Application Possibilities of Selection Indices in the Pannon Ka Rabbit Breed

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Summary

The Pannon Ka is a synthetic breed which can be used as a maternal crossing partner in the Pannon breeding program of the University of Kaposvár, Hungary. In the present study genetic parameters of the number of kits born alive (NBA) and the litter weight at 21 days of age (LW21) were estimated, and a two trait selection index was created in order to test the possible modification of the selection process of this breed. 14465 NBA and LW21 records were collected from 3509 Pannon Ka does between 1999 and 2016 and the total number of animals in the pedigree was 5627. NBA and LW21 were analyzed jointly in a two-trait animal model which was used to estimate the variance components and to predict the breeding values. The considered fixed effects in the model were parity and year and month of kindling. The covariate factors were the number of kits after equalization and age of the kits at measurement for LW21. The random effects were permanent environmental effect and the additive genetic effect for both traits. The estimated heritability of LW21 and NBA were 0.1±0.01 and 0.06±0.01, respectively. Genetic correlation between the traits was 0.16±0.06. The created selection index had a 50-50% contribution of the measured traits. Nevertheless, the selection index scores showed stronger correlation (0.98) with NBA, than with LW21 (0.36) due to its economic importance.

Key words

selection index; breeding value; economic weights; rabbit selection

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Introduction

The main purpose of animal breeding is to improve livestock genetically so, the next population should have better performance than the previous one. For this reason, the whole selection process should not focus on the genetic merit of the current individuals but on the expected merit of the next generation. To build an organized structure for the breeding process, the breeding goal has to be defined. This requires the specification of traits which can genetically improve the population. Thus, the accuracy of breeding value estimation plays an important role in the process, because it shows the amount of the transmitted genotypic value to the offspring. Therefore, the parental generation has to contain individuals with the best breeding values (Oldenborek and Waaj, 2015).

The direct estimation of the breeding value requires specific technical background such as DNA markering, so breeders have to apply phenotypic observations which combine genetic and environmental factors and use a linear model to evaluate the genetic merit of the animals (Henderson, 1975).

For breeding value estimation BLUP method is widely used in the practical animal breeding. Making meat production more intensive, rabbit breeders frequently use three-way crossbreeding schemes, and select lines for paternal and maternal traits to take the advantage of positive heterosis (Baselga, 2004). Some breeding programs operate with profit models, which are able to help the breeder to rank the traits by the mathematical relationship of inputs and outputs (Amero and Blasco, 1992). Therefore the profit function can easily form the breeding goal because it is expressed in terms of economic values of the desired traits, so a number of equations can be calculated if the trait is improved by one unit, how much more profit can be expected.

In our case, Pannon Ka is a synthetic breed which can be used as a maternal crossing partner in the Pannon breeding program, of the Kaposvár University Hungary. This rabbit breed is selected to litter weight at 21 days of age (LW21). But from the economic point of view, the assumed value of the number of kits born alive (NBA) represents greater part of the profits (Eady and Garreau, 2008).

Hazel (1943) worked out a technique to make the selection more effective by using selection indices with appropriate weighting to develop all the measured traits in the breeding goal. These assigned values to the traits are different from breed to breed, region to region and they may change as the market changes. In the Pannon breeding program, the traits of each rabbit line's breeding goal have to be improved simultaneously. However, these traits are not always correlated with each other positively, this fact gave us the idea to make an equation from the breeding goal traits, and test the possibilities of index selection for the maternal line, Pannon Ka.

The aim of the study was to create a selection index between the current selection criteria trait (LW21) and the number of kits born alive to make the breed more profitable as a maternal partner.

Materials and methods

The present analysis was conducted based on 14465 records collected between 1999 and 2016 for litter weight at 21 days (LW21) and the number of kits born alive (NBA). LW21 and NBA data were produced by 3509 does and the total number of animals were 5627 in the pedigree file. One kindling batch was chosen, where the insemination date was 24th of June 2016. A 49-day reproduction rhythm was used with overlapping generations. The average number of the Pannon Ka does and bucks were: 160:60, and approximately 700 kits were born in one cycle and 40 individuals were chosen for further breeding after the selection process. The growing rabbits were housed in a closed rabbit house at the experimental farm of the Kaposvár University in wire mesh cages (0.30 x 0.48 x 0.31 cm). They were fed *ad libitum* with a commercial pellet (16.3% crude protein, 17.7% crude fiber, 10.6 MJ DE/ kg) until weaning (35 days). The current selection was performed in one step at 10 weeks of based on a single-trait (LW21) REML and BLUP evaluation (Groeneveld, 1990, Groeneveld et al., 2008). The descriptive statistics of the measured traits had been summarized in Table 1.

In the present study, LW21 and NBA were also analyzed using REML procedure in order to estimate genetic parameters. LW21 of the successive parities and NBA were analyzed jointly using a two-trait animal model. The structure of the applied model is given in Table 2.

After the estimation of the genetic parameters, a selection index and the absolute economic weights were calculated for LW21 and NBA, with SelAction software and transformed with Z-transformation.

The form of the final index was as follows:

Index=6.5435*LW21+1.136*NBA (*mean*=100, *S. D.*=20)

The index calculation was followed by ranking each individual (from 1 to 25) according to the estimated breeding values of LW21, NBA, and the index in each buck group. With this method, the growing rabbits got three rank numbers in the selection process.

Table 1. The descriptive statistics of the examined traits

Trait	No. of records	Mean	S.D.
Litter weight at 21 days of age (LW21)	14 465	3.00	0.62
Number of Kits born alive (NBA)	14 465	9.29	3.13

Table 2. The structure of the applied animal model

Effect	Type	Levels	Traits	
			LW21	NBA
AE	C	1	x	-
AGE21	C	1	x	-
PAIRITY	F	4	x	x
YEARMONTH	F	193	x	x
A	A	5627	x	x
PE	R	3509	x	x

AE: Number of kits after equalization; AGE21: Exact age of the kits at 21 days of measurement; PARITY: Parity number of the doe; YEARMONTH: Year and month of kindling; A: Additive genetic effect; PE: Permanent environmental effect

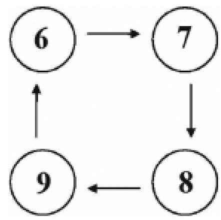

Figure 1. Applied circular mating scheme. The arrow shows the direction of the male transfer (Nagy et al., 2010)

The regular mating scheme applied by the rabbitry of Kaposvár University includes four buck groups (numbered with 6; 7; 8; and 9) with a circular mating plan to avoid inbreeding. The mating schedule is given in Figure 1. To calculate the genetic progress between the normal selection process, another mating plan was created with the index-selected rabbits. This plan was optimized by selecting sires and dams with one criterion: to maximize the breeding values of the litters to LW21 and NBA. The statistical anayisis were performed in R software with RCMNDR 2.4.1 package for the distribution of the selected individuals.

Results and discussion

The estimated heritabilities, genetic correlations, and standard errors were summarized in Table 3. The heritability of NBA was low. Gyovai et al. (2008) and Nagy et al. (2010) estimated similar results in the maternal breed. The LW21 has moderate heritability, and similar results were published previously by other authors (Rastogi et al., 2000; Moura et al., 2001). The distribution of the selected and non-selected individuals was depicted in Figure 2. and 3., where the blue rank numbers represent the selected individuals. The compared ranks of the regular and the index selection method were described in Table 4. and 5. The rank numbers of the indices were in between the LW21

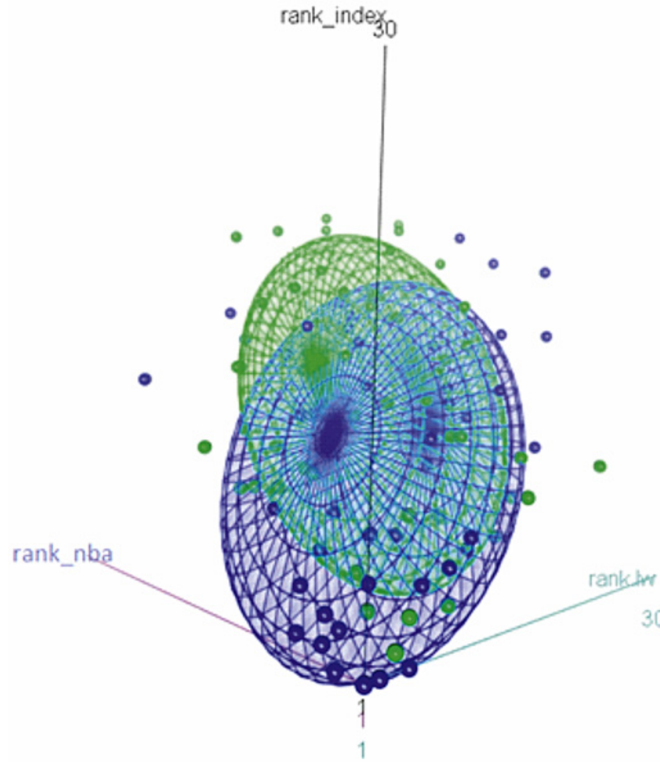

Figure 2. Distribution of the index ranks based on the regular selection

Table 3. Heritabilities, genetic correlations and standard errors of the measured traits

Trait	LW21	NBA
LW21	0.1±0.01	0.16±0.06
NBA	–	0.06±0.01

LW21: Litter weight at 21 days; NBA: Nuber of kits born alive

Table 4. Litters selected by the traditional process

Buck groups	Number of litters	Number of selected litters	Mean of LW21 ranks	Mean of NBA ranks	Mean of index ranks
6	22	11	10.47	11.04	10.70
7	28	12	13.50	14.38	14.10
8	28	11	12.00	13.91	12.90
9	20	13	10.50	11.00	10.70

Table 5. Litters selected by the index

Buck groups	Number of litters	Number of selected litters	Mean of LW21 ranks	Mean of NBA ranks	Mean of index ranks
6	11	11	6.54	7.00	6.70
7	28	12	10.38	8.15	8.30
8	28	11	9.00	8.16	8.20
9	26	13	8.38	7.23	7.75

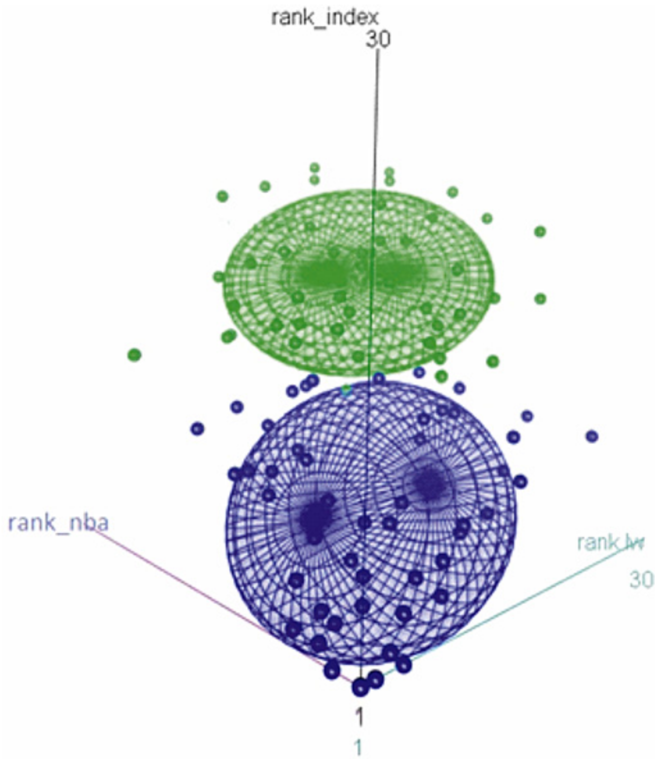

Figure 3. Distribution of the index ranks based on the index selection

and NBA in every buck group and a progress was experienced in each group. The selection index put more weighting factor to the NBA due to its economic importance (Eady and Garreau, 2008, Chartuche, 2014). The genetic progress in NBA and reduction in LW21 were summarized in Table 6. The NBA increased by 4.25% due to the index selection, however, the LW21 decreased with 8.5%. The selection index showed a stronger correlation with the NBA (0.98) than with LW21 (0.36), thanks to this finding, the rabbit farm can earn more profit.

Conclusions

Some traits can be included in the breeding goal only to maintain the reproductive and growing performances. The improvement of reproductive traits with low heritability causes difficulties in breeding programs, but selection indices can help to overcome this problem and make more profit in rabbit breeding even if the measured traits are not positively correlated. According to these results, some selection criteria could be changed to reach more profit and genetic progress for the reproductive traits in the Pannon Ka rabbit breed.

Table 6. Genetic progress and reduction with the application of the selection index for the Pannon Ka

Reduction in LW21 (%)	Progress in NBA (%)
-8.5	4.25

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