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PARTIAL RESULTS OF GENETIC ANALYSIS IN ROMANIAN TROTTER HORSE FROM DOR MARUNT STUDFARM - REPRODUCTIVE ISOLATION AND AGE STRUCTURE

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Abstract

The paper aimed to present an important part of genetic analysis in Romanian Trotter horse. The sample extracted from the population is represented by entire reproductive nucleus of Romanian Trotter breed from Dor Marunt studfarm. We analyzed the reproductive isolation and the age structure. The reproductive isolation are the most important criteria for a flock to be accepted as a population. The other three are morphological and physiological differences, environmental requirements and genetic size, but all these three criteria evolving according to reproductive isolation coefficient. The age structure have an important role in animal breeding (horse breeding in this case) and also in exploitation. Both analyzed components have a capital importance in animal breeding because there has a directly influence in animal population evolution. The reproductive isolation situation was quantified using the relation elaborated by S. Wright and the age structure situation is based on the age distribution histogram.

Key words*: age structure, reproductive isolation, Trotter.*

INTRODUCTION

The reproductive isolation is the most important criteria for a flock to be accepted as a population (Draganescu, 1979; Popescu-Vifor, 1990). In case of sport horses the situation is a little bit different because the stallions with great sportive performances have the wright to be used for reproduction in other breeds than the one it belongs to (Marginean et al., 2005). The explication is very simple: the breeders are focused in principal on performance and not on genetic conservation. But even in this case of sport horses we can talk about infusion and not about absorption. In order to elaborate strategies for inbreeding management, or breeding programme, we must start from genetic analysis (Maftei, 2011). Only in this situation it is possible to obtain great individuals, with a high genetic value, capable to be the parents of a new and valuable generation. Of course, in the same time we will assure about a better genetic and economic efficiency (Maftei et al., 2011; 2022). Regarding the age structure, Regarding the age structure, it has been shown that it directly influences the generation interval and population variability (Popa, 2009). In the same time the age structure is very important in exploitation because influenced the average age directly (Marginean, 2012).

MATERIALS AND METHODS

The biologic material it is represented by entire reproductive nucleus of Romanian Trotter horse from Dor Marunt stud, 60 individuals, 6 stallions (Table 1) and 54 broodmares (Table 2).

Table 1. The sire stallions active in the reproductive nucleus of Romanian Trotter horse

No.	Name	Year of birth	Specification
1	NUROFEN	2002	II
2	VIS	2002	AI
3	BIZAR	2004	AA
4	OLIMP	2009	AA
5	VARTEJ	2009	AA
6	NELUTU	2010	AA

The reproductive isolation coefficient was calculated using the relation developed by S. Wright:

$$R.I.C. = \frac{AA - (AI + II)}{AA + AI + II}$$

where: AA - number of individuals, from reproductive nucleus, with both autochthonous parents;

- AI - number of individuals, from reproductive nucleus, with one autochthonous and one immigrant parent;
- II - number of individuals, from reproductive nucleus, with both immigrants parents.

Table 2. The broodmares from reproductive nucleus of Romanian Trotter horse

No	Name	Year of birth	Specification
1	KINTA	1998	AI
2	RECEPTIA	1998	AI
3	CAMILA	1998	AI
4	STEMATA	1998	AA
5	VRAJA ZORILOR	1998	AI
6	SIAMEZA	1999	AI
7	BRENDA	1999	AI
8	KATRINA	2000	AI
9	RAZA DE LUNA	2000	AA
10	SIMETRIA	2000	AI
11	SOGUNA	2000	AI
12	IALTA NU	2001	AA
13	SOLOMIA	2001	AA
14	NEVADA	2003	AA
15	VRAJA SOU	2003	AI
16	REGINA ANA	2003	AI
17	KATIUSA	2004	AI
18	ROMANITA	2004	AA
19	DIACONITA	2005	AA
20	OSANDA	2005	AA
21	PAMFILA	2005	AA
22	VRAJA LIREI	2005	AI
23	AMICA III	2007	AI
24	PAMELA	2007	AA
25	NEDORA	2007	AA
26	ONDA	2007	AA
27	SARA	2007	AA
28	VOIAJORA	2007	AI
29	RELAXA	2008	AI
30	REGINA ANTOANETA	2009	AA
31	SULTANA	2009	AA
32	VICTORIA	2009	AA
33	KITTY	2010	AA
34	SORANA	2011	AA
35	KISS ME	2011	AA
36	SERENA	2011	AA
37	IRENA	2011	AA
38	FINUTA	2012	AA
39	VRAJA STANCA	2012	AA
40	SENIORITA	2013	AA
41	PATIMA	2014	AA
42	RASFATATA	2014	AA
43	VENERA	2014	AA
44	PANDORA	2015	AA
45	OPS	2015	AA
46	ASTARTE	2015	AA
47	VIDIA ROSIE	2016	AA
48	VRAJA ZAPEZII	2016	AA
49	KIRRA	2016	AA
50	RAMYA	2017	AA
51	NEMARA	2017	AA
52	KINA	2017	AA
53	SOLEDAD	2017	AA
54	SOPHIA	2017	AA

The weight of different age categories from entire population, expressed in years, is defined as the age structure, and it is based on the age distribution histogram.

RESULTS AND DISCUSSIONS

The results regarding reproductive isolation coefficient (RIC) are showed in Table 3.
The age structure for Romanian Trotter, from Dor Marunt stud farm is presented in Table 4, and the share of autochthonous and immigrant individuals, for all analyzed generations are graphically represented in Figures 1, 2 and 3 being much more easy to observe the share of native and immigrant individuals in the reproductive nucleus.

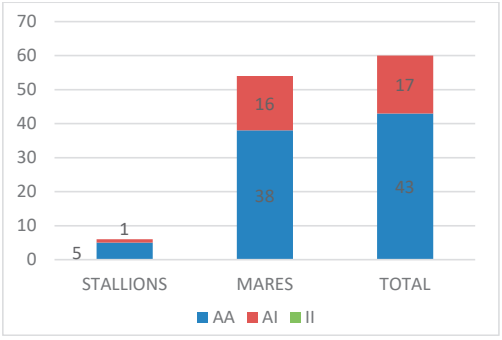

Figure 1. Share of immigrants and autochthonous individuals in the reproductive nucleus

The analyzed data from Table 3 relive the fact that the Romanian Trotter it is a population because the values of reproductive isolation coefficient is between 0 and +1 (Popa, 2009; Maftei et al., 2011) for all three generation.

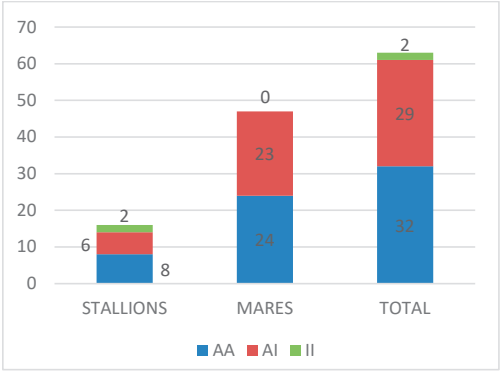

Figure 2. Share of immigrants and autochthonous individuals in case of parents of reproductive nucleus

We are relatively close to the period of the last import, and that is obvious when we look at the R.I.C. value for parents and grandparents of reproductive nucleus. The R.I.C. value for reproductive nucleus (0.4333) reveal the fact that the population is still in the influence area of immigrant populations.

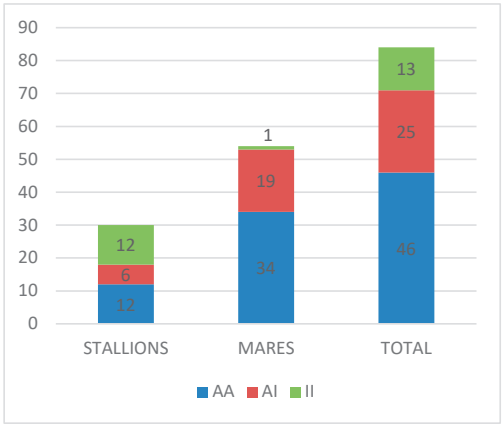

Figure 3. Share of immigrants and autochthonous individuals in case of grandparents of reproductive nucleus

At the grandparents level, in stallion case, R.I.C. value at -0.2 highlights the lack of reproductive isolation. Certainly, at the level of the grandparents of the reproductive nucleus, an infusion cross was made, in order to improve certain characters (especially the speed), using stallions from other trotter populations for reproduction. The value of the same coefficient, but at the level of parents, could not increase significantly due to the overlapping generations. At the same time, the RIC value it was influenced, in this 3 generation, by the promotion to reproduction of a large number of mares with an immigrant parent. All this situation, as mentioned above, is normal if infusion crosses are used, the reproductive isolation being then achieved gradually.

In terms of animal breeding, in order for a herd to be considered a population, respectively to have its own evolutionary path, it must have a value of reproductive isolation coefficient with positive values (to be found in the range 0 ; +1) for a number large enough of generations to allow population differentiation (minimum 3). The situation of perfect reproductive isolation is found at the value of +1 of this coefficient. Wright (cited by Draganescu, 1979 and Popa, 2009) set an optimal value of the coefficient equal to 0.8. This means that populations have an ideal evolution when 20% of the genes are immigrants (a percentage that corresponds to 10% of immigrant individuals, usually males). In this case it is obvious that the Romanian Trotter population is under the effect of infusion crossing, but there is a concern for reproductive isolation and fixation of the desired characters in the population, as can be seen in the figure 4.

The age structure in reproductive nucleus of Romanian Trotter from Dor Marunt stud farm is presented in Table 4 and in Figures 5 and 6. Analyzing presented datas, and also from graphical representation of age distribution in sire stallions and in broodmares livestock, it is easy to observe an unbalanced structure. I such a situation it is difficult, to not say impossible, to maximize the genetic gain and the economic efficiency, even if the age structure in sire stallions case looks a little bit more balanced (2 stallions at 20 years old, 1 stallion at 18 years old, another 2 stallions at 13 years old and one at 12 years old). In the broodmare case the individuals records ages from 5 to 24 years old, from which 24.07% have over 20 years old (almost a quarter from broodmares). This important share of old mares negatively influences the age structure and also the average age, implicitly also the maximization of genetic progress as well as the increasing of economic efficiency. The rest of mares from reproductive nucleus of Romanian Trotter horse is represented by 31.48% mares between 5 and 10 years old (9.27% mares at first parturition), and 44.44% mares between 13 and 19 years old. We suppose that at least 13 mares, born between 1998 and 2001, it will be removed from reproduction due to the old age. This action, associated with the promotion in the reproductive nucleus of a number of mares at least equal to the number of reformed mares can contribute to the optimization of the age structure. At this moment, if we take into account an average gestation time, in horses, of 0.92 years (11 months), at an average age of stallions of 10.7 years, we obtain a generation interval through males at 11.62 years which is not bad. In the broodmares case, the generation interval, calculated in the same style, is 15.23 years (broodmares average age 14.31 years old).

Table 3. Reproductive isolation coefficient values

Specifications		No.	Immigrants (I)	Parents			R.I.C.
				AA	AI	II	
Reproductive nucleus (RN) without last imported stallions	♂	6	-	5	1	-	+0.6667
	♀	54	-	38	16	-	+0.4074
	Total	60	-	43	17	-	+0.4333
Parents of RN	♂	8	2	8	6	2	0.0000
	♀	47	-	24	23	-	+0.0213
	Total	67	2	47	18	2	+0.0159
Grandparents of RN	♂	30	12	12	6	12	-0.2000
	♀	54	2	34	19	1	+0.2593
	Total	84	8	46	25	13	+0.0952

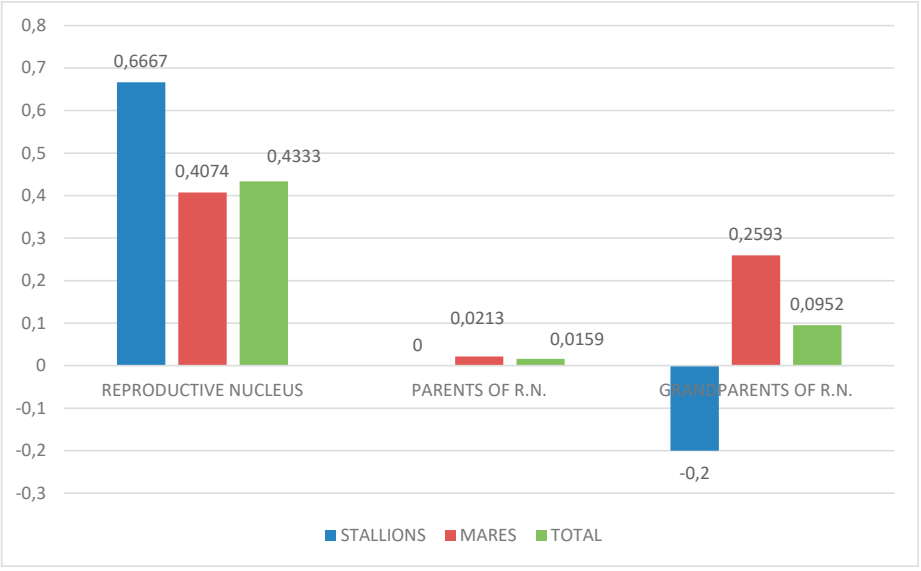

Figure 4. Evolution of R.I.C. values in analyzed population

Table 4. Age structure in the reproductive nucleus of Romanian Trotter horse

Sex	Total	Year of birth																										Average age
		1998		1999		2000		2001		2002		2003		2004		2005		2007		2008		2009		2010		2011		2012		2013		2014		2015		2016		2017		
		N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	
M	6									2	33.33			1	16.66							2	33.33	1	16.66													10.7
F	54	5	9.26	2	3.71	4	7.41	2	3.71			3	5.55	2	3.71	4	7.41	6	11.11	1	1.85	3	5.55	1	1.85	4	7.41	2	3.71	1	1.85	3	5.55	3	5.55	3	5.55	5	9.26	14.31

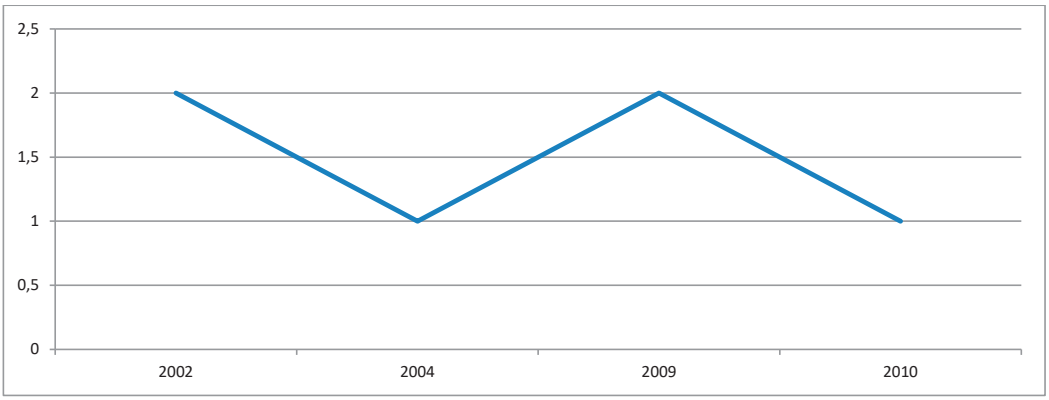

Figure 5. Romanian Trotter - sire stallions age structure

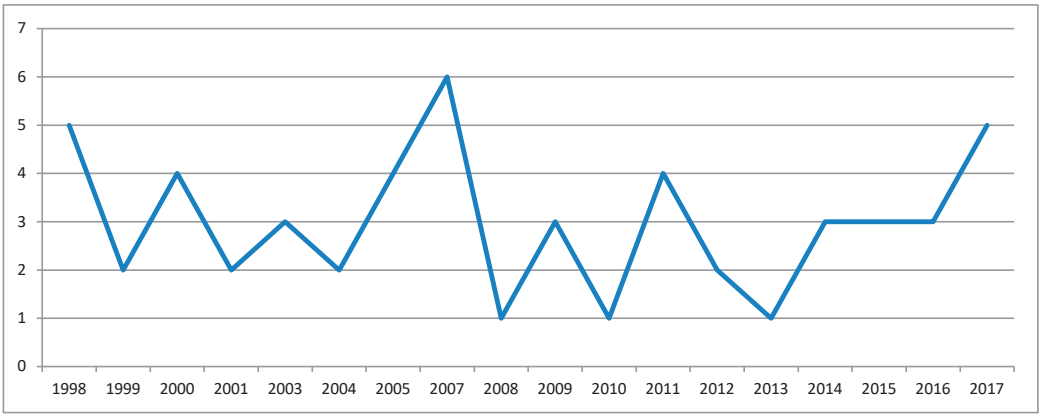

Figure 6. Romanian Trotter - broodmares age structure

Figure 7. View from Ploiesti Hippodrome - Romanian Trotter in action

CONCLUSIONS

1. ***Reproductive isolation*** - It is obvious that, in case of Romanian Trotter horse from Dor Marunt studfarm, exists concerns regarding the improvement of some characters, especially productive traits as velocity, or even the concerning for increasing the genetic variability in order to create a larger action field for selection. All this situation is highlighted also by the important number of broodmares, from reproductive nucleus, with one immigrant parent. Using the infusion crossing through immigrant stallions can contribute to the improvement of the breed in the desired direction but it is very important to not forget that it is a most to return to the reproductive isolation after the infusion process. Otherwise we will not be able to have a breed with his own evolutionary path. It will be just a herd influenced by the genetic structure of immigrants or it will become just a flock from another population because of genes substitution process. Int this situation, when we will import more immigrants to be used in the reproductive nucleus of Romanian Trotter, in time, will make

from Dor Marunt studfarm only a multiplication farm for immigrants and a good financing point for studfarms from which immigrants became. Unfortunately, the comparison of the productive performances of the Romanian Trotter with those of the French Trotter or Standardbred (American Trotter) is made empirically, by ear, without taking into account the influence of the general and special environment. A brief retrospective look at the Romanian Trotter shows that this is a later breed that shows its maximum productive potential after the age of 4-5 years, and that the performances of individuals of this breed, on other European hippodromes, were clearly superior to the performances obtained in Romania.

2. ***Age structure*** - An unexplained fact is the big numbers of old mares, born between 1998 and 2001, and kept till 2021 as broodmares. All this situation, associated with the very small number of mares born in 2008 (1 mare), 2010 (1 mare), 2012 (1 mare) and 2013 (1 mares) and promoted in the reproductive nucleus of the breed led to the existence of an unbalanced age structure. However, if the trend of the last two years is maintained, and if the old specimens are reformed (born between 1998 and 2001) it will be possible to have a balanced age structure. By simply reforming the old mares (born between 1998 and 2001), the generation interval, calculated by mares, can be reduced from 15.23 to 12.55, taking into account an average gestation period of 11 months (0.92 months). Regarding the sire stallions it is very important to promote in reproductive nucleus young stallions, tested on the hippodromes from Romania but also from other european countries and to not at european level. Let's not focus on the use of only imported stallions for breeding. In this way we will be able to maintain the Romanian Trotter livestock as a breed, but also to improve the much desired productive performance. Great care must be taken when keeping mares in the reproductive nucleus with an immigrant parent in order to avoid inbreeding and to have a judicious matching of the pairs. Only in this way will we obtain young and valuable generations, both genetically and athletically point of view.

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REFERENCES

Drăgănescu, C. (1979). *Animal breeding*. Bucharest, RO: Ceres Publishing House.

Maftei, M., Ianitchi, D., Pruna, M., & Dronca, D. (2022). Partial results regarding the genetic determinism of growth process in a native horse breed using wither's height, *Indian Journal of Animal Research, DOI 10.18805/IJAR.BF-1435*

Maftei, M., Popa, R., Popa, D., Marginean, Gh., Vidu, L., Vlad, I., Pogurschi, E., & Girlea, M. (2011). Genetic analysis of Romanian Lipizzaner from Sambata de Jos stud farm: reproductive isolation and age structure, *EAAP - 62nd meeting, Stavanger, Norway*

Maftei., M., Popa, R., Popa, D., Marginean, Gh., Vidu, L., Vlad, I., Girlea, M., & Lapuste, T. (2011). Partial results regarding the genetic analysis of Gidran horse from Tuluceşti studfarm: reproductive isolation and age structure., *Scientific Papers. Series D. Animal Science.*

Maftei, M., Popa, R., Popa, D., Marginean, Gh., Vidu, L., Vlad, I., Pogurschi, E., & Girlea, M. (2011). Partial results regarding genetic analysis of Romanian Pure Arabian horses from Mangalia stud farm: reproductive isolation and age structure, *EAAP - 62nd meeting, Stavanger, Norway*

Maftei., M., Popa, R., Popa, D., Marginean, Gh., Vidu, L., Vlad, I., Girlea, M., & Lapuste, T. (2011). Partial results regarding the genetic analysis of Shagya Araber horse from Rădăuţi studfarm: reproductive isolation and age structure. *Scientific Papers. Animal Sciences, Iasi, 55.*

Mărginean, G. (2012). *Treatise on Hypology*. Bucharest, RO: Romanian Academy Publishing House.

Mărginean, G., Georgescu, G., & Maftei, M. (2005) *Guide to practical work for the operation of horses*. Bucharest, RO: Agrotehnica Publishing House.

Popa, R. (2009). *Breeding programs*. Bucharest, RO: Printech Publishing House.

Popescu-Vifor, Ş. (1990). *Genetica populaţiilor de animale domestice,* Bucharest, RO: Ceres Publishing House.