Application of an AM-BLUP to the station test results of Italian Saddle horse stallions

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ABSTRACT: The data collected in the first seven years of the 100-day Station Test for Italian Saddle Horse stallions have been used to estimate EBVs by single trait - repeatability AM-BLUP. There were 9449 scores for “character” and “gaits”, and 3564 for “jumping ability” in the training period; 344 scores for each trait were also available from the final evaluations assigned by two well-known professional riders; in the pedigree file of the 180 tested horses there were 2837 animals. Heritability estimates were .38±.02 and .23±.14 for “character”, .60±.02 and .58±.04 for “gaits”, and .48±.02 and .52±.04 for “jumping”, in the training period and in the final evaluation, respectively. The training period and the final evaluation were weighted 90% and 10% in each trait index, and the weights for “character”, “gaits” and “jumping” were 25%, 25% and 50% in the overall index. The genetic index was correlated .97 with the current official index, both linearly and in rank: therefore, the 82 licensed stallions give a selection intensity of .85, instead of the theoretical maximum of .87. Although the difference in the response to selection that the switching to BLUP could assure is low, the breeders could make comparisons between stallions approved in different editions.

Key words: 100-day station test, Italian Saddle Horse, Heritability, BLUP.

INTRODUCTION – In Italy, the Maremmano Horse Studbook was the first one to use a 100-day Station Test to evaluate stallions: this started in 1993 with experimental trials, and since 1996 it became the official method for licensing stallions (Pieramati et al., 2000). Following this experience, in 1999 the III Section of the Italian Saddle Horse Studbook decided to use a similar methodology. To be admitted, young males must qualify in two trials: trotting evaluation when they are 2-year old and free jumping at 3 year, just before the beginning of the station test. Each year, 42 horses qualify for the performance test; after 30 days of adaptation, each day a horse is randomly assigned to a trainer: every day, trainers score each horse for “character” and “gaits”, and twice a week also for “jumping”; the same traits are also scored at the end of the training period by two well-known professional riders. A mixed model with no relationships is used to calculate partial Performance Test Indexes, weighing 90% the scores from the training period and 5% each those assigned by the riders: the traits weights are 25%, 25%, 50% to get an overall Performance Test Index, with the maximum for “jumping” since this is the main attitude of Italian Saddle Horse. A maximum of 15 horses per year according to the overall index can be licensed as stallion if their rank is grater than 60% (Pieramati et al., 2001). The aim of this work is to investigate whether the selection programme can be improved by the use of pedigree information: BLUP estimates could be more accurate and would allow for comparison among horses from different editions.

MATERIAL AND METHODS – There were 10,393 records collected in the first 7 editions of the 100-day station test, but only records of the 180 horse that completed the test have been used (Table 1). The pedigree file was set up with 4 generations of ancestors: as a result, there were 2837 horses in it. Since the statistical analysis was in first editions performed using different commercial software, and trait weights
also changed from the original 1/3 each to current 1/4, 1/4 and 1/2 values, the dataset was analyzed again using “R” package (R Development Core Team, 2005), and the Performance Test Index successfully compared with official results.

The MTDFREML package (Boldman et al., 1993) and VCE program (Kovac and Groeneveld, 2003) were used to estimate genetic parameters in 4 different ways: single or multiple trait on indexes, and single or multiple trait on data. In the model used for indexes only random additive effect and error were fitted. In the models for the evaluation from raw data, the same effects used in the calculation of official index were fitted: for the training period scores, fixed effects of trainer and date, and random effects for horse and trainer*horse interaction and for error; for the final scores, fixed effect of rider and random effects for horse and error. Training period and final scores were analyzed separately before weighing them in order to build the trait index.

**RESULTS AND CONCLUSIONS** – The pedigree file showed that the relationships between the 180 tested horses are very few: for instance, they were from 159 sires and 180 mares. The first analysis with a single trait model on partial and overall indexes gave the same results with both software: estimates of heritability converged to 1 for all indexes but “character”, of which estimate was .96. These estimates show that the number of observations is too low: this is because the multiple trait analysis of the performance indexes showed up unfeasible, when MTDFREML failed to converge and VCE heritability estimates were null. In the univariate models on raw data both software gave the same estimates, from different priors and with different optimization method: the results are shown in Table 2.

The multiple trait analysis was set up separately for the two periods. The number of scores in the finals were not enough to get components estimates: both software always bounced on 1 genetic correlations; on the contrary, it was possible to obtain estimates for the training period, although there were slight differences (Table 3).

Following the results of genetic parameter estimates, it was decided to estimate EBVs from the univariate models from raw data, then to calculate an overall value for each horse by the official weights. The mean accuracy ranged between .90 and .93.

| Table 1. Data set summary. |
|---------------------------|
| Year of testing | Horses | Training period |
| | | Trainer | Scoring days | Character Gaits | Jumping | Final scores |
| 1999 | 21 | 9 | 45 | 1084 | 550 | 37 |
| 2000 | 24 | 10 | 46 | 1059 | 352 | 43 |
| 2001 | 32 | 11 | 50 | 1564 | 689 | 61 |
| 2002 | 23 | 10 | 57 | 1251 | 453 | 46 |
| 2003 | 30 | 10 | 57 | 1695 | 565 | 60 |
| 2004 | 24 | 9 | 57 | 1268 | 439 | 48 |
| 2005 | 26 | 9 | 60 | 1528 | 516 | 49 |
| Total | 180 | 68* | 372 | 9449 | 3564 | 344 |
| * within year. |

| Table 2. Heritability ± s.e. estimates in single trait analysis from raw data. |
|---------------------------|
| Period | Character | Gaits | Jumping |
| Training | .38 ± .02 | .60 ± .02 | .48 ± .02 |
| Finals | .23 ± .14 | .58 ± .04 | .52 ± .04 |

It must be stressed that, although the number of records for final scores, estimates for the two periods were really closed for gaits and jumping; character in the final period had a lower estimate, but with a greater s.e.. The trainer*horse interaction ranged between 3%-8% of the total variance.

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The analysis of variance and the Kruskal-Wallis test showed no difference in the values of horses tested in different editions, and also no trend was found by linear or ranking regression analysis. Within every edition, the correlation between partial indexes and EBVs for a trait was at least .89 linearly and .92 in rank; in the 7 years period, the overall index and EBVs were correlated .97 both linearly and in rank. In the first seven editions, 82 stallions out of 180 tested horses have been licensed: that is 45.6%, corresponding to a selection intensity .87; the mean EBV of these stallions resulted .635, whilst the choice of the best 82 according to EBVs could get a mean of .658: the effective selection intensity was therefore .85.

It can be concluded that the data collected in the 100-day station test seem to be sufficient to get genetic parameters estimates of the selection traits, at least in univariate mode: however, because of the lack of relationships between candidates, the introduction of BLUP evaluations could give in the short term a 4% improvement to the current programme; it can be supposed that the relationships will increase in the next years, so the improvement will be greater too. The main result that the breeders can actually get from EBVs is a comparison between stallions tested in different years.

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| Character | Gaits | Jumping | Character | Gaits | Jumping |
|-----------|-------|---------|-----------|-------|---------|
| MTDFREML  | .33   | .71     | .79       | .26 ± .11 | .68 ± .11 | .83 ± .10 |
| VCE       | .57   | .89     | .46       | .56 ± .06 | .87 ± .06 | .45 ± .04 |

Table 3. Heritability and genetic correlations estimates by MTDFREML and VCE (± s.e.).