

PAPER

Optimization of the performance test length for the *Sella Italiano* stallion

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Abstract

The *Sella Italiano* stallions are selected by 100-day performance test, but many breeders organisations use station test of shorter length. In twelve editions, 17,394 ten-point scores both for character and gaits, and 6291 scores for jumping were assigned to 314 candidate stallions. By means of the comparison of univariate EBVs, calculated from the complete dataset or from the reduced subsets, a dataset lasting only from 33rd day to 78th day of the training period was selected: it included less than 70% of the original data. The subset was validated by 3-trait AM BLUP: there were no evident effects on the estimates of variance component or ratio, and the aggregated selection index for the three traits showed a 99% rank correlation with the official index. These findings demonstrate that the training period could be reduced without affecting the genetic progress in the *Sella Italiano* breed.

Introduction

The European organisations use three different types of data to select stallions for show jumping: competition data, field test and station performance test (Bruns *et al.*, 2001; Thorén Hellsten *et al.*, 2006). Field test traits usually show a lower heritability than station test traits, but the field test counteracts the heritability reduction by testing a greater number of unselected horses; competition data have the advantage of collecting a large amount of information with relatively low cost (Ricard *et al.*, 2000).

In Italy, the Maremmano horse breeders association (ANAM) started the evaluation of candidate stallions by 100-day station test in 1992; in 1998, the National Union for the

Improvement of Horse Breeds (UNIRE) started the same type of evaluation for the *Sella Italiano* stallions (Giontella *et al.*, 2008). There is a variability of the testing period in different countries: in the Netherlands it lasts 70 days (<http://www.kwpm.org>) and in Germany the length ranges from 30 to 70 or 100 day according to the breed; in Denmark, the period was reduced from 70 to 35 days in 2006 (<http://www.warmblood.dk>); in Sweden, the period lasts only 8 days, because of a good correlation of such a short period with evaluation from field data (Olsson, 2006). In USA, 100-day test has been demised for 70-day test in 2009 (<http://www.cfequestrian.com>). During the twelve editions of the 100-day performance test, 4-year-old *Sella Italiano* candidate stallions have always been scored for 3 traits: character, gaits and jumping; however, the length of the staying in the station was not the same.

The aim of this work is to investigate the effect of a reduction of the testing period on i) genetic parameters for traits scored during the performance test (*i.e.*, character, gaits and jumping); and ii) the selection index of the candidate stallions obtained by combing with appropriate weights the abovementioned traits.

Materials and methods

In the *Sella Italiano* performance test, after a short adaptation period, the candidate stallions are daily judged by the trainers (usual number of 9 trainers). At the beginning of each business day, the candidate stallions are randomly matched with the trainers (*i.e.*, 2 or 3 candidate/trainer) and, at the end of the work, the trainers assign the scores to the candidate stallions, using a scale from 1 to 10, for character and gaits; two days a week, the candidate stallions receive a ten-point score also for jumping under rider. The random matching has an exception, in order to get estimates of the trainer×horse interaction: every trainer needs to judge every candidate stallion at least twice. In the last day of the testing period, two famed riders are invited to drive in blind all candidate stallions, and then they judge them; these scores have been excluded from the analysis, because it would not be possible to slide the censoring time; however, these scores have a weight of 10% only in the final index produced for each stallion.

The dataset with the records of 314 candidate stallions which completed the twelve editions of the station test included 17,394 scores for character and for gaits, and 6,291 scores for

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jumping (Table 1); the number of scores for each candidate stallion (mean±standard deviation) was 55.4±6.1 for character and gaits, and 20.0±2.6 for jumping; the scores (mean±standard deviation) were 6.67±1.15 for character, 6.84±1.20 for gaits and 7.12±1.23 for jumping. Although the average length of the testing period was 99 days, that is very close to the classical 100-day performance test, a 19 days of range was observed: in fact, the minimum length was 89 days in the 2007/08 edition and maximum length was 108 in 2004/05 (Figure 1). There were four generation of ancestors for each candidate stallion in the pedigree file, so that the whole pedigree had 4144 horses.

The study had two phases: the first one aimed at analysing the effect of a progressive reduction of the number of scores by censoring the dataset at the beginning or at the ending of the training period; the second phase aimed at validating a reduced dataset: variance component and breeding value estimates from the complete dataset and the reduced one were compared. The censoring at the ending simulates a shorter training period, which determines a reduction of the cost. Since the first day of scoring changed between different editions, the censoring at the beginning was performed to get a better distribution of the data, and eventually define a standardized length also for the adaptation period; obviously the censoring at the beginning does not affect the cost, since the candidate should be maintained and trained anyway.

After checking the distributions of the traits,

the first phase of the study started with the calculation of the breeding values of the horses by a mixed model with no relationship; there were included in the model the fixed effects of the scoring day and of the trainer, and the random effects of the horse, of the trainer×horse interaction and of the residual. After this, the breeding values of the horses have been recalculated several times with the same model, but with progressively reduced dataset: in these subsets, the scores recorded at the beginning of the period have been excluded one day at a time, until the last one included only the scores assigned from 51st day to the end of the training period; with a similar pattern, the breeding values were also recalculated several times with the same model, but progressively excluding one day at a time from the ending of the training period, until the last subset included only the scores assigned from the beginning to 51st. The correlations between the breeding values from the completed dataset and those from the subsets, censored at the beginning or at the ending, were calculated to find the subset to validate: the censoring was fixed, both sides, at the day that the correlations fell below 0.99.

In the second phase of the study, the complete dataset and the validation subset were used to evaluate the candidate stallions according to the official method (Giontella *et al.*, 2008): a three variate Animal Model BLUP, with the same effects included in the previous mixed model, but including also relationships. Dataset were compared by analysing genetic parameters and the correlation between overall selection indexes obtained with the whole

or the reduced dataset. The overall selection index was prepared by weighting character and gaits 25% each, and jumping for the remaining 50%.

Statistical analysis has been performed by R package (R Development Core Team, 2007), while BLUP estimates have been calculated by MTDFREML (Boldman *et al.*, 1993).

Results and discussion

Although the three traits fail the Kolmogorov-Smirnov test for normality, they all show a good bell-shaped distribution, with a low negative skewness; the kurtosis coefficients are slightly positive for character and

Table 1. The dataset of the candidate stallions that completed the twelve editions of the *Sella Italiano* performance test.

Edition	Candidate stallions	Trainers	Training period Scoring days	Scores	
				Character and gaits	Jumping
I (1998/99)	21	9	45	1.084	550
II (1999/2000)	24	8	46	1.059	352
III (2000/01)	32	11	50	1.564	689
IV (2001/02)	23	10	57	1.251	453
V (2002/03)	30	10	57	1.695	565
VI (2003/04)	24	9	57	1.268	439
VII (2004/05)	26	9	60	1.528	516
VIII (2005/06)	27	10	59	1.567	540
IX (2006/07)	28	9	62	1.636	545
X (2007/08)	29	9	60	1.719	577
XI (2008/09)	27	9	57	1.462	562
XII (2009/10)	23	10	68	1.561	503
Total	314	113*	678**	17,394	6291

*Some trainers participated in more than one edition, so that 74 different people were actually involved in training and scoring candidate stallions; **character and gaits were scored in every business day; jumping is scored later, and only two days a week, therefore this trait was scored in a total of 243 days.

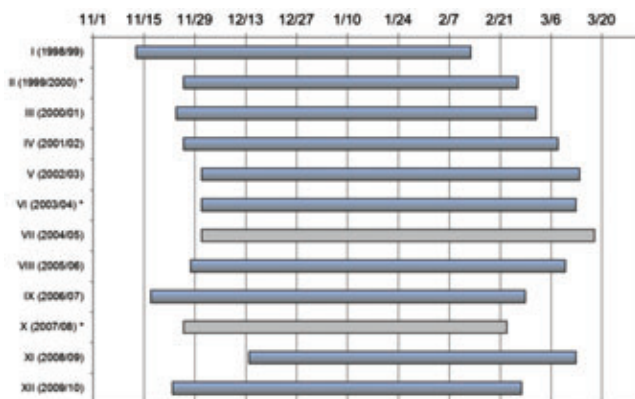


Figure 1. Length of the testing period in the twelve editions: the mean is 99 days, with a range from 89 days (edition X) to 108 days (edition VII). The edition marked with * refer to a leap year.

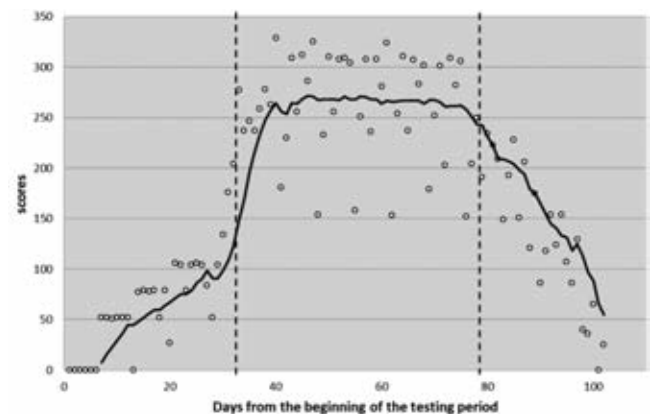


Figure 2. Number of scores by day in the twelve editions of the 100-day station test; line is a week moving average; dotted lines show the 33rd and 78th day.

jumping, and negative for gaits. It must be considered that the power of the normality test is very high when the sample has so many observations. The overall number of scores by day is shown in Figure 2: during the adaptation period, horses receive no scores; this period lasts at least a week, but it is influenced by the previous training or climate conditions, so that the number of scores recorded during the first month of testing is generally reduced.

When the scores at the beginning of the training period are deleted, the breeding values of the horses calculated by the mixed model lose their correlation with the breeding values from the complete dataset; the decline is slower for gaits, whilst jumping correlation falls at 99% if the data recorded in the first 33 days are deleted (Figure 3). Also deleting the data from the ending period is less important for gaits, whilst deleting all records from 78th days on reduces the correlation for character at 99%. There is a clear overlapping between the amount of recorded data shown in Figure 2 and the dotted window in Figure 3. The validation dataset started from the 33rd day and it ended on day 78th for each edition: it included 12,051 scores for character and for gaits, and 4488 scores for jumping; because of this, the number of scores for each candidate stallions (mean±standard deviation) reduced to 38.4±2.6 for character and gaits, while those for jumping reduced to 14.3±2.9: these values are 69.3% and 71.5%, respectively, of the complete dataset. The estimates of the variance component by Multiple Trait AM BLUP show that there is a small reduction in phenotypic

variance when only data from the reduced dataset are used in horse evaluation; heritabilities and genetic correlations are unaffected (Table 2). The European organisations score different traits in their performance test stations. The character trait is not widely assessed; the present heritability estimate of 0.39 seem to be in the middle of the observed range; in fact, the lowest heritability estimates for character trait in 100-day station test is 0.14 in Polish warmblood (Borowska *et al.*, 2011), while the highest is 0.52 in Dutch warmblood (Huizinga *et al.*, 1991). The gaits trait is usually divided into three different traits, that is walk, trot and canter; also the

jumping trait is sometimes divided into free jumping and jumping under rider (Thorén Hellsten *et al.*, 2006); however, since the admission to the performance test of *Sella Italiano* candidates is based on a trot evaluation at 2 years of age, and a free jumping evaluation the following year, these traits are not scored in the station test: furthermore, gaits evaluation in the first year of the *Sella Italiano* performance test was split in two traits, but they showed a 95% phenotypic correlation (Pieramati *et al.*, 2001). The strongest genetic correlations between walk, trot and canter were found in the old 100-day Dutch warmblood test: they ranged from 0.88 to 0.97; the average

Table 2. Estimates of variance component and ratios from the complete and reduced dataset.

	Complete dataset			Records from day 33 to day 78		
	Phenotypic variance			Phenotypic variance		
	Character	Gaits	Jumping	Character	Gaits	Jumping
Character	1.126			1.011		
Gaits	0.625	1.199		0.525	1.108	
Jumping	0.646	0.749	1.179	0.519	0.521	1.077
	Heritabilities and genetic correlations			Heritabilities and genetic correlations		
	Character	Gaits	Jumping	Character	Gaits	Jumping
Character	0.39			0.39		
Gaits	0.70	0.62		0.66	0.62	
Jumping	0.76	0.80	0.47	0.76	0.77	0.46

*Some trainers participated in more than one edition, so that 74 different people were actually involved in training and scoring candidate stallions; **character and gaits were scored in every business day; jumping is scored later, and only two days a week, therefore this trait was scored in a total of 243 days.

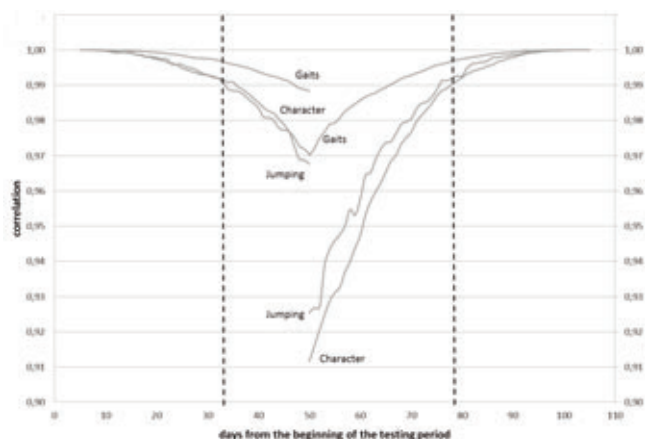


Figure 3. Correlation coefficient between EBV of candidate stallions from the complete and the subsets of data: dotted lines show the 33rd and 78th day, when the correlation reaches 0.99 for all traits.

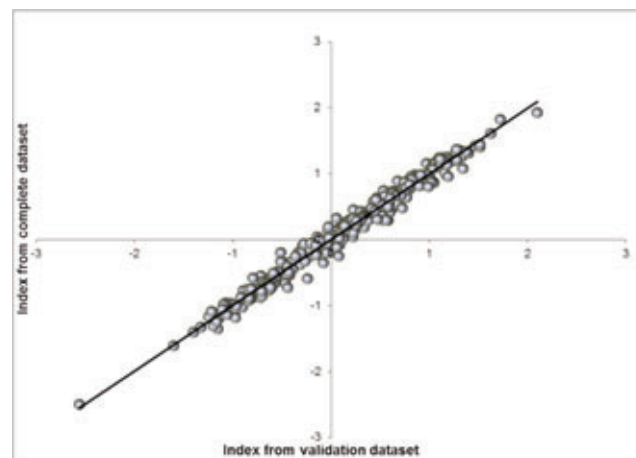


Figure 4. Plot of overall indexes calculated from the complete and the validation dataset.

heritability of the three traits was 0.64 (Huizinga *et al.*, 1991): this seems to be very close to our estimate of 0.62 for gaits heritability. The heritability estimates for jumping range from 0.30 in Polish warmblood (Borowska *et al.*, 2011) to 0.50 in Swedish warmblood (Gelinder *et al.*, 2001): the 0.47 estimate for the *Sella Italiano* is the same value reported by Olsson *et al.* (2008).

The correlation coefficient between the genetic index of the 314 candidate stallion estimated from the two dataset was calculated: for each trait it was greater than 98%, both as EBVs and as ranks, and for the overall selection index it was 99% both as EBVs (Figure 4) and as ranks.

Conclusions

Many breeders' organizations reduced the length of the station test from the classical 100 days; it can be considered that the new standard duration on the station test of warmblood stallions is 70 days. The results from the analysis of the dataset of the twelve editions of the performance test of the *Sella Italiano* stallions show that a similar reduction can be safely adopted also in Italy. The impact of this shortening will be very low, if any, on the genetic progress. On the contrary, the reduction of the cost will be important, and it could lead to an increase in the number of tested horses.

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