Genetic Evaluation of Dressage performance in Spanish Purebred horses

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Abstract

Young horses have participated in specific competitions of dressage, eventing and show-jumping since 2004 in Spain. The results obtained in these competitions were used to estimate the breeding value of the animals for each discipline, since it is greatly simplified and is easy to manage for disciplines having many participants. The evaluation was based on partial (basic evaluation and each reprise score) and final (average score for dressage exercises) scores.

The breeding values of Spanish Purebred (SPB) horses for dressage were calculated by a repeatability multivariate BLUP Animal Model. Type of racetrack (grouped in 3 levels), ambient (measures like temperature*humidity, grouped in 7 levels) and level of stress before the competition (using transport*duration of the journey*rest time before the competition, 33 levels) were included as fixed effects in the model. The random variables were judge, rider and individual additive.

The data file included dressage performances collected in 30 different competitions between 2004-2005 for 387 SPB young animals. The pedigree file was created including four generations of the participant horses, obtained from the Stud-book of this breed, and had a total of 2,753 animals.

Three traits were analysed. The values of heritability and the breeding values were estimated for each one. The levels of heritability were: 0.231 ± 0.036 for the basic evaluation (conformation and gaits), 0.232 ± 0.054 for the reprise score and 0.237 ± 0.084 for the final ranking for dressage exercises. The results were published using a total selection index, in which the different breeding values were weighed up.

Keywords: dressage, heritability, andalusian horse.

Introduction

In 2002, the Spanish Minister of Agriculture, Fisheries and Food (MAPyA) approved an official measure for the Organization and Promotion of Equine Sector in this country. This includes the development and regularization of genetic equine improvement as one of the main aims.

Since then, Young Horse Competitions (YHC) have been developed in Spain. Their main aim is to contribute to equine selection programs in dressage, eventing and show-jumping performance. Although indirectly, they also contribute to equine early training programs, that have an important influence on later performance (Kunusose et al., 2002). The YHC are very important in horse selection because high genetic correlations have been found between analysed traits and competition results, and that implies a very good predictability from young horses' performance (Wallin et al., 2003).

In the different countries and horse breeds, some traits are used in animal selection (Koenen & Aldridge, 2002), for example: gait characteristic (that could provide an early criteria for breeding in dressage and jumping breeding programs in horses -Barrey et al., 2002-), conformation traits (that have impact on performance -Langlois et al., 1978, Langlois, 1979, Holmström et al., 1990- and are related to length of life -Wallin et al., 2001-) or behaviour related traits (since it is possible to predict a substantial part of the performance of a horse later in life by personality traits analysed earlier in life-Visser et al., 2003-). However,

traits based on competition results and performance test scores represent the main selection criteria in most breeding schemes of sport horses (Giulotto, 2001).

The SPB is the most important horse breed in Spain, because of the high number of animals (65.96% of the national horse population). The Breeding Scheme of this breed has been approached by the breeders associations (ANCCE and FENACE), the MAPyA and a group of geneticists (AGR-158) since 2003.

This scheme includes conformation, riding and dressage ability as main selection aims. The genetic evaluation of conformation traits is going to be made by a linear methodology and the genetic evaluation of riding ability will be made in base on traits obtained in a testing centre. The results of the dressage competitions are going to be used in dressage ability evaluation, as federated competitions as YHC, where four to six year-old animals (including males and females) participate separated into different age groups.

Therefore, the results of dressage YHC, held in Spain during 2004-2005, have been used to estimate the breeding value of young SPB horses for dressage at the first time.

Material and Methods

The animals have performed three exercises in each YHC: a conformation and gaits basic evaluation and two dressage exercises, following the rules of the MAPyA1 . In the basic evaluation, the animals have been judged in based on their conformation (8 traits related to a subjective judgement of the morphology according to its relation to dressage ability) and gaits characteristics (5 traits: walk, trot, gallop, attitude and general evaluation of gaits). The dressage exercises have been judged by professional judges (federated judge). The level of the exercise varies according to the age group (4, 5 and 6 years-old).

There have been included 814 performance data of 377 SPB horses in the first dressage genetic evaluation for dressage ability in Spain They have been collected in 30 different competitions held in 2004-2005.

Three traits have been included in the analysis: the scores of the basic evaluation (BE, conformation and gaits) for participation by judge, the scores of each dressage exercise (RE, reprise) for participation and a weighing (from 100 to 0) of the final ranking for dressage exercises (FR). The scores of the basic evaluation are more subjective, so we have to include more external factors in the model to correct their effects.

Four generations of the participant horses, obtained from the Stud-book of this breed, have been used for the relationship matrix. The pedigree file has a total number of 2,753 animals.

The age-group, type of racetrack, condition of racetrack, level of stress before the competition (transport*duration of journey*rest time before competition), ambient (temperature*humidity), breeder and judge have been included as fixed variables, and judge*animal and individual additive have been included as random variables in the genetic evaluation of the animals by the score of the basic evaluation (BE).

$$Y = a_i + b_j + c_k + d_l + f_m + g_n + h_o + i_p + e_{ijklmnop}$$

Where: a_i is age-group, b_j is type of racetrack, c_k is condition of racetrack, d_l is level of stress before the competition, f_m is ambient, g_n is breeder, h_o is judge, i_p is judge*animal.

The genetic evaluation of dressage exercises (RE and FR) includes: age-group, type of racetrack, level of stress before the competition, rider and judge as fixed variables, and rider*animal interaction and individual additive as random variables.

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[1] http://www.mapa.es/es/ganaderia/pags/equino/pruebas.htm

$$Z = a_i + b_j + c_k + d_l + f_m + g_n + e_{ijklmnop}$$
$$W = a_i + b_j + c_k + d_l + f_m + g_n + e_{ijklmnop}$$

Where: a_i is age-group, b_j is type of racetrack, c_k is level of stress before the competition, d_l is rider, f_m is judge, g_n is rider*animal.

The heritability parameters have been estimated by a repeatability multivariate BLUP Animal Model, using VCE software package v.5.0 (Kovac et al., 2002). The breeding values have been calculated by PEST software (Groeneveld, 1990). The results were published using a total selection index, in which the different breeding values were weighed up, as follow:

$$GI = 0.2BE + 0.4RE + 0.4FR$$

Results and Discussion

In this first genetic evaluation for dressage ability 377 SPB participants have been analysed (2.16 average participations by horse). Each horse has participated in 1 to 8 competitions by year.

According to our results the average number of participations by year increase with the age of the animal and there has also been an increase of participations in the last analysed year (table 1). It could be because 2004 was the first year of celebration of this kind of competitions (YHC) in Spain, and in spite of the economic helps that the MAPyA give to the breeders, they were reticent in participate. Besides, the SPB is the breed with the higher number of participations in dressage YHC during 2004 and 2005.

Table 1. Total participation and percentage of participation of SPB in dressage Young Horse Competitions held during 2004-2005 in Spain.

	Classification competitions		Final competitions	
	Total participations	% SPB	Total participations	% SPB
2004	404	80,69	95	87,36
2005	523	89,29	64	92,18

Where: SPB is Spanish Purebred horse.

We have obtained a heritability value of 0.231 ± 0.036 for BE, 0.232 ± 0.054 for RE and 0.237 ± 0.084 for FR; and a repeatability of 0.39, 0.39 and 0.38 respectively (table 2). All this values are in a normal range according to Ricard et al. (2000), which indicate a range from 0.10 to 0.30 as normal dressage heritability. They are also higher than the heritability values showed by Bruns & Schade (1998) in young riding horses.

Besides, we have obtained the same values as Ricard (1996) for dressage performance traits. This author has affirmed that the heritability values are lower in adult horses and that this parameter decrease with age. Bruns & Schade (1998) have also shown that heritability estimates of riding ability or dressage are highest when recorded in stallions' test and are lowest when recorded in competitions. So we can accept our heritability values as adequate for genetic valuation.

Table 2. Estimates of genetic parameters for the three analized traits of Dressage Young Horse Competitions in Spain.

Parameter	BE	RE	FR
$\sigma^2_{\text{JUDGE-ANIM}}$	0.442		
$\sigma^2_{\text{JUDGE-BREED}}$	0.266		
$\sigma^2_{\text{RIDER-ANIM}}$		3.233	82.226
σ^2_{ANIM}	1.044	4.780	135.620
σ^2_{RESID}	2.772	12.598	353.641
h^2	0.231	0.232	0.237

Where: BE is basic evaluation (conformation and gaits),
RE is score by reprise and FR is final ranking.

Estimates of genetic parameters for the analized traits have also been shown in table 2. The influence of the judges and their interaction with the animal and the breed on basic evaluation (conformation and gaits) has been shown. There also have a high influence of the rider on each dressage exercise and the final ranking. So we have included this parameters in the model for genetic evaluation.

The genetic indexes (GI_BE, GI_RE, GI_FR) ranged from 80 to 120 and have shown a normal distribution (figure 1). The average value of all these indexes is 100 with an average R^2 of 0.055.

*Figure 1. Histogram of breeding values for SPB.*
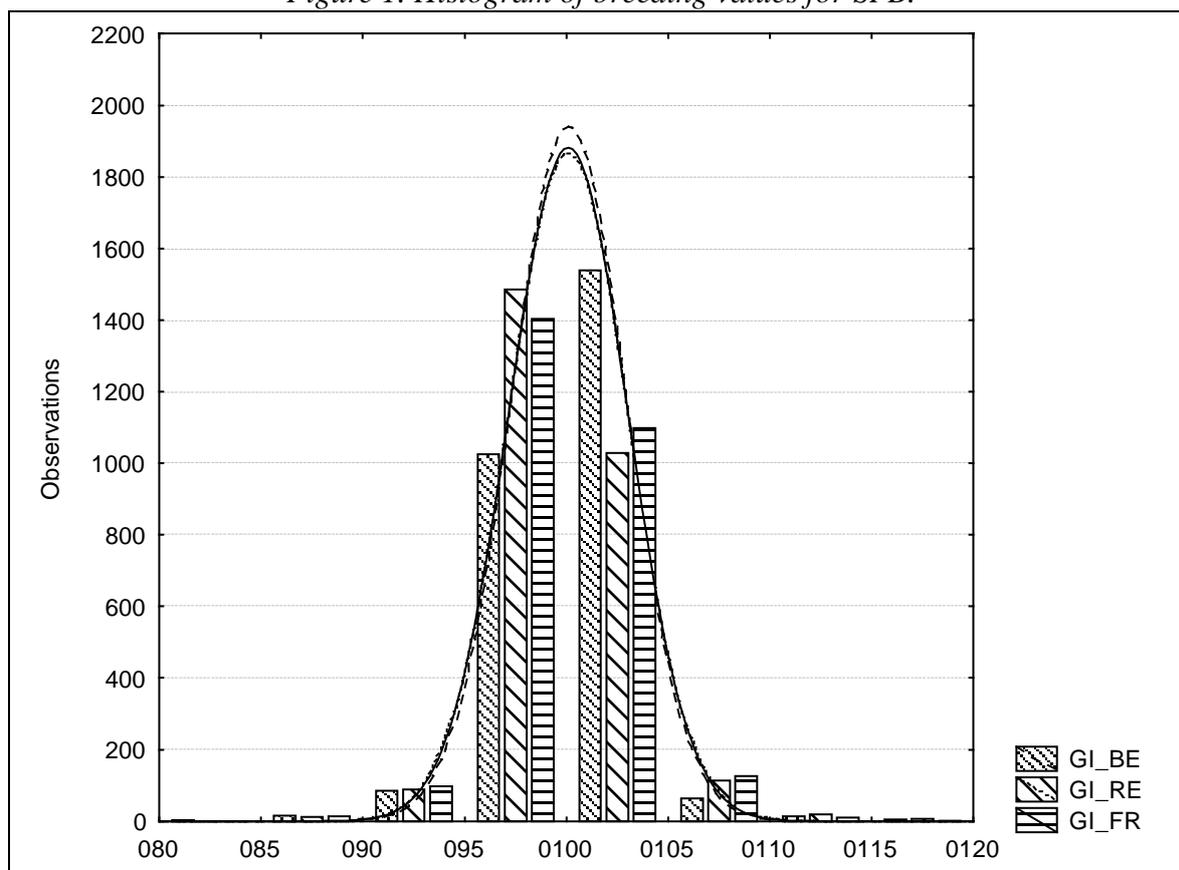
Where: GI_BE is the genetic index for the basic evaluation, GI_RE is the genetic index for the score by reprise and GI_FR is the genetic index for the final ranking of dressage reprises.

In the figure 2, we shown the evolution of the breeding values related to the year of birth. All the analysed traits (BE, RE, FR and GL) have showed an little improvement of their

breeding values, so genetic evaluation and selection have never been done in SPB horses for dressage performance in Spain. This improvement allows us to confirm the correct phenotypic selection made by the breeders during the last years. We can hope that the genetic evaluation, which is going to be made annually in Spain for SPB horses, give to the breeders an adequate tool to select the correct reproducers within their mating programme.

Figure 2. Evolution of breeding values obtained for the genetic valuation for dressage related trait in Young Horse Competitions across the year of birth.
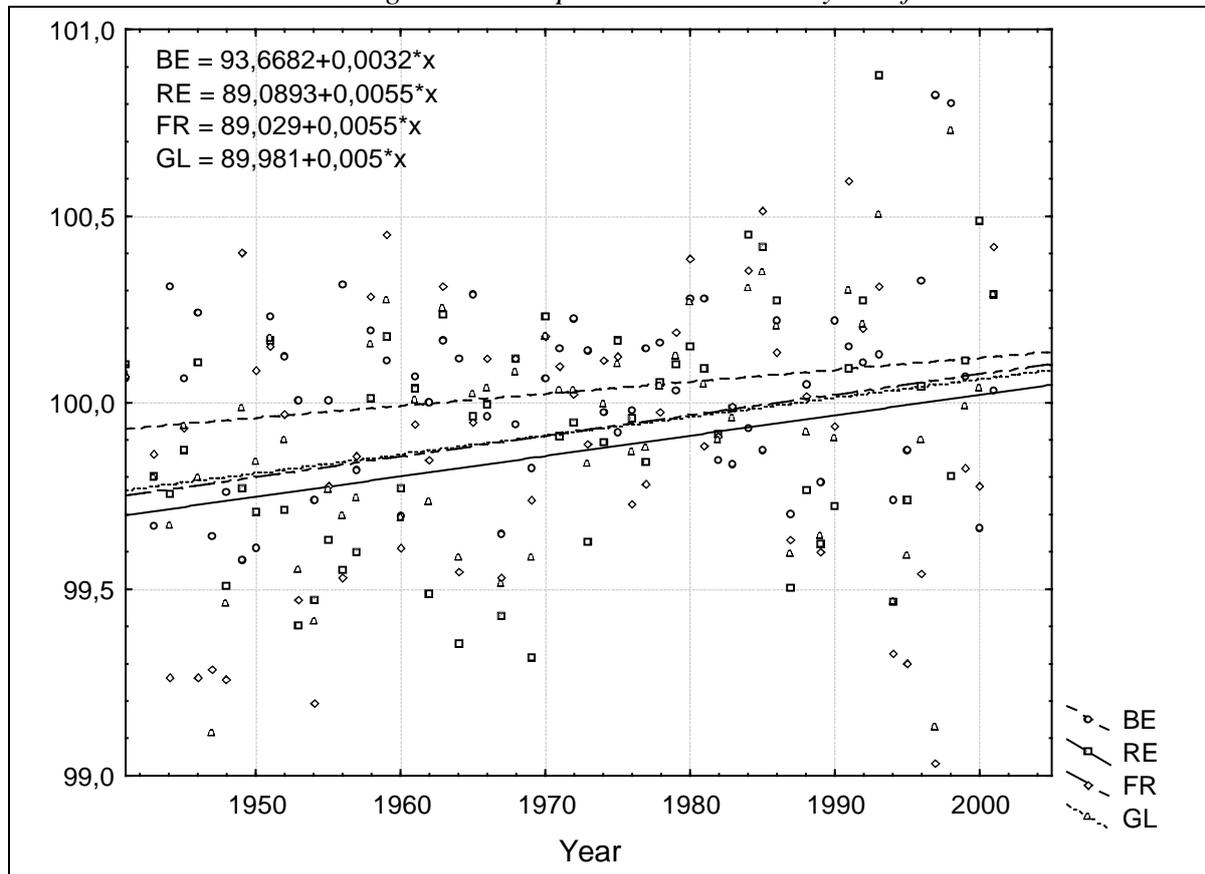
Where: BE is the breeding value of basic evaluation (conformation and gaits), RE is the breeding value of score by reprise, FR is the breeding value of the final ranking for dressage exercises and GL is the global breeding value (global genetic index).

Acknowledgements

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Riding performance Jumping (earnings) Dressage (earnings). Cutting ability Thoroughbred racing. Genetic evaluation of a bull is based primarily on how his daughters' milk production compares to that of their contemporaries. Milk production is a mod-erately heritable trait (25%), and the average milk cow today produces nearly five times as much milk as the average cow in 1940; this is a most noteworthy example of selection pressure, even though the trait is not expressed in the bull (Table 13.7). The performance comparison of the re-sulting progeny illustrated that breeders had been very successful in changing the growth rates of their cattle (Table 13.9). Note that birth weights increased along with growth rate and frame size.