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LINEAR TYPE TRAIT ANALYSIS IN THE SIRE LINES OF THE OLD KLADRUB HORSE

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Linear type evaluations for 32 traits on 214 individuals in the genetic resource of the "Old Kladrub horse" were used to analyse the effect of the sire line, sex (stallions and mares) and age of these traits. The linear model included only the fixed effects for these factors. The present analysis was concentrated on sire lines. The effects of sex and age class were analysed in a preceding paper (Jakubec et al., 1997). In the present paper, the two varieties of the Old Kladrub horse (gray and black) were analysed, too. The traits were grouped according to four body regions: front, body, rear and limbs. For all body regions significant and highly significant differences between the sire lines were found in most of the traits. Thus, the lines showed quite a typical expression of the traits. The lines of SOLO and ROMKE are taller while the line of GENERALISSIMUS is smaller in height. The original and the older lines have a conspicuous convex head profile compared to the lines of RUDOLFO and ROMKE which were founded only recently and brought in genes of the Lusitano and Friesian breeds. The black horses show as a rule a shorter neck and withers than the gray ones. The lines of the gray variety have a broader and deeper chest than the black lines. The gray lines also have a straight back and a longer and more sloped shoulder. The line of ROMKE is longer in the croup than the other ones. The stance of forelimbs and hind limbs is more correct in the gray lines than in the black ones.

Old Kladrub horse; linear type traits; sire lines; analysis

INTRODUCTION

The oldest lines of the Old Kladrub horse were founded at the end of the 18th and at the beginning of the 19th century. Therefore it is an important genetic resource of horses not only on the scale of the Czech Republic and

Europe, but also worldwide. At present the breed is divided into 5 gray sire lines (GENERALE, GENERALISSIMUS, FAVORY, RUDOLFO, SACRAMOSO-GRAY) and 4 black sire lines (SACRAMOSO-BLACK, SOLO, SIGLAVY PAKRA, ROMKE). The initial lines were GENERALE, GENERALISSIMUS, SACRAMOSO-BLACK and NAPOLEONE. The line NAPOLEONE was extinguished in 1922. The rest of the existing lines was established in the 20th century.

The population of Old Kladrub horses is mainly concentrated in the studs of Kladruby nad Labem (gray variety) and Slatiňany (black variety) in Eastern Bohemia. The black variety experienced a dramatic sell-out in the 1930's, and it was not before 1940 that the animals could be gathered again in Slatiňany (Bílek, 1955). After the recovery of the black variety (Dušek, 1992) both varieties together consist now of about 30 stallions and 250 mares.

The Old Kladrub horse is a heavy coach horse and one of the largest breeds of warm-blood horse, strong, kind, with short strides and high knee action. It is described as showing a noble head with a convex face, a muscular and crested neck and sloped shoulders. The body is long and shallow, the hind-quarters are rounded and muscular and the limbs are clean. The extraordinary type and the specific external traits of this breed should be saved for the next generations. It is evident that for such a specific coach horse the breeding objective must be focused on the external type traits. Due to imperial tradition, the breed consists of a gray and a black variety.

In 1995, a new linear type trait classification system was developed for the Old Kladrub horse (Jakubec et al., 1995). The integral parts of this system are the description of colour and aggregate evaluation of type, sex expression, frame, bulkiness, conformation, nobleness, harmony and gaits. This system is based on linear type trait classification systems for horses which were proposed by several authors and partly introduced into breeding schemes (Mahrrens, Schertler, 1987; Holmström et al., 1990; Swalve, Flock, 1990; Preisinger et al., 1991; Weymann, 1992; Van Bergen, Van Arendonk, 1993; Hartmann et al., 1994; Koenen et al., 1994).

Jakubec et al. (1997) used the linear type evaluation for the analysis of the effect of the variety (gray and black), sex (stallions and mares) and age on these traits. Significant differences were found between both varieties in almost two thirds of traits. Significant differences between both sexes were observed in a few traits. Only 12 of 32 traits show significant changes with age.

In the present investigation the variation between sire lines was analysed with regard to the linear type traits.

I. Distribution of individuals for sire lines

Factor	Line									
	1	2	3	4	5	6	7	8	9	10
No. of individuals	10	35	25	14	29	20	36	15	19	11

Line identification:

- 1 – GENERALE GRAY VARIETY
- 2 – GENERALISSIMUS GRAY VARIETY
- 3 – FAVORY GRAY VARIETY
- 4 – RUDOLFO GRAY VARIETY
- 5 – SACRAMOSO GRAY VARIETY
- 6 – SACRAMOSO BLACK VARIETY
- 7 – SOLO BLACK VARIETY
- 8 – SIGLAVI PAKRA BLACK VARIETY
- 9 – ROMKE BLACK VARIETY

10 – GENERALISSIMUS BLACK VARIETY; this is not a sire line in the very sense of the word: The individuals are progeny of a stallion of the line of GENERALISSIMUS GRAY VARIETY and mares of the black variety. The progeny of these matings are also mostly gray. Given the fact that the black lines account for 50 per cent of the genotype of this progeny, this group was evaluated as a separate line from the gray ones.

MATERIAL AND METHODS

A group of three horse classifiers described 214 stallions and mares of the gray and black variety in the herds at Kladruby nad Labem and at Slatiňany. The individuals were aged 3 to 25 years. Of the 32 traits described in Table II, 4 traits were evaluated on 213 individuals, 2 traits on 212 individuals and 1 trait on 211 individuals. The traits evaluated on numbers of individuals different from 214 are indexed in the tables. Data analysis included three main factors: sire lines, sex (stallions and mares) and age. Table I shows the distribution of individuals by sire lines as the distribution for sex and age classes was already given by Jakubec et al. (1997).

All traits were analyzed by the method of least squares using the GLM procedure (SAS, 1997).

The model used for analyzing the data included the following fixed effects:

$$Y_{ijkl} = \mu + LINE_i + SEX_j + AGE_k + e_{ijkl}$$

- where: Y_{ijkl} – observed value of linear type trait
 μ – overall average
 $LINE_i$ – fixed effect of i -th line ($i = 1, \dots, 10$)
 SEX_j – fixed effect of j -th sex – stallion and mare ($j = 1, 2$)
 AGE_k – fixed effect of k -th age group ($k = 1, \dots, 7$)
 e_{ijkl} – random residual error

II. Description of the traits of the linear scoring system

Trait	Scores	
	1	9
Front	measured in cm and transferred by a scale in scores (low – high)	
1. Height at withers	concave	convex
2. Head profile	long	short
3. Neck length	low	high
4. Neck tethering	concave	convex
5. Neck topside	short	long
6. Withers length	low	high
7. Withers height		
Body		
8. Back length	short	long
9. Back vault	weak	straight
10. Loin length	short	long
11. Loin vault	weak	straight
12. Shoulder length	short	long
13. Shoulder shape	straight	sloping
14. Chest girth	measured in cm and transferred by a scale in scores (low – high)	
15. Chest length	short	long
16. Chest width	narrow	broad
17. Chest depth	shallow	deep
18. Breast width	narrow	broad
Rear		
19. Croup length	short	long
20. Croup width	narrow	broad
21. Croup shape	sloping	straight
22. Croup profile (back view)	roofy	vaulty
23. Tail tethering	low	high
Limbs		
24. Forelimbs – front view	narrow	broad
25. Forelimbs – side view	back at the knee	over the knee
26. Bulkiness – cannon bone circumference	measured in cm and transferred by a scale to scores (low – high)	
27. Foretoes – side view	sloping	weak
28. Forehoof – side view	sloping	weak
29. Forehoof width	narrow	broad
30. Forehoof size	small	large
31. Hind limbs – side view	sickle hocked	straight
32. Hind limbs – back view	narrow	broad

RESULTS AND DISCUSSION

The main analyzed factor is the sire line. The factors of sex and age were included in the model in order to eliminate their effects. Sex and age categories had been analyzed as specific factors by Jakubec et al. (1997). Therefore the respective tables for sex and age classes with the subsequent analysis of results and discussion are not given here.

Table II features the frequency distribution for the sire lines. In comparison to the traditional classification of lines into gray (GENERALE, GENERALISSIMUS, FAVORY and RUDOLFO) and black (SACRAMOSO, SOLO, SIGLAVI PAKRA and ROMKE), it can be seen that gray stallions were bred with black mares and vice versa in the past which led to the line of SACRAMOSO GRAY and the breeding group of GENERALISSIMUS BLACK. It is necessary to mention that the formation of gray horses is a relatively easier and faster breeding method than the formation of black horses.

Individuals of the SACRAMOSO GRAY line originated from breeding of stallions of the line SACRAMOSO BLACK to gray mares. Provided that gray horses are as a rule homozygous for the dominant gene G responsible for the gray colour and black horses recessively homozygous for both loci, gg for gray and aa for black colour, the progeny of the breeding of gray and black horses is heterozygous Gg. The progeny of such mating is gray when adult as the gene G is dominant over g even in heterozygous state regardless of whether there is an individual recessively homozygous for black colour (aa) at locus A or not because gene G at locus G interacts epistatically not only with locus A but with other loci as well. In order to allow any colour which may be based also on other loci such as, e.g. locus E or D, the combination at locus G has to be gg. However, it is by now clear and must be emphasized that for horses which get gray the gray colour is based on the locus G and the allele G. Foals are born with different colour and get gray with age so that individuals get entirely gray when adult, i.e. at approximately 7 years of age. However, when adult some individuals were not entirely gray in recent years. This phenomenon can be explained by the possibility that the individuals with different shades of gray have the genotype Gg at locus G and are heterozygous for gray colour. A higher frequency of such light gray individuals can be explained by mutual breeding of gray and black horses.

The change of a gray into a black line is more complex and takes longer time. Mating of gray stallions GG with black mares gg results in gray heterozygous animals. It is only mating between these heterozygous genotypes Gg which creates individuals of this genotype in the proportions: 25 percent GG, 50 percent Gg and 25 percent gg. However, only a quarter of the individuals of the genotype gg has an entirely black phenotype while the pheno-

III. Average scores generated by the method of the least squares (LSM) and standard error (SE)

Trait	Line										Significance
	Gray										
	Generale		Generalissimus		Favory		Rudolfo				
	LSM	SE	LSM	SE	LSM	SE	LSM	SE			
Front											
1. Height at withers	5.65	0.58	4.91	1.33	5.13	0.39	5.54	0.50			
2. Head profile	5.54	0.47	5.99	0.27	5.10	0.32	4.86	0.40			
3. Neck length	5.70	0.32	5.01	0.18	5.36	0.22	6.08	0.28			
4. Neck tethering	6.11	0.25	6.30	0.14	6.08	0.17	6.32	0.21			
5. Neck topside	5.63	0.45	5.44	0.26	5.69	0.30	6.30	0.39			
6. Withers length	5.16	0.32	4.88	0.18	4.98	0.22	5.45	0.28			
7. Withers height	4.89	0.33	4.71	0.19	5.00	0.23	4.71	0.29			
Body											
8. Back length	5.35	0.32	5.08	0.18	5.51	0.22	5.59	0.28			
9. Back vault	4.55	0.23	4.17	0.13	4.38	0.15	4.59	0.19			
10. Loin length	6.14	0.36	5.63	0.20	5.75	0.24	5.90	0.31			
11. Loin vault ¹	4.76	0.30	4.63	0.17	4.68	0.21	4.86	0.26			
12. Shoulder length	4.00	0.20	4.12	0.12	4.08	0.14	4.20	0.18			
13. Shoulder shape	3.82	0.20	4.24	0.11	4.28	0.13	4.41	0.17			
14. Chest girth	6.60	0.71	6.26	0.40	6.77	0.48	5.53	0.61			
15. Chest length	6.22	0.31	5.98	0.18	6.07	0.21	5.74	0.27			
16. Chest width ¹	5.83	0.33	5.82	0.19	6.19	0.23	5.17	0.29			
17. Chest depth	5.65	0.36	5.91	0.20	5.72	0.24	5.43	0.31			
18. Breast width	5.90	0.34	5.81	0.20	6.04	0.23	5.03	0.30			
Rear											
19. Croup length	4.30	0.25	4.20	0.14	4.25	0.17	4.29	0.21			
20. Croup width	5.87	0.30	6.40	0.17	6.14	0.20	6.13	0.26			
21. Croup shape	4.09	0.29	4.50	0.16	4.94	0.20	4.19	0.25			
22. Croup profile (back view)	5.91	0.57	6.37	0.33	5.89	0.39	5.68	0.50			
23. Tail tethering ¹	5.56	0.39	6.54	0.22	5.95	0.27	5.34	0.39			
Limbs											
24. Forelimbs – front view ¹	5.50	0.34	5.79	0.19	6.24	0.23	5.40	0.29			
25. Forelimbs – side view ¹	4.77	0.38	3.53	0.21	4.65	0.25	4.81	0.32			
26. Bulkiness – cannon bone circumference	5.73	0.40	6.25	0.23	6.14	0.27	6.35	0.35			
27. Foretoes – side view	3.90	0.26	4.30	0.15	4.21	0.18	3.89	0.23			
28. Forehoof – side view	4.26	0.25	4.38	0.14	4.38	0.17	4.04	0.22			
29. Forehoof width ²	5.10	0.26	4.89	0.15	5.12	0.18	4.62	0.22			
30. Forehoof size ²	4.53	0.28	5.13	0.16	5.32	0.19	4.61	0.24			
31. Hind limbs – side view	4.17	0.32	3.81	0.18	4.02	0.21	3.90	0.27			
32. Hind limbs – back view ³	4.68	0.28	5.58	0.17	5.64	0.19	5.15	0.24			

¹⁾ n = 213, ²⁾ n = 212, ³⁾ n = 211

Levels of significance: * P < 0.05; ** P < 0.01

of traits of the linear scoring system in sire lines.

Line	Gray		Black								Significance		
	Sacramoso		Solo		Siglavi Pakra		Romke		Generalissimus				
	LSM	SE	LSM	SE	LSM	SE	LSM	SE	LSM	SE			
	5.44	0.36	5.15	0.42	6.08	0.32	5.76	0.48	5.99	0.43	4.01	0.58	*
	7.80	0.29	5.36	0.34	5.16	0.26	6.72	0.39	4.42	0.35	6.20	0.47	**
	5.28	0.20	3.94	0.23	4.64	0.18	4.58	0.27	4.74	0.24	3.85	0.32	**
	6.07	0.15	6.48	0.18	6.45	0.14	6.44	0.21	6.72	0.19	6.30	0.14	
	7.84	0.28	4.04	0.33	5.15	0.25	4.23	0.37	4.86	0.34	5.10	0.45	**
	4.58	0.20	4.25	0.23	3.91	0.18	3.90	0.27	4.28	0.24	3.31	0.33	**
	5.15	0.21	4.60	0.24	3.87	0.19	4.25	0.28	4.25	0.25	3.74	0.34	**
	5.07	0.20	5.57	0.23	5.53	0.18	5.96	0.26	5.85	0.24	5.10	0.32	
	4.47	0.14	3.99	0.16	4.41	0.13	3.51	0.19	3.88	0.17	3.76	0.23	**
	5.29	0.22	6.02	0.26	5.68	0.20	5.81	0.30	5.92	0.27	5.02	0.36	
	4.77	0.19	5.42	0.22	5.03	0.17	4.76	0.26	4.87	0.23	4.79	0.31	
	4.09	0.12	3.38	0.15	3.63	0.11	3.48	0.17	3.46	0.15	3.06	0.20	**
	4.05	0.12	3.54	0.14	3.56	0.11	3.32	0.17	3.57	0.15	3.07	0.20	**
	6.77	0.43	7.04	0.51	7.47	0.39	6.25	0.58	7.23	0.53	6.83	0.71	
	5.51	0.19	5.74	0.22	6.00	0.17	5.66	0.26	6.12	0.23	5.25	0.31	*
	5.21	0.21	4.73	0.24	4.80	0.19	4.53	0.28	4.70	0.26	4.98	0.34	**
	5.56	0.22	5.18	0.26	5.34	0.20	4.79	0.29	4.83	0.27	5.78	0.36	**
	5.11	0.21	4.68	0.25	4.69	0.19	4.59	0.28	4.67	0.26	4.95	0.35	**
	3.98	0.15	3.91	0.18	4.33	0.14	3.91	0.20	4.92	0.18	3.96	0.25	**
	5.88	0.19	5.39	0.22	5.88	0.17	5.32	0.25	6.08	0.23	5.52	0.30	**
	4.18	0.18	4.68	0.21	5.17	0.16	4.70	0.24	3.92	0.22	4.95	0.29	**
	5.63	0.35	5.50	0.42	5.91	0.32	5.51	0.48	6.41	0.43	5.26	0.58	
	6.21	0.24	6.51	0.29	6.39	0.22	5.73	0.32	5.48	0.29	6.03	0.40	*
	5.16	0.21	4.79	0.25	4.76	0.19	4.57	0.28	4.74	0.25	4.86	0.34	**
	4.98	0.23	3.37	0.27	4.04	0.21	4.34	0.31	4.10	0.28	2.80	0.40	**
	6.39	0.25	6.01	0.29	6.67	0.23	5.92	0.34	6.24	0.30	5.81	0.41	
	4.20	0.16	3.87	0.19	3.70	0.15	3.99	0.22	3.64	0.20	3.86	0.27	*
	4.44	0.15	4.21	0.18	4.14	0.14	3.64	0.21	4.10	0.19	4.30	0.25	
	5.41	0.16	4.06	0.19	4.42	0.15	4.41	0.22	4.64	0.19	4.23	0.26	**
	5.38	0.17	4.18	0.21	4.17	0.16	4.43	0.24	4.21	0.21	3.94	0.28	**
	3.70	0.19	3.25	0.23	3.45	0.18	3.64	0.26	3.11	0.24	2.89	0.32	**
	5.12	0.17	4.90	0.21	5.12	0.16	5.07	0.23	4.98	0.21	4.91	0.29	*

type of the genotypes GG and Gg, or 75 percent of individuals, is gray. Black individuals can also be generated by mating of heterozygous gray individuals of the genotype Gg with black individuals of genotype gg. The result in this case is 50 per cent of the recessive homozygous genotypes gg of black colour and 50 percent of the heterozygous genotypes Gg of gray colour. Presently a study of Old Kladrub graying horses is performed in order to find an explanation to the relation between the intensity of the graying of individuals and their genotype GG or Gg.

Table II shows that the frequency of individuals in the sire lines varies in the range from 10 individuals in the line of GENERALE GRAY VARIETY and 11 in the group of GENERALISSIMUS BLACK VARIETY up to 36 individuals in the line of SOLO, 35 of GENERALISSIMUS GRAY VARIETY and 29 of SACRAMOSO GRAY VARIETY. Despite a current attempt to perform matings between lines within the gray lines and within the black lines, it happened in practice that the new line of SACRAMOSO GRAY VARIETY was born.

Although it seems today that gray horses are better bred than black ones, the possibility of mating gray with black individuals can be utilized as an important breeding method to eliminate the risk of a higher proportion of inbred individuals and thus an inbreeding depression. One breeding method also proposed an exchange of sires between lines. However, this breeding method has to go hand in hand with a careful selection of individuals both in the black and the gray varieties and a sensible and high-quality preparation of breeding programmes for the individuals of both lines. Another objection against the mating of gray and black horses is also an excessive variability and low balance of the black population. An important principle of modern breeding methods is to be mentioned here: If there is sufficient variability of the phenotypes and the related genotypes in a population of farm animals, in this case specifically in the Old Kladrub horse breed, a more effective selection is possible in the required direction, or in the given situation, towards the required breeding objective. In the past, extensive "blood refreshment" from foreign breeds was used in order to cut consequences of inbreeding. Given the fact that this is an irreversible process and that genes of these breeds which formed new lines are present in the Old Kladrub breed, these genes can be used after their immigration and the breed's closing towards genes of other, even related breeds for selection within the breed. Moreover, the breed is so numerous at the time being that the inbreeding coefficient can be maintained at a very low level by sires' rotation between lines as shown by previous genetic analyses (Volenec et al., 1995; Jakubec et al., 1996b).

Comparison of sire lines

Table III shows least squares means for the scores (LSM) and standard errors (SE) of traits of the linear scoring system for the sire lines. Significant or highly significant differences between the lines were observed for 24 of the overall 32 traits.

Concerning all traits in the front part of the body, except neck tethering, all differences between the sire lines were significant or highly significant. The lines of SOLO (score of 6.08) and ROMKE (score of 5.99) showed the top height at withers while the groups of GENERALISSIMUS GRAY and GENERALISSIMUS BLACK showed the lowest scores for this trait of 4.91 and 4.01, respectively. A very conspicuous convex head profile is featured by the lines of SACRAMOSO GRAY (score of 7.80), SIGLAVI PAKRA (score of 6.72) and the groups of GENERALISSIMUS BLACK (score of 6.20) and GENERALISSIMUS GRAY (score of 5.99). As expected, the specific head profile was less conspicuously expressed in the lines of ROMKE and RUDOLFO with scores of 4.42 and 4.86, respectively. The correlation between neck length and length of withers seems to be positive as gray horses are longer in these traits than black ones. The top neck length (score of 6.08) and length of withers (score of 5.45) in gray varieties were observed in the line of RUDOLFO. The groups of GENERALISSIMUS BLACK and the line of SACRAMOSO BLACK had the shortest neck with scores of 3.85 and 3.94, respectively, while the group of GENERALISSIMUS BLACK (score of 3.31) and the lines of SIGLAVI PAKRA (score of 3.90) and SOLO (score of 3.91) have the shortest length of withers. The lines of SACRAMOSO GRAY and, at a greater distance of RUDOLFO have the most convex neck topside with scores of 7.48 and 6.30, respectively. The lines of SACRAMOSO GRAY and FAVORY feature relatively high withers with scores of 5.15 and 5.00, respectively.

Differences between lines are not significant in 4 of 11 traits of the body, namely in back length, loin length, loin vault and chest girth. In general terms, gray lines have a straighter back than black ones. Gray lines also feature a longer and more sloping loin than the black ones although these traits show certain fluctuations both in the gray and black varieties. The lines of RUDOLFO and GENERALE feature a straight and firm back with scores of 4.59 and 4.55, respectively. Both the girth and length of chest show an outstanding development practically in all lines. A positive correlation exists also between the chest and breast width; the lines of gray varieties are wider in chest and breast than the black ones. The width at both sites (chest and breast) is largest in the line of FAVORY (scores of 6.19 and 6.04) and smallest in the line of SIGLAVI PAKRA (scores of 4.53 and 4.59). Although

in general gray horses have a deeper chest than black ones, the specific property of the line of GENERALISSIMUS prevails over colour: The groups of GENERALISSIMUS GRAY and GENERALISSIMUS BLACK show quite a deep chest with scores of 5.91 and 5.78, respectively.

Although significant differences between both colour varieties were not observed in the traits of the rear part of the body (Jakubec et al., 1977), different lines featured significant or highly significant differences in all the traits, except in the back view of the croup profile. The line of ROMKE (score of 4.92) shows a slightly longer croup than the other lines although a croup with a score of about 5 is not particularly long. All lines have a relatively broad width and slightly sloping shape of croup and high tethering of tail.

Differences between the lines were not observed in the traits of bulkiness – cannon bone circumference and the side view of forelimbs. Concerning the stance of forelimbs, lines of the gray variety showed a broader front view with the line of FAVORY (score of 6.24) featuring an extraordinary broad stance. The side view of forelimbs is correct as a rule in the lines of both varieties, especially in the gray one. An exception to this rule is the line of GENERALISSIMUS (the black variety with a score of 2.80 as well as the gray one with a score of 3.53) and the line of SACRAMOSO BLACK (score of 3.37) featuring forelimbs strongly back at the knee in the side view. Although there is a significant difference between the lines in the side view of foretoes, this trait seems to be quite normal for all lines. The largest size of forehoof was observed in the line of FAVORY and the group of GENERALISSIMUS GRAY with scores of 5.32 and 5.13, respectively, and the smallest size featured in the group of GENERALISSIMUS BLACK (score of 3.94).

Scorings of hind limbs in the side view varied in a range of 2.89 to 4.17. The differences between lines in this trait were highly significant. A touch of sickle hocked stance was observed in the group of GENERALISSIMUS BLACK and the line of ROMKE with scores of 2.89 and 3.11, respectively. Although differences between lines in the back view of hind limbs are significant, their stance is as a rule close to the optimum (score of about 5).

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Analýza znaků lineárního typu v otcovských liniích starokladrubského koně.

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Popis 32 znaků lineárního typu byl proveden u 214 jedinců genové rezervy „starokladrubský kůň“ za účelem analýzy efektu otcovské linie, pohlaví (hřebci a klisny) a věku (7 tříd) u těchto znaků. Lineární model zahrnoval fixní efekty pro uvažované faktory. Analýza byla soustředěna na otcovské linie. Šlechtění v genové rezervě je do značné míry závislé na rozdílnosti mezi liniemi, jakož i na rozdílnosti jedinců uvnitř linií. Efekt pohlaví a věkové třídy u stejného plemene byl již analyzován v naší předchozí práci (Jakubec et al., 1997). V této práci byly rovněž analyzovány obě variety (bělouši a vraníci). Pro analýzu byly znaky rozděleny do čtyř krajin: přední část, trup, zád a končetiny. Na všech čtyřech krajinách byly u převážné většiny znaků zjištěny významné a vysoce významné rozdíly. Jednotlivé linie jsou s ohledem na popsané znaky mnohdy velmi typické. Linie SOLO a ROMKE jsou vyšší, zatímco linie GENERALISSIMUS je nižší. Původní a starší linie mají výrazný klabonos v porovnání s liniemi RUDOLFO A ROMKE, které vznikly v posledních letech imigrací genů plemen lusitano a fríský kůň. Linie vrané vykazují zpravidla kratší krk a kohoutek než linie běloušů. Linie ve varietě bílé mají širší a hlubší hrudník než linie vraníků. Linie běloušů mají rovný hřbet, jakož i delší a šikmější plec než linie vraníků. Linie ROMKE je v zádi delší než ostatní linie. Linie běloušů vykazují korektnější postoj hrudních i pánevních končetin než linie vraníků.

starokladrubský kůň; znaky lineárního typu; otcovské linie; analýza

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