Breeding value estimation by repeatability and random regression models in Hungarian Sport Horses

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Introduction

Hungarian Sporthorse is a noble horse with aesthetic and functional conformation.

Breeding goal invokes first of all a horse for riding and show-jumping

The aims of the study

To analyze the breeding value estimation alternatives for the Hungarian Sport Horses

- **Evaluation of mare self performance tests results**
- **Show-jumping performance evaluation with a repeatability animal model**
- **Show-jumping performance evaluation with a random regression model**

Evaluation of mare self performance tests results

Traits judged at mare performance test

Traits scored on a 0-10 scale.
600 test results

Conformation

type, head, neck,
saddle region, frame,
forelimbs, hind limbs,
regulatory of movement,
impulsion and
elasticity of movement,
overall impression

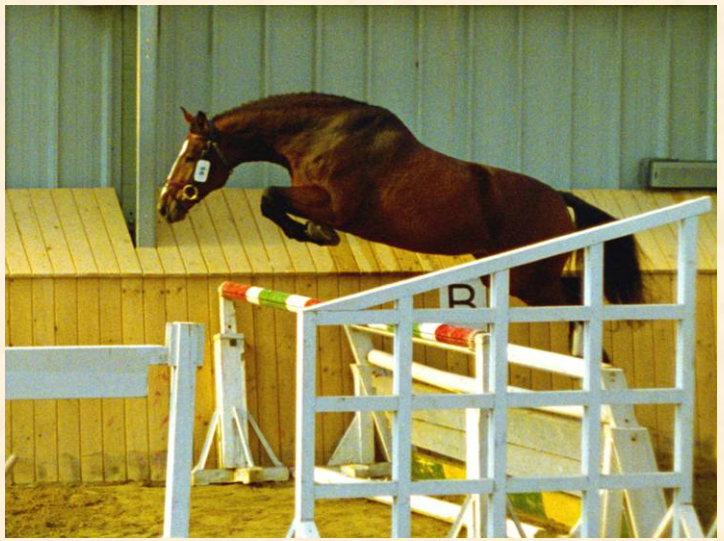
Traits judged at mare performance test

Movement analysis

walk, trot, canter,
overall impression,
test rider's score

Free jumping

jumping style,
jumping ability-
sense of distance,
observation during training



Dataset

- **Results of Hungarian Mare Self Performance from the interval 1993–2004 were analysed**
- **Pedigrees were known at least two generations back**

Materials and Methods

- **Animal model:**

$$Y_{ijklm} = \mu + Year_i + Age_j + Owner_k + Animal_l + e_{ijklm}$$

Genetic parameters were estimated with VCE-5

Breeding values were estimated with the use of PEST software

Estimated heritabilities and correlations for conformation traits

Trait		1	2	3	4	5	6	7	8	9	10
1	Type	0.45	0.71	0.58	0.74	0.74	0.59	0.29	0.24	0.38	0.80
2	Head	0.54	0.42	0.31	0.55	0.43	0.60	0.12	0.26	-0.02	0.57
3	Neck	0.42	0.34	0.28	0.71	0.66	0.54	0.17	0.55	0.78	0.89
4	Saddle region	0.47	0.33	0.46	0.53	0.84	0.79	0.43	0.24	0.40	0.89
5	Frame	0.61	0.34	0.41	0.47	0.40	0.76	0.27	0.39	0.50	0.91
6	Forelimbs	0.35	0.23	0.24	0.37	0.35	0.30	0.20	0.49	0.23	0.75
7	Hind limbs	0.27	0.17	0.19	0.21	0.27	0.29	0.35	0.29	0.13	0.66
8	Regularity of movement	0.21	0.12	0.22	0.10	0.25	0.28	0.20	0.32	0.77	0.56
9	Imp. and elastic. of movement	0.32	0.17	0.36	0.18	0.34	0.19	0.23	0.41	0.43	0.73
10	Overall impression	0.63	0.46	0.57	0.51	0.58	0.49	0.42	0.39	0.62	0.43

Estimated heritabilities and correlations for performance traits

Trait		1	2	3	4	5	6	7	8
1	Jumping style	0.29	0.99	0.83	0.87	0.74	0.50	0.42	0.55
2	Jumping ability–sense of distance	0.82	0.52	0.83	0.54	0.63	0.53	0.55	0.83
3	Observation during training	0.36	0.44	0.32	-0.06	0.40	0.37	0.78	0.66
4	Walk	0.26	0.20	0.29	0.22	-	0.41	0.56	0.68
5	Trot	0.27	0.28	0.34	0.36	0.36	0.55	0.84	0.64
6	Canter	0.24	0.13	0.19	0.30	0.50	0.51	0.83	0.78
7	Overall impression	0.30	0.45	0.26	0.46	0.54	0.66	0.33	-
8	Test rider’s score	0.49	0.53	0.31	0.26	0.31	0.48	0.57	0.51

Show-jumping performance evaluation with a repeatability animal model

Dataset

- **Show-jumping results of horses with at least two generations known pedigree from the period between 1996 and 2004**
  - **–22.860 sport competition results**

Materials and Methods

- **Transformations on ranks**

–Square root

–Cubic root

–Quad root

–Blom normalized ranks

–Cotangent transformed ranks

–Difference between high of fence and fault points

Materials and Methods

Repeatability animal model

- **Fixed effects: gender, breeder, age of the horse, year and place of the competition and height of the fence**
- **Random effects: rider and permanent environment effect**

Genetic parameters were estimated with VCE-5

Breeding values were estimated with the use of PEST software

Results of the comparison of different measurement variables of show-jumping

Measurement variable	Kolmogorov-Smirnov values	R^2	K-S values of residuals	h^2
Square root of ranks	0,071	0,25	0,023	0,091
Cubic root of ranks	0,047	0,24	0,012	0,092
Quad root of ranks	0,043	0,24	0,016	0,091
Blom normalized ranks	0,034	0,11	0,016	0,054
Cotangent transformed ranks	0,173	0,10	0,143	0,035
Difference between high of fence and error score	0,108	0,63	0,112	0,041

Show-jumping performance evaluation with a random regression model

Dataset

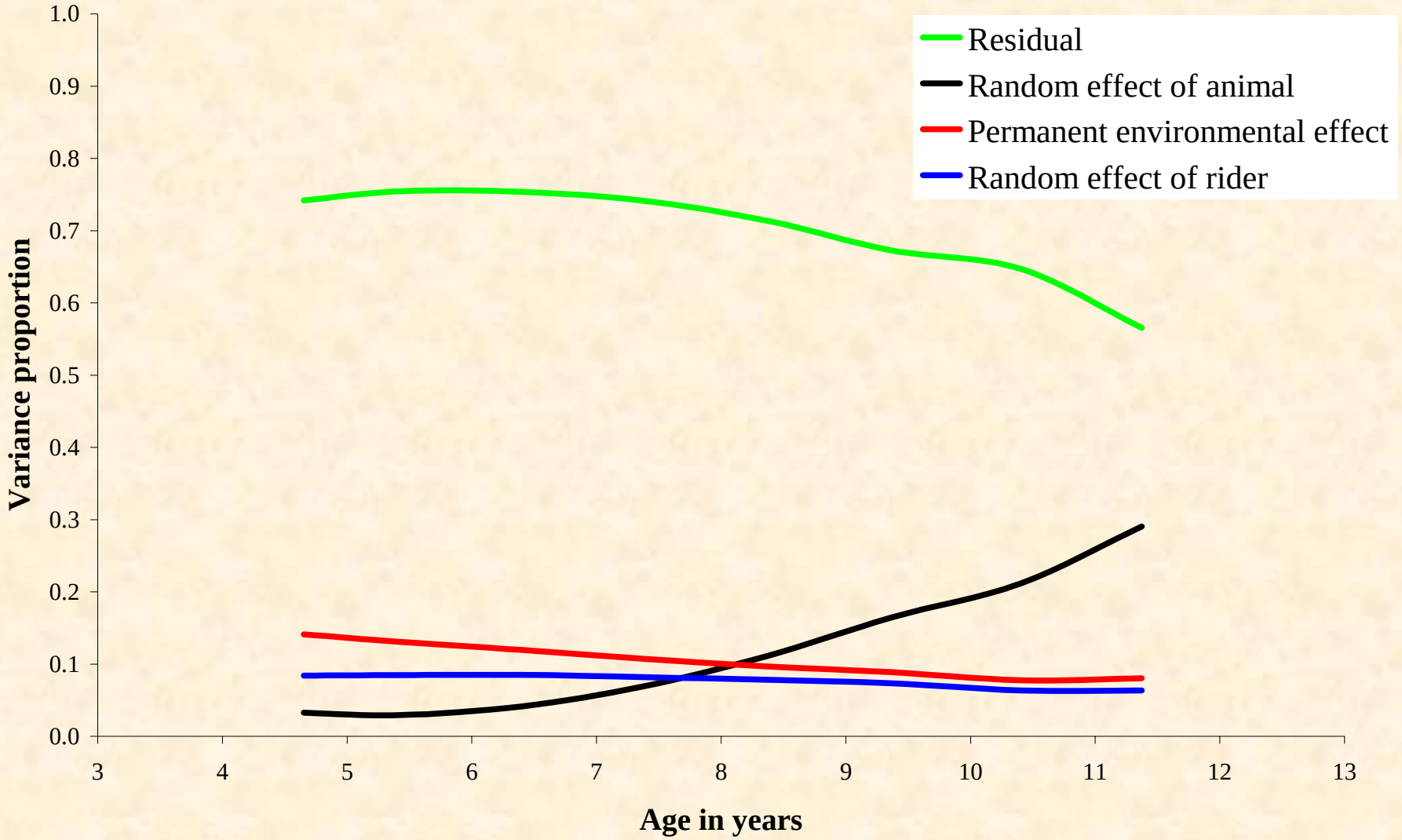
- **Horses between the age of four and eleven with at least five starts**

Materials and Methods

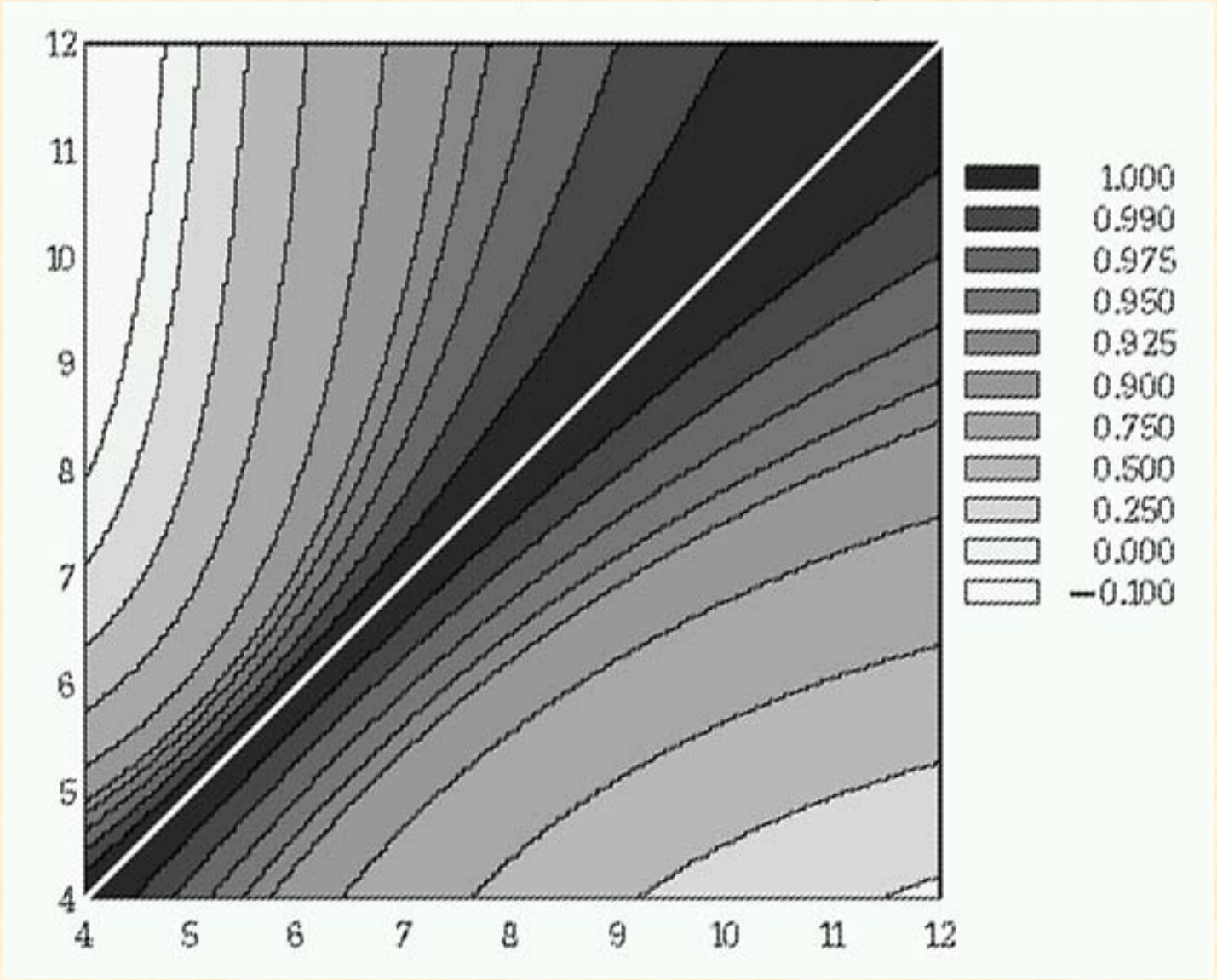
- **Random regression model was fitted to the most favourable measurement variable based on repeatability model analysis**
- **Legendre polinomial was used for fitting**

Fitting were done using VCE-5

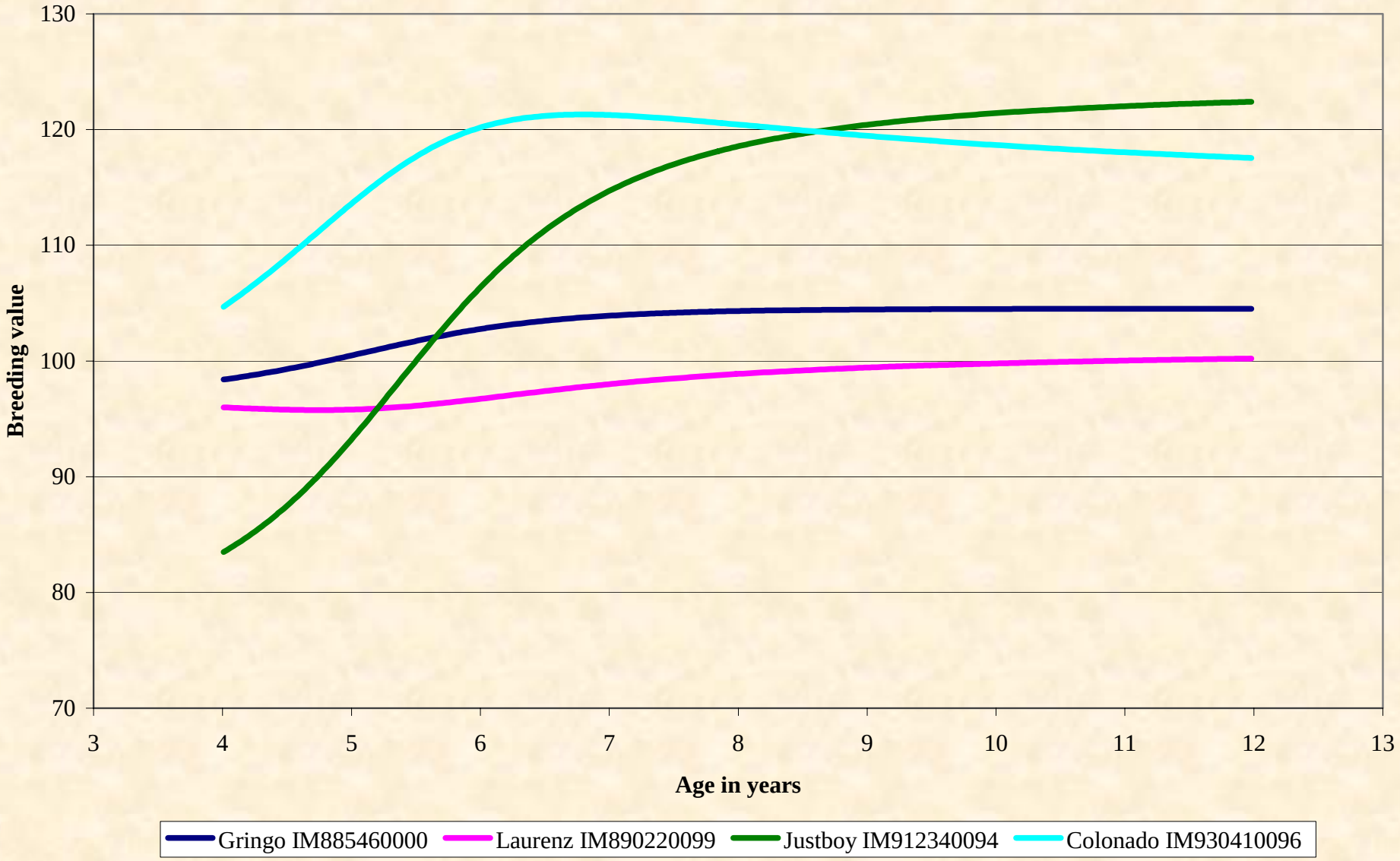
Variance proportions for the random and residual effect



Genetic and phenotypic correlations between Blom-scores in different age classes



Breeding values estimated with random regression model



Breeding values (BV) estimated with random regression model in different ages

	2534 Gringo	3648 Laurenz	2972 Justboy	3114Colonado
Four-year-old	98	96	83	105
Six-year-old	103	97	106	120
Eight-year-old	104	99	119	120
Ten-year-old	104	100	121	119
Twelve-year-old	105	100	122	118
Mean of BVs	102.90	98.32	110.47	116.30
Standard deviation of BVs	2.62	1.87	16.37	6.60
CV% of BVs	2.55	1.90	14.82	5.68
Breeding value index	102.90	98.32	110.47	116.30

Thank you
for
your attention!