrease of accuracy of constructed selection indices.

Key words: sows, breeding value, selection index, correlation between index and aggregate genotype

Introduction

One of the main goals of selection of any species of domestic animals is to obtain the highest possible effect of the selection. In this sense, it is of special importance to achieve the highest possible accuracy of evaluation of breeding value of animals considering it's direct influence on realized results of selection. Total breeding value of an animal is determined by great number of quantitative traits. Selection index is one of linear methods based on simultaneous selection on more traits. Breeding value of an animal is expressed cumulatively in selection index which is in maximum correlation with aggregate genotype.

Criteria for choice of selection index that will be applied for evaluation of breeding value of animals is correlation between index and aggregate genotype (r_{IH}), as parameter which reflects accuracy of selection when certain method is used. Value of this parameter in research presented by *Irvin (1975)* varied from r_{IH} = 0.550 to r_{IH} = 0.690 depending on the traits that were included in the index for evaluation of sow breeding value based on fertility traits.

Gajić et al. (1979) presented that breeding value of sows for fertility traits can most accurately be evaluated is the selection index is constructed based on number of live born piglets, mass of litter on the second day subsequent to farrowing, number of reared piglets and mass of litter on 28th day. It was established that value of correlation coefficient between index and aggregate genotype was higher (r_{IH} = 0.610 in relation to r_{IH} = 0.470) when parameters necessary for construction of index are calculated based on fertility results realized in first three farrowings and not only based on the first one.

Similar conclusions were made also by *Knap (1986)*. He stated that accuracy of selection index is increased from r_{IH} = 0.180 to r_{IH} = 0.460 if parameters are calculated based on realized fertility in first four farrowings in relation to situation when parameters are calculated based on fertility of primiparous sows.

Accuracy of selection index was r_{IH} = 0.380 in the research presented by *Dufek and Buchta (1987)*, whereas, considerably higher accuracy of selection index for fertility traits were established by *Korotkov (1987)*. Selection index constructed based on litter size at birth and weaning, as well as evaluated milk yield of sows was connected to aggregate genotype in the value of r_{IH} = 0.590 as stated by authors.

Accuracy of constructed indices for evaluation of breeding value of female breeding animals based on realized fertility can vary based on traits included in aggregate genotype and scope of analyzed data used for calculation of necessary parameters essential for their construction, as presented by *Radojković et al. (2006)*. Correlation coefficients in this research varied in the interval from 0.346 to 0.472 when they were calculated based on parameters determined on the basis of analysis of the fertility in primiparous sows, from r_{IH} = 0.410 to r_{IH} = 0.502 when analysis included also results of first two farrowings, i.e. 0.327 to 0.479 when fertility in first three farrowings was analyzed.

Objective of this paper was to establish to what extent the accuracy of constructed selection indices will change depending on the scope of analyzed data on fertility based on which the parameters necessary for construction of selection indices were established.

Materials and Methods

Parameters necessary for construction of selection indices were established based on fertility results of Swedish Landrace sows realized on three farms in Republic of Serbia (Farm 1, 2 and 3). Number of sows included in the research on three farms varied from 1677 (Farm 2) to 2422 (Farm1), whereas the number of sires was the lowest on the Farm 3 (61), and the highest on the Farm 1 (84). Average number of daughters per sire varied from 23.75 on Farm 2 to 33.39 on Farm 3. Analyzed data included realized fertility of sows which originated only from sires with ten and more daughters. This is minimum number of progeny which provides objectivity of established genetic parameters when additive component of heritability is evaluated by method of intraclass correlation of half-siblings according to the sire.

Since objective of this research was to determine to what extent accuracy of this method of selection depends on the scope of data used in analysis, sub selection of data was carried out, i.e. from basic data sets for each farm three groups of data were separated. First group included fertility results of sows realized only in the first farrowing, the second group included results from first two farrowings and the third group in first three farrowings. This step was undertaken in order to observe potential differences occurring in regard to accuracy of the evaluation of breeding value of animals depending on the fact what scope of data was used for evaluation, which is especially important in traits which are repeated several timed during production life. Since duration of genetic interval is a value on which, among other things, the effect of selection is directly dependant, it is of great significance to evaluate to which extent the evaluations of breeding values, based on first result for certain traits during production life of an animal, are reliable. In this case, these are fertility results realized in the first farrowing, i.e. evaluation of breeding value of the animal based on these results. Fertility traits of sows on Farms 1, 2, and 3 were analyzed in the first (2422, 1677 and 2015 litters), in the first two (4190, 2897 and 3377 litters) and in the first three (5576, 3809 and 4425 litters) farrowings. Aggregate genotype of fertility traits of sows in this research is presented by number of live born piglets (LBP) and number of reared piglets (RP) in litter.

Establishing of parameters necessary for construction of selection indices was carried out by application of mixed models of the method of Least Squares, and for this purpose software package "LSMLMW and MIXMDL, PC-2 VERSION" was used *(Harvey, 1990)*.

Based on established parameters and relative ratios of economical values of observed traits determined by method presented by *Vukelić et al. (2004)*, three selection indices were constructed for evaluation of breeding value of sows based on realized fertility for each of analyzed farms. For matrix calculations necessary

for construction of selection indices adequate procedures (IML) of the program package "SAS/STAT" were used *(SAS Inst. Inc., 2001)*.

Accuracy of selection indices as method for evaluation of breeding value of sows was assessed using correlation coefficient between index and aggregate genotype (r_{IH}).

Results and Discussion

Established values of partial regression coefficients of constructed selection indices, as well as values of corresponding correlation coefficients between index and aggregate genotype are presented in Table 1.

Table 1. Equations of selection indices (SI) constructed based on parameters established by analysis of different scope of data on farms and corresponding values of correlation coefficients between index and aggregate genotype (r_{IH})

FARM	SELECTION INDEX	r_{IH}
1	SI1[1] = 0.1614 (x_1[2] - $\bar{x}_1$) + 0.0404 (x_2 - $\bar{x}_2$)	0.393
	SI2 = 0.1067 (x_1 - $\bar{x}_1$) + 0.0505 (x_2 - $\bar{x}_2$)	0.321
	SI3 = 0.0721 (x_1 - $\bar{x}_1$) + 0.0384 (x_2 - $\bar{x}_2$)	0.266
2	SI1 = 0.0463 (x_1 - $\bar{x}_1$) + 0.0902 (x_2 - $\bar{x}_2$)	0.289
	SI2 = 0.0417 (x_1 - $\bar{x}_1$) + 0.0441 (x_2 - $\bar{x}_2$)	0.231
	SI3 = 0.0621 (x_1 - $\bar{x}_1$) + 0.0201 (x_2 - $\bar{x}_2$)	0.255
3	SI1 = 0.1653 (x_1 - $\bar{x}_1$) + 0.0478 (x_2 - $\bar{x}_2$)	0.405
	SI2 = 0.0939 (x_1 - $\bar{x}_1$) + 0.0475 (x_2 - $\bar{x}_2$)	0.308
	SI3 = 0.1002 (x_1 - $\bar{x}_1$) + 0.0427 (x_2 - $\bar{x}_2$)	0.314

[1] - SI1: parameters necessary for construction of SI determined based on fertility realized in the first farrowing SI2: parameters determined based on fertility realized in the first two farrowings, SI3: parameters determined based on fertility realized in the first three farrowings

[2] - x_1: number of live born piglets of an individual animal for which the SI value is determined; $\bar{x}_1$: average value for number of live born piglets in observed population; x_2: number of reared piglets of an individual animal for which the SI value is determined; $\bar{x}_2$: average value for number of reared piglets in observed population

Accuracy of selection indices obtained by analysis of fertility results realized on the Farm 1 varied in the interval from r_{IH} = 0.266 (SI3) to r_{IH} = 0.393 (SI1), and it was the highest when genetic and phenotypic (co)variances were calculated based on fertility realized in the first farrowing. Introduction into analysis of fertility results realized in the second and third farrowing caused permanent

decrease of values of determined correlation coefficients between index and aggregate genotype.

In case of selection indices constructed based on parameters evaluated by analysis of fertility results realized on Farm 2, accuracy varied in the interval from r_{IH} = 0.231 (SI2) to r_{IH} = 0.289 (SI1). In this case, also, the accuracy was the highest when parameters necessary for construction of SI were calculated based on fertility of primiparous sows.

Similar tendencies in change of accuracy of SI depending on the scope of analyzed data in evaluation of parameters necessary for their construction were demonstrated in case of Farm 3. Accuracy of observed selection method was the highest when parameters were evaluated based on fertility results obtained in the first farrowing (r_{IH} = 0.405), and the lowest when basis for evaluation of parameters was fertility realized in the first two farrowings (r_{IH} = 0.308).

Accuracy of selection indices constructed based on parameters evaluated by analysis of fertility results realized on observed farms varied within limits of low, and only in case of SI2 for Farm 2 it was in the category of very low. These results were expected considering that traits included in the aggregate genotype (LBP and RP) are considered as traits of low heritability.

In this research, accuracy of selection indices varied in the interval from r_{IH} = 0.231 (SI2; Farm 2) to r_{IH} = 0.405 (SI1; Farm 3). In accordance with presented interval of values of observed parameter are values which were obtained also by *Dufek and Buchta (1987)* as well as *Radojković et al. (2006)*, when accuracy was established for SI constructed based on same traits as in this research, whereas values were higher when aggregate genotype included also mass of litter at weaning.

Results presented by *Irvin (1975)*, *Gajić et al. (1979)*, *Knap (1986)* and *Korotkov (1987)* state that correlation between index and aggregate genotype, in which different fertility traits were included, can be considerably higher than the one determined in this research.

Results obtained in this research relating to change of the value of correlation coefficient between index and aggregate genotype dependant on the scope of analyzed data based on which parameters necessary for the construction of SI were evaluated are contrary to results obtained by *Gajić et al. (1979)*, *Knap (1986)* and *Radojković et al. (2006)*. Namely, in stated researches, accuracy of SI increased with the expansion of the scope of analyzed data, which was not the case in this study.

Established differences in regard to obtained results, among other things, could have been caused by the fact that within the aggregate genotype in different researches different fertility traits were included, and that in evaluation of parameters different scope of data was analyzed, that sows have realized these results in very different production conditions, that different pig breeds have been

in question, and that for evaluation of parameters different methodical approaches have been used as well as models within them.

Conclusion

Accuracy of selection indices constructed based on parameters evaluated by analysis of fertility results on observed farms varied within limits of low r_{IH} = 0.255 (SI3 for Farm 2) to r_{IH} = 0.405 (SI1 for Farm 3), and only in case SI2 for Farm 2 it was in the category of very low (r_{IH} = 0.231).

Introduction into analysis of fertility results of sows realized in the second and third farrowing resulted in decrease of accuracy of constructed selection indices.

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D. Radojković, M. Petrović, M. Mijatović, Č. Radović

Rezime

U ovom radu rezultati istraživanja su pokazali da je tačnost selekcijskih indeksa konstruisanih na osnovu parametara ocenjenih analizom rezultata plodnosti (BŽP i BOP) ostvarenih na posmatranim farmama bila od r_{IH} = 0.255 (SI3 za Farmu 2) do r_{IH} = 0.405 (SI1 za Farmu 3), a samo je u slučaju SI2 za Farmu 2 bila u kategoriji jako slabe (r_{IH} = 0.231).

Povećanje obima analiziranih rezultata plodnosti dovelo je do smanjenja tačnosti SI.

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