Genetic analysis of the precocity potential in trotting races of Spanish Trotter Horses

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Abstract **42982**

Spanish Trotter horse

INTRODUCTION

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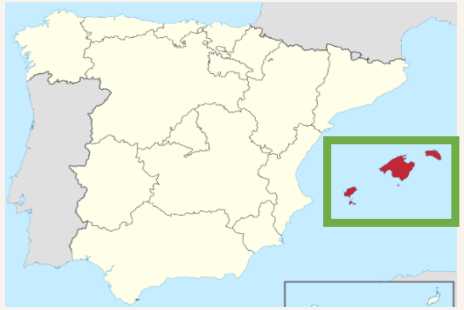
The **Spanish Trotter** horses have extraordinary resistance make them ideal for trotting races.

This breed was formed from trotting horses from France, USA, Sweden, Denmark, Italy, and Germany.

The breeding is notable in the Islas Baleares (Spain).



This breed is currently managed by the Association of Breeders and Owners of Trotting Horse (ASTROT). The breeding program was approved in the year 2005, and since then, genetic evaluation has been carried out for this breed.

Trotting races have been held since the beginning of the 20th century.

Annually about 1,150 races are held in 7 different hippodromes, with around 650 horses participating/by year.

Precocity

INTRODUCTION

Trotter horses can compete in races over **different distances** during their sporting lives; and also at **different ages**, because their career can last a long time (in Spain, they start at 2 years old and continue to 18 years old or more).

The ideal is to obtain a horse economically better adapted to race and, according to race programs, with a better :

Precocity : money won during the first years of the trotting career (%) / total actual earnings won during the whole trotting career

In Spain, the most important trotting races are held for animals when they are 3 years-old: The National Grand Prix.

Therefore, the industry tends to favor :

- ✓ **precocious horses** that can not only start competing,
- ✓ but also **win at a young age.**

OBJETIVE

The objectives of this study were to investigate the usefulness of **5 different traits** related with ranks in the genetic evaluation of precocity for the STH population, and determine the **genetic parameters** , in order to evaluate their possible inclusion in the official genetic program of this population, in an effort to facilitate the selection of the best parents for producing the next generation.

Database

MATERIAL AND METHODS

Spanish Trot Federation for races held (1990-2022) → **475,049** Race records of **8,368** animals.

Data cleansing

In order to evaluate the genetics parameters:

Into account

- ✓ National animals
- ✓ First 60 months of their life

Deleted

- ✓ Gelding horses
- ✓ Animals starting their sportive career after 42 months of life
- ✓ Animals without registered participation during 12 consecutive months.

The final dataset included → **176,137** Race records of **4,947** animals.

The average number of participations by horse was **56.8** races.

Description of Traits

MATERIAL AND METHODS

Five different traits, based on race results of the STH, were tested for as precocity:

1. Age at the first ranked race (for animals placed between 1st to 3rd place in the ranking) measured in months **(AFR).**
2. Age of the animal when it reached the 50% of ranked races in the reference period (first 60 months of their life) **(A50%).**
3. Age of the animal when it reached the first 10 ranked races **(A10).**
4. Total number of races in which the animal competes before the first ranked race **(NRC).**
5. Percentage of first placings (1st to 3rd) in the races by year of participation **(PFP).**

Statistic and genetic analysis

MATERIAL AND METHODS

Statistical analyses were performed with **Statistica for Windows v11.0 Software**

StatSoft STATISTICA

Heritability coefficients and genetics correlations were estimated using **GIBBSF90+** of the **BLUPF90 Software,** using a Bayesian approach:

Genetic Models

AFR: $y_i = \mu + tr + xib + ziu + e$

A50%, A10: $y_i = \mu + nrr_1 + nrr_2 + x_ib + z_iu + e$

NCR: $y_i = \mu + tfrr + x_ib + z_iu + e$

PFP: $y_i = \mu + age + nrr_1 + x_ib + z_iu + e$

Where :

y = vector of observations
μ = overall mean
tr = covariate, time in the race in seconds
nrr1 = covariate, the number of registered races
nrr2= covariate, number of ranked races
tfrr = covariate, time needed for the first ranked race
age = covariate, the age at first race (days)

b = vector of fixed effects
u = vector the random additive genetic effect
e = vector of random residual effect

X= incidence matrix of fixed effects
Z= incidence matrix of additive genetic contribution

Genetic Models

MATERIAL AND METHODS

Trait	Covariates	Fixed effects
AFR	Time in the race (seconds)	Sex (2 levels); Type of start (2 levels) Distance of the race (3 levels); Hippodrome (4 levels) Earnings in the race corrected by the inflation rate (3 levels)
A50%	Total number of registered races Total number of ranked races	Sex (2 levels) Total earnings in the 50% of ranked races/number of ranked races (3 levels)
A10	Total number of registered races Total number of ranked races	Sex (2 levels) Total earnings in the first 10 ranked races/10 (3 levels)
NRC	Time needed for the first ranked race (difference between the age at the first ranked race and the age at first race, in months)	Sex (2 levels) Age in months for the first ranked race (3 levels)
PFP	Age at first race in days Total number of registered races	Sex (2 levels) Total earnings in 60 months/number of ranked races (3 levels)

Statictic

RESULTS

Descriptive statistics for the five precocity traits analysed in the Spanish Trotter horse population

Traits	N	Mean ± s.e.	Min.	Max.	CV%
AFR Age at first ranked race	4214	33.05 ± 0.106	14.90	60.00	20.75
A50% Age when it reached 50% of ranked races	4080	40.99 ± 0.113	16.74	58.48	17.69
A10 Age when it reached the first 10 ranked races	2512	42.31 ± 0.160	19.35	58.90	18.96
NRC Number of races in which the animal competes before the first ranked race	4387	3.34 ± 0.053	1.00	42.00	16.20
PFP Percentage of first placings in the races by year of participation	4387	37.80 ± 0.285	1.49	100	49.87

The most homogeneous trait was **NRC**, with a CV of 16.20%. Its average value evidenced the positive results obtained by the animals. They only needed 3 participations to obtain a ranked result, and therefore to obtain the first economic prize of their sportive career.

The most heterogeneous trait was **PFP**, with a CV of 49.87%.

Both age traits, **A50%** and **A10**, shown very close average values, being also their CV close to this for the **AFR** (20.75%).

Average value of **AFR** was 33 months. So, we can affirm that STH are in general a precocious breed.

Heritability

RESULTS

Genetic parameters for the precocity traits analyzed in the Spanish Trotter Horse population				
Traits	σ_u^2	σ_e^2	h^2	**HPD (95%)**
AFR Age at first ranked race	5.17	19.30	0.21	0.14 - 0.28
A50% Age when it reached 50% of ranked races	12.16	26.98	0.31	0.23 - 0.39
A10 Age when it reached the first 10 ranked races	17.12	33.72	**0.34**	0.25 - 0.42
NRC Number of races in which the animal competes before the first ranked race	0.39	4.17	**0.09**	0.04 - 0.14
PFP Percentage of first placings in the races by year of participation	67.01	155.31	0.30	0.22 - 0.38

Heritability values were of medium-low level, ranged from **0.34** (**A10**: Age when it reached the first 10 ranked races) to **0.09** (**NRC**: Number of races in which the animal competes before the first ranked race).

This lower value evidenced the important influence of environmental effects on the number of races in which the animal competes before the first ranked race.

Whereas the higher values ensure that the indicated traits are adapted to an effective genetic selection.

Heritability

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A heritability value of **0.21** was obtained for **AFR** (Age at first ranked race). The age at beginning of the sportive career was mainly conditioned due to environmental factors, but the obtained results also evidenced the existence of genetic differences in precocity, soundness and ability to respond to training.

Heritability value of AFR in other trotter populations :

Standardbred trotters: 0,15

Finn-horse trotters: 0,10

(Saastamoinen and Nylander, 1996)

Heritability

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The **PFP** (Percentage of first placings in the races by year of participation) shown a heritability value of **0.30** in the STH population

Heritability value of PFP in other populations

Spanish Trotter Horse: 0.14 (in a year analyzed) (Gómez et al., 2010)

Nordic Trotters: 0.25 (Arnason, 2008)

Sweden Standardbred : 0.32 (Arnason et al. 1989).

Genetic/Phenotypic correlations

RESULTS

Genetics correlations (above diagonal) and phenotypic correlations (under diagonal) between the five precocity traits in the Spanish Trotter Horse population.

Trait	AFR	A50%	A10	NRC	PFP
AFR Age at first ranked race		0.86	0,88	-0.22	-0.84
A50% Age when it reached 50% of ranked races	0.550		0.96	-0.33	-0.73
A10 Age when it reached the first 10 ranked races	0.677	0.662		-0.15	-0.83
NRC Number of races in which the animal competes before the first ranked race	0.373	0.177	0.211		-0.31
PFP Percentage of first placings in the races by year of participation	-0.195	-0.105	-0.381	-0.362	

The positive genetic correlations ranged from 0.96 **(A50%-A10)** to 0.86 **(AFR-A50%).**

The negative genetic correlations ranged from -0,84 **(AFR-PFP)** to -0,15 **(A10-NCR)**

Only the NRC shown lower genetic correlations, which can be caused by the higher influence of external factors on this trait, as evidenced its low heritability.

The negative genetic correlations obtained between NRC and PFP with the other analyzed traits are remarkable, because the sign has to be considered in the inclusion of the traits in the selection program of this population.

CONCLUSIONS

1. The genetic parameter estimates indicated that precocity traits could be improved with a suitable selection program based on the genetic evaluation.

2. The precocity evaluated through these new criteria, is a predictive tool for selection of horses for early racing performance and for informing training decisions.

3. Precocity traits analyzed in STH population may be susceptible to be included in their official genetic selection program, because they are measurable, variable, heritable and economically important for breeders. Percentage of first placings in the races by year of participation (PFP) could be the most accurate variable to include in the breed improvement program as an early maturity criterion.

Thank you very much for your attention!

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