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EVALUATION OF PERFORMANCE TRAITS IN THE GENETIC RESOURCE OF THE OLD KLADRUB HORSE

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INTRODUCTION

THE OLD KLADRUB HORSE - warmblood created on the basis of Old Spanish and Old Italian horses and bred continuously in the Czech Republic since the end of th 18th century
LOCATION - National Stud Kladruby nad Labem and private studs in the middle of Bohemia and southern parts of Moravia.
BREEDING OBJECTIVE - robust carriage (coach) horse, which was originally used for ceremonial purposes by the Habsburg emperors. The extraordinary type, specific external and performance performance traits of this breed should be saved for the next generation
PERFORMANCE RECORDING – traits were scored by a committee of three skilled horse classsifiers
OBJECTIVE - analysis and evaluation of the performance recording within the span from 1995 to 2004.

MATERIAL AND METHODS

All traits were recorded in total of 372 horses. Traits included in the analysis: type and sex expression, conformation, which is characterized by: body lines, fundament, general harmony, dressage, general impression, walk, trot, canter, marathon, dressage test, obstacle driving test, first, second and third pull. The classifiers used a scale of scores from 1 to 10.

All traits were analysed by the least-squares analysis using the GLM procedure (SAS, 2006)

$$Y_{ijklmn} = \mu + VAR_i + STUD_j + SEX_k + YEAR_l + AGE_m + LINE_n + (VAR \times STUD)_{ij} + (STUD \times LINE)_{jn} + e_{ijklmn},$$

where:

Y_{ijklmn}	= observation of a trait
μ	= overall mean
VAR_i	= fixed effect of the *i-th* variety
$STUD_j$	= fixed effect of the *j-th* stud
SEX_k	= fixed effect of *k-th* sex
$YEAR_l$	= fixed effect of *l- th* year of birth
AGE_m	= fixed effect of *m - th* age of classification
$LINE_n$	= fixed effect of *n- th* line
$(VAR \times STUD)_{ij}$	= fixed effect of *ij- th* interaction between variety and stud
$(STUD \times LINE)_{jn}$	= fixed effect of *jn - th* interaction between stud and line
e_{ijklmn}	= random residual error

The differences between the LSM of traits were tested at the significance level *P < 0.05 and **P < 0.01.

RESULTS AND DISCUSSION

The estimates of the parameters characterize the specific properties and variation of the breed in its current state (Table1).

Least squares means (LSM) and standard errors (SE) for the varieties, studs, the corresponding interactions and level of significance are presented in Table 2.

The differences between the varieties were highly significant for 5 of 15 traits. The differences between the studs were highly significant for the traits: type and sex expression, body lines, fundament and general harmony in favor of the stud Kladruby. In general, the studs of the National stud of Kladruby showed a better conformation than the studs of private farmers. Significant first order interactions variety x stud were found for walk and canter

The impact of sex to the traits is displayd in Table 3. In 11 traits 15 were the differences between both sexes significant (2) and highly significant (9). The superiority of stallions over mares is due to the more intensive selection of stallions.

Table 4 demonstrates the effect of the year at birth on the traits. The year at birth played only a small role. The environment, especially the nutrition, were well-balanced during the monitored period.

The influence of the age at classification on the traits is illustrated in Table 5. This factor has only a supplemental meaning. According to the new regulations of performance recording the animals should be classified at the age of 4 years.

In Table 6 the effect of sire lines on the traits is demonstrated. The effect of the sire line has an important genetic background. Today the population is divided into 5 gray lines (GENERALE, GENERALISSIMUS, SACRAMOSO, FAVORY and RUDOLFO) and 5 black lines (SACRAMOSO, SOLO, SIGLAVY PAKRA, ROMKE and GENERALISSISIMUS). The difference between the lines was in 9 of 15 performance traits highly significant and significant.. The interaction variety × stud was only significant for 2 traits. The circular mating system practised with the sire lines is an important tool for the conservation of the diversity within the breed and for retaining specific performance traits for next generations. The performance recording and circular mating practised with the sire lines contribute in an essential manner to the increase of the phenotype and genetic variability of the animals within the breed.

The interactions sire line x stud are presented in Table 7 . The interaction sire line x stud was significant and highly significant for 8 traits.

CONCLUSION

The traits can be chosen as selection criteria for the breeding of varieties and sire lines when the differences between trait means of varieties and sire lines were significant and highly-significant and if interactions do not exist. For the final choice of selection criteria will be decisive the magnitude of genetic parameters and economic values.

Table 1

Treit	Mean	SD	CV (%)
Type and sex	7.15	0.53	7.35
Body lines	7.00	0.50	7.08
Fundament	6.82	0.45	6.59
General harmony	7.05	0.48	6.80
Dressage	7.09	0.90	12.72
General impression	7.08	0.82	11.60
Walk	6.73	0.79	11.76
Trort	7.16	0.88	12.33
Canter	6.76	0.80	11.85
Marathon	8.48	1.44	17.01
Dressage test	7.36	1.07	14.50
Obstacle driving test	7.70	1.10	14.28
First pull	8.11	1.57	19.36
Second pull	8.19	1.65	20.16
Third pull	8.32	1.74	20.88

Error probability: *P<0.05, **P<0.01

Table 2

Trait	Overall mean	Variety				Level of significance		Stud				Level of significance		Interaction variety x stud	
		Gray		Black				Kladruby		Private					
Number of animals	372	178		194				137		235				Level of signif.	
	LSM	LSM	SE	LSM	SE			LSM	SE	LSM	SE				
Type and sex expression	7.25	7.20	0.11	7.29	0.11	0.52		7.37	0.10	7.13	0.09	0.00	**	0.25	
Body lines	7.10	7.06	0.10	7.14	0.11	0.53		7.20	0.10	7.00	0.08	0.00	**	0.39	
Fundament	6.86	6.91	0.09	6.80	0.10	0.34		6.93	0.09	6.78	0.08	0.00	**	0.27	
General harmony	7.20	7.23	0.10	7.17	0.10	0.65		7.32	0.09	7.08	0.08	<.0001	**	0.32	
Dressage	7.05	7.27	0.19	6.83	0.20	0.04	*	7.13	0.17	6.96	0.15	0.13		0.54	
General impression	7.04	7.33	0.17	6.76	0.18	0.00	**	7.13	0.16	6.95	0.14	0.07		0.13	
Walk	6.70	7.04	0.16	6.36	0.17	0.00	**	6.74	0.15	6.66	0.14	0.39		0.02	*
Trot	7.03	7.30	0.18	6.76	0.19	0.02	*	7.03	0.17	7.04	0.15	0.93		0.17	
Canter	6.64	6.91	0.17	6.36	0.17	0.00	**	6.65	0.15	6.62	0.14	0.74		0.03	*
Marathon	9.03	8.95	0.30	9.11	0.31	0.65		9.04	0.28	9.01	0.25	0.89		0.68	
Dressage test	7.65	7.63	0.22	7.68	0.23	0.84		7.77	0.20	7.54	0.18	0.08		0.60	
Obstacle driving test	7.85	7.76	0.23	7.94	0.24	0.52		7.92	0.21	7.78	0.19	0.31		0.97	
First pull	8.68	8.57	0.32	8.78	0.34	0.58		8.77	0.30	8.58	0.27	0.34		0.92	
Second pull	8.82	8.78	0.34	8.86	0.36	0.85		8.87	0.32	8.77	0.28	0.59		0.58	
Third pull	9.19	9.27	0.36	9.10	0.38	0.69		9.28	0.33	9.10	0.30	0.40		0.48	

Error probability: *P<0.05, **P<0.01

Table 3

Trait	Overall mean	Sex				Difference	Level of significance	
		Stallions		Mares				
Number	372	79		293				
	LSM	LSM	SE	LSM	SE			
Type and sex expression	7.15	7.31	0.11	7.19	0.09	0.12	0.09	
Body lines	7.00	7.15	0.10	7.04	0.08	0.11	0.11	
Fundament	6.82	6.96	0.09	6.75	0.07	0.21	0.00	**
General harmony	7.05	7.25	0.10	7.15	0.08	0.11	0.09	
Dressage	7.09	7.20	0.18	6.89	0.15	0.31	0.01	*
General impression	7.08	7.22	0.16	6.87	0.14	0.34	0.00	**
Walk	6.73	6.86	0.16	6.54	0.13	0.31	0.00	**
Trot	7.16	7.20	0.18	6.87	0.15	0.33	0.009	**
Canter	6.76	6.90	0.16	6.37	0.13	0.53	<.0001	**
Marathon	8.48	9.07	0.29	8.98	0.24	0.09	0.66	
Dressage test	7.36	7.85	0.21	7.45	0.18	0.40	0.009	**
Obstacle driving	7.70	8.01	0.22	7.69	0.18	0.32	0.03	*
First pull	8.11	8.96	0.32	8.39	0.26	0.57	0.009	**
Second pull	8.19	9.14	0.33	8.49	0.27	0.65	0.00	**
Third pull	8.32	9.60	0.35	8.77	0.29	0.83	0.00	**

Error probability: *P<0.05, **P<0.01

Table 4

Trait	Overall mean	Year at birth																				Level of significance	
		1991		1992		1993		1994		1995		1996		1997		1998		1999		2000			
Number	372	7		23		34		43		62		43		35		38		57		30			
	LSM	LSM	SE	LSM	SE	LSM	SE	LSM	SE	LSM	SE	LSM	SE	LSM	SE	LSM	SE	LSM	SE	LSM	SE		
Type and sex expression	7.15	7.11	0.22	7.28	0.15	7.22	0.11	7.48	0.12	7.19	0.12	7.11	0.12	7.36	0.13	7.33	0.13	7.16	0.12	7.22	0.14	0.1236	
Body lines	7.00	6.83	0.21	7.11	0.14	7.00	0.11	7.12	0.11	7.18	0.11	7.04	0.11	7.19	0.12	7.26	0.12	7.01	0.11	7.22	0.13	0.18	
Fundament	6.82	6.35	0.19	6.83	0.12	6.87	0.10	7.05	0.10	6.99	0.10	6.92	0.10	7.01	0.11	6.98	0.11	6.68	0.10	6.90	0.12	0.0004	**
General harmony	7.05	6.99	0.20	7.30	0.13	7.11	0.10	7.25	0.11	7.27	0.11	7.14	0.11	7.29	0.12	7.32	0.12	7.07	0.11	7.25	7.25	0.2259	
Dressage	7.09	7.06	0.38	7.02	0.25	6.83	0.19	7.36	0.20	6.89	0.20	7.14	0.21	7.13	0.22	7.03	0.22	6.94	0.20	7.07	0.24	0.4097	
General impression	7.08	6.98	0.35	6.80	0.23	6.82	0.18	7.31	0.18	6.99	0.18	7.27	0.19	7.10	0.20	7.10	0.20	7.00	0.19	7.06	0.22	0.2207	
Walk	6.73	6.53	0.33	6.43	0.22	6.51	0.17	6.80	0.17	6.89	0.18	6.90	0.18	6.67	0.19	6.76	0.19	6.64	0.18	6.90	0.21	0.2771	
Trot	7.16	6.79	0.37	6.45	0.24	6.82	0.19	7.29	0.19	7.55	0.20	7.21	0.20	7.09	0.21	7.12	0.21	6.99	0.20	7.02	0.23	0.0005	**
Canter	6.76	6.21	0.34	6.19	0.22	6.57	0.17	6.92	0.18	6.74	0.18	6.95	0.18	6.62	0.19	6.76	0.19	6.55	0.18	6.85	0.21	0.0103	*
Marathon	8.48	9.96	0.61	8.26	0.40	8.72	0.31	8.88	0.32	8.84	0.32	9.09	0.33	8.74	0.35	8.92	0.35	9.37	0.33	9.49	0.38	0.0651	
Dressage test	7.36	8.21	0.45	7.53	0.30	7.42	0.23	7.85	0.23	7.64	0.24	7.70	0.25	7.91	0.26	7.52	0.26	7.39	0.24	7.36	0.28	0.2463	
Obstacle driving test	7.70	8.45	0.46	7.65	0.30	7.80	0.23	8.15	0.24	8.20	0.25	7.75	0.25	8.11	0.26	7.57	0.27	7.39	0.25	7.43	0.29	0.003	**
First pull	8.11	9.79	0.66	7.70	0.43	8.46	0.33	8.34	0.35	8.68	0.35	8.73	0.36	8.54	0.38	8.43	0.38	9.15	0.36	8.94	0.42	0.0427	*
Second pull	8.19	9.87	0.69	7.76	0.46	8.70	0.35	8.54	0.36	8.89	0.37	8.86	0.38	8.66	0.40	8.66	0.40	9.29	0.37	8.97	0.44	0.0786	
Third pull	8.32	9.93	0.73	8.14	0.48	8.81	0.37	8.93	0.38	9.23	0.39	9.43	0.40	9.22	0.42	9.17	0.42	9.46	0.39	9.56	0.46	0.2175	

Error probability: *P<0.05, **P<0.01

Table 5

Trait	Overall mean	Age at classification																Level of significnace	
		3		4		5		6		7		8		9		11			
Number	372	27		241		62		17		14		7		2		2			
	LSM	LSM	SE	LSM	SE	LSM	SE	LSM	SE	LSM	SE	LSM	SE	LSM	SE	LSM	SE		
Type and sex expression	7.15	7.02	0.12	7.19	0.05	7.19	0.08	7.23	0.14	7.39	0.16	7.53	0.21	7.01	0.39	7.42	0.39	0.4068	
Body lines	7.00	6.87	0.11	7.03	0.04	6.96	0.07	7.08	0.13	7.15	0.15	7.40	0.20	6.79	0.37	7.48	0.37	0.2239	
Fundament	6.82	6.56	0.10	6.86	0.04	6.89	0.06	7.00	0.12	6.84	0.13	7.05	0.18	6.58	0.33	7.06	0.34	0.0645	
General harmony	7.05	7.00	0.11	7.09	0.04	7.02	0.07	7.23	0.13	7.20	0.14	7.46	0.19	7.16	0.35	7.43	0.36	0.3236	
Dressage	7.09	7.37	0.20	7.19	0.08	7.26	0.13	6.71	0.24	6.69	0.27	7.31	0.36	7.03	0.67	6.82	0.67	0.2415	
General impression	7.08	7.15	0.18	7.22	0.07	7.23	0.12	6.68	0.22	6.70	0.24	7.36	0.33	7.04	0.61	6.97	0.61	0.184	
Walk	6.73	6.73	0.18	6.84	0.07	6.82	0.11	6.45	0.21	6.26	0.24	6.61	0.32	6.66	0.58	7.24	0.59	0.2192	
Trot	7.16	6.89	0.20	7.34	0.08	6.98	0.13	6.45	0.24	6.65	0.26	7.30	0.36	7.18	0.65	7.47	0.66	0.0011	**
Canter	6.76	6.67	0.18	6.95	0.07	6.99	0.11	6.30	0.21	6.43	0.24	6.83	0.32	6.24	0.59	6.67	0.60	0.0332	*
Marathon	8.48	8.93	0.32	8.60	0.13	8.48	0.21	7.79	0.39	9.15	0.43	9.23	0.58	9.78	1.06	10.25	1.08	0.069	
Dressage test	7.36	7.25	0.24	7.72	0.10	7.44	0.15	6.86	0.29	7.49	0.32	7.96	0.43	7.62	0.79	8.88	0.80	0.024	*
Obstacle driving test	7.70	7.72	0.24	8.08	0.10	7.50	0.16	6.97	0.29	7.78	0.33	8.01	0.44	7.83	0.81	8.92	0.82	0.0009	**
First pull	8.11	7.70	0.35	8.40	0.14	8.10	0.23	8.75	0.42	8.07	0.47	9.31	0.64	9.92	1.16	9.16	1.18	0.1294	
Second pull	8.19	7.62	0.37	8.43	0.15	8.26	0.24	9.05	0.44	8.54	0.49	9.76	0.67	9.76	1.22	9.13	1.24	0.0669	
Third pull	8.32	7.61	0.38	8.64	0.16	8.53	0.25	9.05	0.47	8.42	0.52	10.07	0.70	10.70	1.28	10.48	1.30	0.0165	*

Error probability: *P<0.05, **P<0.01

Table 6

Trait	Overall mean	Sire line																Level of significance	
		Favory		Generale		Generalissimus		Sacramoso		Solo		Siglavi P.		Romke		Rudolfo			
Number	372	33	8.9%	36	9.7%	62	16.6%	133	35.8%	55	14.8%	15	4.0%	24	6.5%	14	3.8%		
	LSM	LSM	SE	LSM	SE	LSM	SE	LSM	SE	LSM	SE	LSM	SE	LSM	SE	LSM	SE		
Type and sex expression	7.15	7.08	0.07	6.65	0.07	6.58	0.06	7.41	0.05	7.05	0.06	7.83	0.09	7.84	0.08	8.37	0.10	<.0001	**
Body lines	7.00	6.84	0.10	6.74	0.10	6.71	0.08	7.18	0.07	6.85	0.09	7.60	0.13	7.55	0.11	7.91	0.15	<.0001	**
Fundament	6.82	6.81	0.10	6.50	0.09	6.59	0.08	6.88	0.07	6.65	0.09	7.30	0.13	7.16	0.10	7.52	0.14	<.0001	**
General harmony	7.05	6.96	0.09	6.72	0.09	6.82	0.08	7.29	0.07	6.95	0.08	7.73	0.12	7.60	0.10	8.12	0.13	<.0001	**
Dressage	7.09	6.93	0.22	6.95	0.21	6.87	0.19	7.13	0.17	6.97	0.19	6.36	0.29	7.41	0.24	7.33	0.32	0.03	*
General impression	7.08	6.87	0.20	6.89	0.19	6.79	0.17	7.11	0.15	6.95	0.17	6.42	0.26	7.51	0.21	7.35	0.29	0.002	**
Walk	6.73	6.53	0.20	6.66	0.19	6.63	0.16	6.65	0.15	6.60	0.17	6.22	0.25	7.05	0.21	7.02	0.29	0.103	
Trot	7.16	6.88	0.22	6.94	0.21	6.80	0.18	7.09	0.16	7.20	0.19	6.41	0.28	7.55	0.23	7.19	0.31	0.004	**
Canter	6.76	6.53	0.19	6.48	0.19	6.28	0.16	6.64	0.14	6.49	0.17	6.09	0.25	7.12	0.21	6.71	0.28	0.001	**
Marathon	8.48	9.03	0.36	8.87	0.34	8.75	0.30	8.96	0.26	8.83	0.31	8.05	0.46	9.12	0.38	0.38	0.52	0.399	
Dressage test	7.36	7.48	0.26	7.36	0.25	7.34	0.22	7.65	0.19	7.34	0.23	6.81	0.34	7.78	0.28	8.50	0.38	0.006	**
Obstacle driving test	7.70	7.79	0.27	7.61	0.26	7.58	0.23	7.82	0.20	7.70	0.23	7.02	0.35	7.98	0.29	8.50	0.39	0.071	
First pull	8.11	8.56	0.40	8.52	0.38	8.34	0.33	8.63	0.29	8.80	0.35	8.25	0.51	8.73	0.42	9.26	0.58	0.711	
Second pull	8.19	8.53	0.41	8.68	0.40	8.72	0.35	8.76	0.31	8.93	0.36	8.21	0.54	8.73	0.44	9.59	0.60	0.692	
Third pull	8.32	9.03	0.44	9.00	0.42	9.04	0.37	8.95	0.32	9.05	0.38	8.56	0.57	9.20	0.46	9.95	0.64	0.806	

Error probability: *P<0.05, **P<0.01

Table 7
Interactions sire line x stud and levels of significance

Trait	Level of signifance (sire lines)		Level of signifance (studs)		Significance of interaction (sire line x stud)	
Type and sex expression	**	<.0001	**	0.0002		0.3859
Body lines	**	<.0001	**	0.0010		0.6427
Fundament	**	<.0001	**	0.0043		0.2514
General harmony	**	<.0001	**	<.0001		0.8644
Dressage	*	0.0296		0.1319	*	0.0192
General impression	**	0.0016		0.0741	**	0.0036
Walk		0.1028		0.3913	**	0.0013
Trot	**	0.0035		0.9270	**	0.0016
Canter	**	0.0012		0.7382	**	0.0017
Marathon		0.3987		0.8857	**	0.0067
Dressage test	**	0.0060		0.0781	**	0.0041
Obstacle driving test		0.0705		0.3080	**	0.0068
First pull		0.7110		0.3354		0.7162
Second pull		0.6923		0.5868		0.4204
Third pull		0.8062		0.4004		0.4290

Error probability: *P<0.05, **P<0.01

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