

EVALUATION OF FOALS SIRED BY STALLIONS BELONGING TO VARIOUS CLASSES OF DESCENT*

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Abstract

The evaluation concerned the progeny born to Polish pedigree stallions, to Polish-born stallions by imported sires, and to stallions imported to Poland. All traits (type, body conformation and development, health status and movement) were evaluated on a point scale. A highly significant effect of stallion on his progeny evaluation was observed. The highest mean for the total points in foal evaluation was noted for the offspring of imported sires. That class differed highly significantly from the foals by Polish-origin stallions and the foals by Polish-born stallions with imported sires. The gathered results clearly show the changes in purpose type over the years, and, consequently, in horse conformation. Horses have been becoming more noble in type, and their competitive potential has been increasing.

Key words: stallions, foal evaluation, descent

In the contemporary riding horse breeding industry it is a sport that defines the requirements for the breeders to meet. Present trends in the competition horse market show increased interest in half-blood horses (Kubacki et al., 2006; Ruhlmann et al., 2009). In sport horse breeding it is the score that counts, therefore breeders use crossbreeding for the possible heterosis effect, taking advantage of breeding success of distinguished and world-renowned stables. Results from performance tests and competitions of young horses are used by major European warmblood horse breeding associations for genetic evaluations (Koenen et al., 2004; Thorén Hellsten et al., 2006). Thorén Hellsten et al. (2006) recommend that test results are encouraged to be used across countries for genetic evaluation of imported stallions and semen.

The Polish horse breeding industry tries to equal the results achieved by leading centres in Western Europe, both by conducting breeding work on local genetic material and by importing valuable stallions or their semen (Kaproń et al., 2000 a, b).

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The aim of the study was to compare the evaluation results for the foals sired by stallions divided into three groups of origin: imported stallions, Polish-born stallions sired by imported sires, and Polish-origin stallions.

Material and methods

The analysis included 1654 foals, born in 1998–2010, by stallions of three classes: imported stallions (imp.), stallions by imported sires (by imp.), and Polish-origin stallions (Pol.). Pedigree information and point evaluation were provided by the Wielkopolska Association of Horse Breeders.

Imported stallions, 10 Polish stallions and 10 stallions by imported sires were chosen randomly. The records were gathered for 1654 foals born in 1998–2010 to selected stallions, however a total number of records analysed was 2010, as some animals had been evaluated twice or three times. The point-scale evaluation comprised type, body conformation and development, health status and movement. A total of points for evaluated traits was also analysed.

Out of 1654 individuals evaluated 1574 were suckling foals or were described as staying with the mares, 264 were yearlings and 172 individuals were older than one year. Only 58 foals were evaluated three times, and 240 were evaluated twice.

Polish-born stallions were entered into the Half-blood studbook and the Wielkopolski horse studbook. Imported stallions were of Belgian Warmblood breed, Hanoverian, KWPN and Oldenburg stud book.

Over half of the analysed group of foals were fillies – 878 individuals. 129 of all the foals had already received a license, and 4 individuals had been refused a license. The remaining animals had not received a license yet.

The particular traits: type, body conformation and development, health status and movement were evaluated on a 1–5 point scale. The maximum of points was 20. The range of the values in the analysed database was between 8 and 20 points.

The values for point evaluation of foals, as well as stallion bonitation are discrete values, therefore it was necessary to use multiplier correction (Žuk et al., 1980). The influence of individual effects on the point value of evaluated traits had been analysed using the model presented below:

$$Y_{ijklmn} = \mu + Y_i + K_j + S_{jk} + G_l + O_m + e_{ijklmn}$$

where:

Y_{ijklmn} – analysed trait (number of points for type, body conformation, health status, movement and the total of points),

μ – the expected value,

Y_i – the effect of year of birth class, $i = 1, 2, 3, \dots, 13$,

K_j – the effect of sire origin class, $j = 1, 2, 3$,

S_{jk} – the effect of sire from the sire origin class, $jk = 1, 2, 3, \dots, 10$,

G_l – the effect of gender class, $l = 1, 2$,

O_m – the effect of foal age class, $m = 1, 2, 3$,

e_{ijklmn} – random error.

The statistical package used for analyses was SAS v.9.1.3. (SAS/STAT 2010). MEANS procedure was used for estimating basic statistical parameters, and CORR procedure was used for estimating Spearman's rank correlation coefficient. The regression line was created with REG procedure, while estimating trends in trait value changes over the analysed years.

The significance of experimental factors was analysed with MANOVA (multiway analysis of variance), using GLM procedure. For detailed comparison of treatment means, Duncan's multiple range test was employed, together with Student's t-test.

Results

The evaluation of foals comprised type, body conformation, health status and movement assessment, and the total of points. From among 1654 foals born to 32 sires, 240 had been evaluated twice, and 58 foals had been evaluated three times. Therefore 2010 observations were used for the analysis. Table 1 includes basic descriptive statistics for the analysed traits.

Table 1. Numerical characteristics of analysed traits

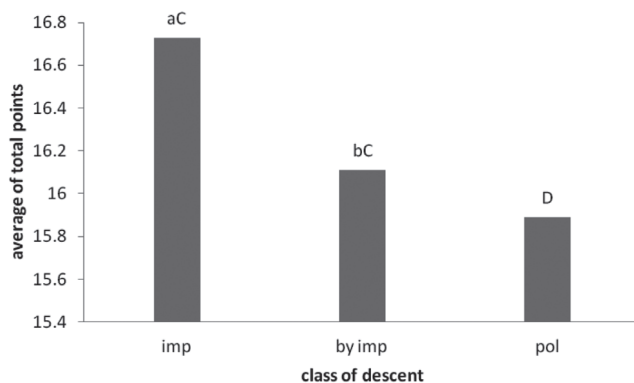
Trait	Code	Mean	StdDev	Min	Max
Type	Type	4.13	0.53	3.00	5.00
Body conformation	Conf	3.98	0.42	2.00	5.00
Health status	Hs	4.08	0.51	1.00	5.00
Movement	Mov	4.04	0.37	1.00	5.00
Total	Total	16.23	1.30	8.00	20.00

Individual stallions belonged to three categories, according to their descent: stallions of Polish pedigree (Pol), Polish-born stallions, by imported sires (by imp.), and imported stallions (imp). Figure 1 presents total point scores for foals by sires of the three categories of descent. Figure 1 a shows mean values of points for type, body conformation and development, health status and movement of foals born to sires of various descent.

The means marked with identical letters are not significantly different. Small letters (a, b, c) describe statistically significant differences ($P \leq 0.05$), capital letters (A, B, C) – highly significant differences ($P \leq 0.01$).

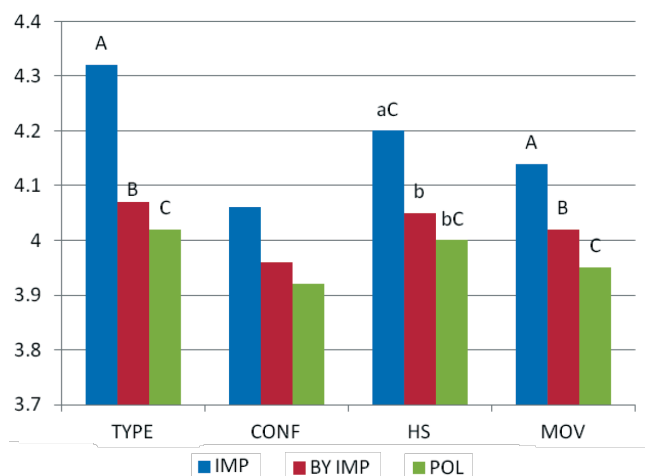
The means marked with identical letters are not significantly different. Small letters (a, b, c) describe statistically significant differences ($P \leq 0.05$), capital letters (A, B, C) – highly significant differences ($P \leq 0.01$).

The investigation of total points achieved for particular traits by the progeny of sires of different origin classes showed that the highest marks had been given to imported stallions' offspring (Figure 1 a) The lowest point value for type, body conformation and development, health status and movement was achieved by the progeny of Polish origin sires.



The means marked with identical letters are not significantly different. Small letters (a, b, c) describe statistically significant differences ($P \leq 0.05$), capital letters (A, B, C) – highly significant differences ($P \leq 0.01$).

Figure 1. Mean values for point evaluation of foals born to sires of various descent



The means marked with identical letters are not significantly different. Small letters (a, b, c) describe statistically significant differences ($P \leq 0.05$), capital letters (A, B, C) – highly significant differences ($P \leq 0.01$).

Figure 1 a. Mean values of points for type, body conformation and development, health status and movement of foals born to sires of various descent

Highly significant differences in the number of points for type, and the number of points for movement had been observed among the three analysed groups of sire origin. Evaluation for health status showed that the imported sires' progeny had achieved highly significantly higher marks than the progeny born to the sires of Polish origin and significantly higher marks than foals born to the stallions by imported sires.

The investigation of mean point values for health and conformation (CONF) proved that the foals born to imported sires achieved the highest marks. Slightly lower point values were obtained by the progeny born to sires by imported stallions, and the lowest point values applied to the foals born to Polish origin sires. There were no statistically significant differences reported for means for the three analysed categories.

The charts below present mean values of points for type, body conformation and development, health status and movement of foals born to stallions by imported sires (Figures 2, 3), to Polish-pedigree stallions (Figures 4, 5) and to imported stallions (Figures 6, 7).

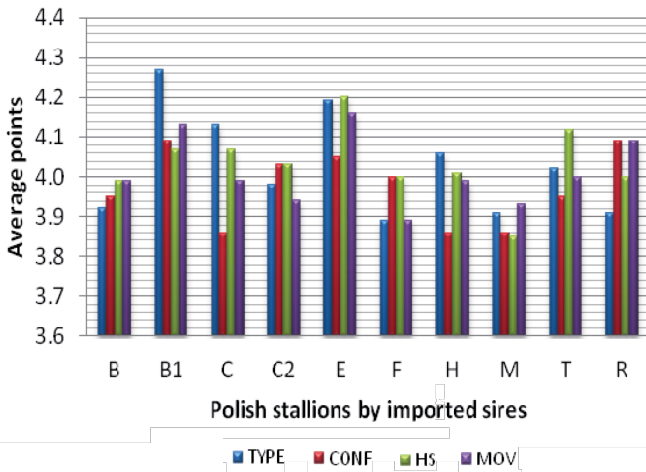
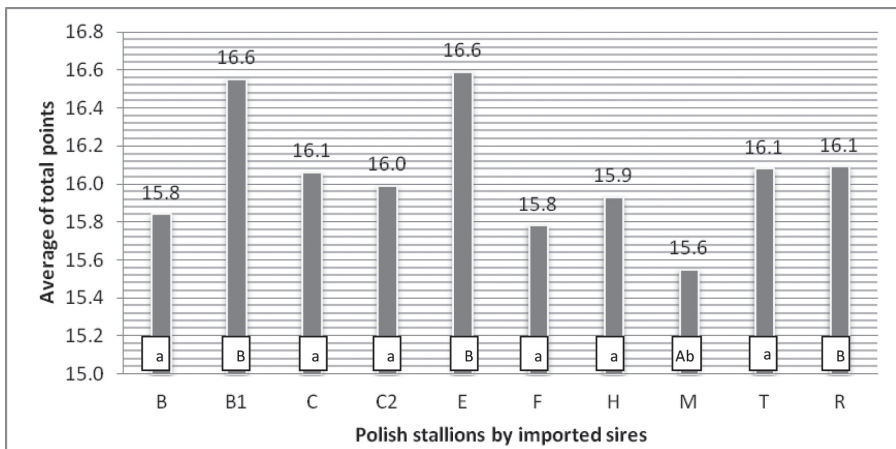


Figure 2. Mean values of points for type (TYPE), body conformation and development (CONF), health status (HS) and movement (MOV) of foals by stallions with imported fathers



Description as in Figure 1.

Figure 3. Mean values of total point score for evaluation of the foals born to Polish stallions by imported sires

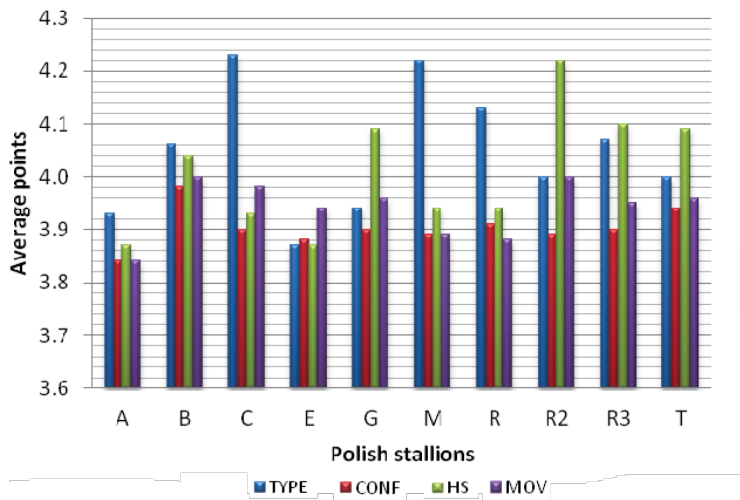
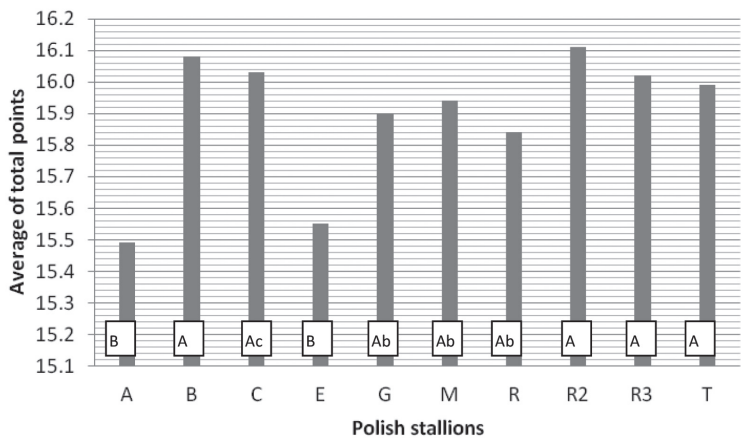


Figure 4. Mean values of points for type, body conformation and development, health status and movement of foals born to Polish stallions



Description as in Figure 1.

Figure 5. Mean values of total point score for evaluation of the foals born to Polish stallions

The highest mean value of total evaluation points had been achieved by foals by imported sires (Figure 1). That class was statistically significantly different from the foals by Polish stallions and by Polish-born stallions by imported sires. The lowest mean had been noted for foals by Polish-born stallions. Statistically significant differences had been reported for mean values of analysed traits for the group of Polish-born stallions and for the group of Polish-born stallions by imported sires. The highest mean value of points for analysed traits had been achieved by foals by imported

sires, a lower level concerned foals derived from sires of “by imp” category, and Polish sires had the lowest level of points for analysed traits (Figure 1 a).

A highly significant effect of sire on the point evaluation had been noted, both for the entire foal database, and for the foals within particular descent groups. In the linear model a sire had been nested within the class of his descent. In that case, as well, the class of descent-sire effect proved to be statistically highly significant.

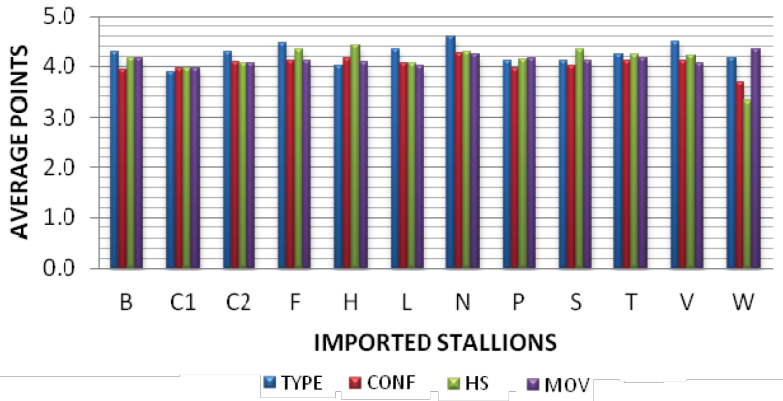
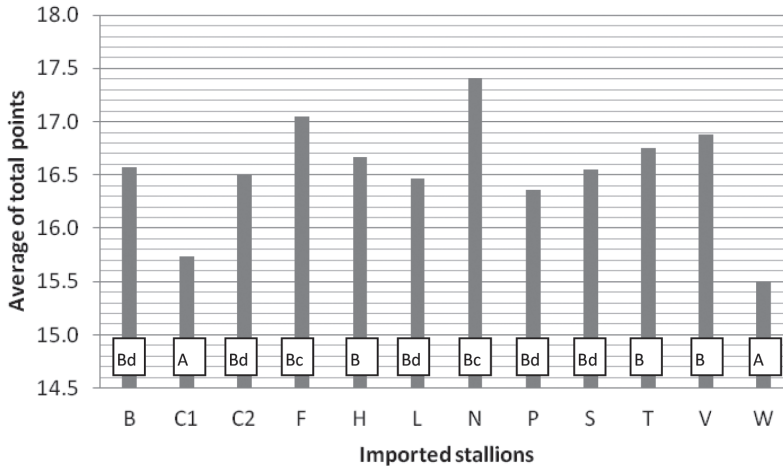


Figure 6. Mean values of points for type, body conformation and development, and movement of foals by imported stallions



Description as in Figure 1.

Figure 7. Mean values of total point score for evaluation of the foals by imported stallions

Figures 2 and 3 present mean values of points for type, body conformation, health status and movement (Figure 2) and the total point score for evaluation of the foals born to Polish stallions by imported sires. The highest mean values of points for type had been noted for the progeny of B1 and E stallions, and the lowest mean values of points for type had been noted for the foals born to F. The differences between means for the above-mentioned stallions were highly significant.

Stallions C and H left behind the progeny with statistically significantly poorer body conformation than R and B. The best health status was reported for the progeny of E and T, and the lowest mean value of that trait was noted for the foals by M.

Respective to the total point score, stallion M differed highly significantly from E and B, and only significantly from the remaining stallions, i.e. T, C, H, C2, B and F (Figure 3).

Figures 4 and 5 present values of evaluation points for foals by Polish stallions. The highest mean values of points for type were achieved by stallions R, M and C (Figure 4). Mean values of points for type for the foals born to those stallions highly significantly exceeded means for the remaining sires' progeny. The poorest mean was noted for E. Stallions A and E achieved the lowest point notes for body conformation and development. The highest point notes for body conformation and development were given to the progeny of B. The differences among means for type were not statistically significant.

Stallion R2 highly statistically significantly exceeded the other stallions as far as the health status of foals was concerned. The means of points for that trait for animals G, R and T were more significant than the means for the progeny of stallions C, M, R, E and A, and for the latter two the lowest values had been noted for that trait. The foals by stallions B and R were characterized by highly significantly better movement compared to the progeny of fathers marked as M, R and A (Figure 4).

While analysing the total point score for evaluation of foals born to Polish sires (Figure 5), it had been noted that the progeny of A and E achieved highly significantly lower notes than the progeny of other stallions. Moreover, the progeny of C got statistically significantly higher point grade than the foals by stallions M, G and R.

Considering the point evaluation of foals by imported sires, one can notice the rare equalization of means (Figure 6). The particular traits (type, body conformation and development, health status and movement) were estimated on the similar level, without the fluctuation of means observed, so typical for foals of Polish origin. Only stallion P had a statistically significantly lower note for the health status of foals, compared to C1 and T.

While analysing means of total point score for foal evaluation (Figure 7), only for 2 stallions (C1 and W) the values lower than 16 points had been reported. The means for the foals of those stallions were highly significantly different from the means for the progeny of other sires. The foals by stallions F and N had statistically significantly better notes than the foals by stallions C2, L, S, B, P, and highly statistically significantly better notes than the progeny of C1 and W.

The foals comprising the analysed database were evaluated at different age. Most of the records (over 95%) referred to foals that stayed with their mothers, and most of those foals were sucklings. The age class at the moment of foal evaluation did not affect the point score value significantly, however the higher mean values for analysed traits had been noted for foals younger than 1 year of age. That group was characterized by slightly higher standard deviation values. The reason for that might had been the poorer equalization of individual foals in the analysed class. Attention should also be drawn to the wide range of results.

Another factor differentiating the foals was gender. Just as in the case of age class, a foal's gender did not affect the evaluation statistically significantly. The highest standard deviation values usually concerned geldings, which proves a considerable differentiation of animals in that gender class. The analysis had also been conducted within the subclasses of stallions' descent. The differences among means for respective classes turned out to be statistically insignificant.

The birth year of foal (1998–2010) statistically significantly affected the value of evaluation points. Besides assessing significance of differences among trait means for the analysed years, a regression line had also been drawn in order to present the point evaluation value trends in the analysed 13 years.

The regression appeared to be significant for the traits of type, body conformation and development, however the regression coefficients were statistically insignificant for health status and movement. Negative values of regression by year of analysis suggest that from year to year foals were obtaining fewer evaluation points. This does not mean that each age-group is worse than the previous one, but that selection has been getting more and more intense.

The breeding market requires not a large number of horses, but individuals of needed type and performance – thus more emphasis is put on type and health status of foals.

Table 2. Spearman's rank correlation coefficients for the analysed traits

	Conf	Health	Mov
Type	0.35 <.0001	0.32 <.0001	0.34 <.0001
Conf		0.30 <.0001	0.33 <.0001
Health			0.33 <.0001

The values of Spearman's rank correlation coefficients together with their significance are presented in Table 2. All the calculated correlations turned out to be statistically highly significant. The correlation coefficient values among type, body conformation and development, health status and movement ranged between 0.3 (correlation among body conformation, development and health status) to 0.35 (correlation between type and body conformation).

Discussion

While analysing the pedigree database it should be noted that Polish competitive horse populations of Half-blood and Wielkopolski breeds include representatives of

renowned Western European breeding lines. This offers hope for success in breeding quality competitive horses in Poland, provided the selection is more intense. The advantageous effect of renowned sires on Polish horse population has also been reported by Byszewski (1997).

Similarly, Arnason and Ricard (2001), Koenen et al. (2004), and Thorén Hellsten et al. (2006, 2008, 2009) pointed to the effect of imported stallions on the breeding value and performance of local population.

Kubacki et al. (2006) indicated a highly significant effect of sire on biometrical traits and bonitation value of half-blood horses, which has also been proved in the present study.

Thorén Hellsten et al. (2009) had analysed the effect of imported sires on breeding value and performance of SWB breed. The Swedish sport horse population had been mostly influenced by Hannoverian breed, and, later in time, by KWPN breed. The authors noted that the horse population in Europe is highly uniform and based on half-blood horses, and not on particular breeds. Due to specific requirements of entering the studbooks, the effect of breed was not considered in the present paper. Breed class was replaced by sire's descent class, which proved to have a highly significant effect on foals.

Koenen et al. (2004) analysed breeding goals of 19 breeding organisations and associations, and noticed that most traits were hardly measurable for competitive horses, so directional selection was difficult to use. It is objectively hard to compare jumping ability or rideability, because they are affected by various environmental factors, e.g. rider effect, competition class, the level of training etc. Moreover, Ruhlmann et al. (2009) suggest that the performance tests for stallions and mares should be more unified, especially in Europe. More precise estimation of breeding values and performance would be possible then, making it easier to draw country comparisons.

Breeding goals optimisation and unification of breeding value estimation methods, just as in the case of dairy cattle breeding, is considered important by Ruhlmann et al. (2009). The authors reported low correlation coefficients among horse breeding values estimated in 7 EU countries (0.08–0.51). In the present research the analysis was performed on the point evaluation of foals. The range of results for investigated classes of descent suggests that it might also be necessary to analyse competitive and breeding perspectives of the foals.

Olsson et al. (2000) estimated genetic parameters for traits evaluated in the Swedish stallion performance test (SPT) and correlations between stallion performance test traits and 4-year-old offspring results from field tests. Heritability coefficients were 0.40 on average. Olsson et al. (2000) concluded that the field tests are well suited for early progeny testing of the stallions, and will improve the accuracy in selection of stallions for performance traits.

The younger we can test the horses with a satisfying heritability, the earlier we can predict the breeding value of the stallions and get a shorter generation interval (Olsson et al., 2000; Koenen et al., 2004; Thorén Hellsten et al., 2006). When we decide to use imported stallions, keeping complete and correct pedigree registers is crucial for the assessment of reliable EBVs of horses. It is especially important to

consider when imported horses are going to be evaluated (Thorén Hellsten et al., 2009).

Summarizing, it has been noted that distinguished sires of Polish origin together with imported stallions improved to great extent the Polish sport horse breeding industry. The significant influence of stallion on his foals' performance has been proved. The best results in the analysed population were noted for imported individuals, exceeding the progeny of stallions by imported sires, and the progeny born to sires of Polish origin.

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ZBIGNIEW SOBEK

Ocena źrebiąt po ogierach o różnym pochodzeniu

STRESZCZENIE

Oceniano potomstwo po ogierach o polskim rodowodzie, po ogierach urodzonych w Polsce, ale pochodzących od importowanych ojców oraz po ogierach importowanych do Polski. Poszczególne cechy: typ, budowa i rozwój, zdrowotność oraz ruch oceniane były w skali punktowej. Stwierdzono wysoko istotny wpływ ogiera na punktową ocenę jego potomstwa. Najwyższą średnią wartość sumy punktów za ocenę źrebiąt odnotowano dla potomstwa po importowanych ojcach. Klasa ta różniła się wysoko istotnie od źrebiąt po ogierach polskich oraz po ogierach urodzonych w Polsce, pochodzących od importowanych ojców. Uzyskane wyniki wyraźnie pokazują, jak na przestrzeni lat zmienia się typ użytkowy, a co za tym idzie, pokrój koni. Konie stają się szlachetniejsze, wzrasta ich potencjał sportowy.