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I. Tkachova, Candidate of Agricultural Sciences
Institute of Animal Science, National Academy of Sciences of Ukraine

SYSTEM OF SELECTION IN HORSE BREEDING

The purpose. To analyze and elaborate system of selection-breeding work with the basic factory breeds of equines in conditions of limited gene pool. **Methods. Zootechnical**, genealogical, statistical. **Results.** Key parameters are specified of selection-breeding work with the most spread factory breeds of equines in Ukraine: Ukrainian and pure-blooded riding, Orlovskaia and Russkaia race horses, Novoalexandrovskaia draft-type horse. **Conclusions.** Various demands to breeds of equines require researches in methods of reception of desirable types of pedigree, sport, common and productive equines, and also development of methods, programs and business-designs aimed at maintenance of competitiveness of breeds in Ukraine in view of social and economic conditions. The optimum combination of selection methods of equines depends on opportunities of their application in uniform complex. The priority in selection work with factory breeds of equines should be given to pure breeding based on branched genealogical structure.

Key words: equines, system of selection, gene pool, stud farm, pedigree reproducer, working productivity.

One of the decisive factors are effective animal science is an animal's genetic improvement by the use of its own resources as well as the best imported gene pool [1]. The successful selection and breeding work in horse breeding required a certain level of variability both inside single population and between different populations [2]. The breeds and original breed characteristics saving is possible under a low cost technology using compared with high-intensity. Local or locally adapted breeds more consistent with priority modern requirements to organic production, environment preservation, animal welfare, product diversity, human health and so on. At the same time the insufficient knowledge about the genetic basis of animals adaptation to the environment are still. So, perhaps, the most properly strategy is the management of species - bring in them the least genetic changes, and the greatest attention be given to adaptation characteristics, even by slowing down the progress of other breeding traits if they developed at a sufficient level [3].

The goal of selection of quantitative traits consists in the genetic improved through selection of animals for next generation. The rate of genetic improvement depends on population genetic variation, accuracy of selection criteria, selection intensity and the generation interval. Genetic variability is reduced due to genetic drift and increases through mutation. Thus, the minimum population size for genetic variation maintaining determined by the rate of mutation [4]. The breed’s genetic

diversity loss associated with the use of inbreeding, which directly depends on the number of breeding animals. The theory of inbreeding degree envisages in the population which is subject to selection, allows to focused optimize short-term effects in breeding schemes [5].

Thus, in a limited gene pool condition of breeds is necessary to determine the optimal border of pure breeding and crossbreeding applying for the breeds further evolution with genetic originality maintaining.

The goal. The aim of research an analysis of system of selection and breeding work with the horses main factory breeds by the genetic and selection process analyzing in a limited gene pool conditions.

Materials and methods. Scientific and methodological approaches are based on the zootechnical and genealogical analysis of herd of factory breeds horses (Ukrainian riding, Thoroughbred horse, Orlov's and Russian trotter) and retrospective analysis of selection processes in the breed. The research was carried out in 2000-2016, respectively. As material for research was served a database created by the initial accounting breeding material, test horses records, peer review results of modern breeding of Thoroughbred horse, half-bred and trotting horse breeds of Ukrainian selection. In the statistical calculation the whole reproductive structure of these horses' breeds in Ukraine in dynamics was considered, exception the unconfirmed origin horse. Reproductive structure has been allocated for linear affiliation. Linear compatibility was calculated by offspring's prize workability derived from different variants of line selection. The efficiency of the pure breed selection by lines using outbreed and inbred selection techniques was estimated. The crossing efficiency was analyzed. During the study of the effectiveness of pure breed selection the genealogical structure of each of the studied species forming were analyzed.

The breeds genealogical structure evaluation bylines, families and nests performed by family analysis based on pedigrees constructing. Linear compatibility for the main selection characteristics were evaluated by comparison of obtained analogues in the respective selection. Inbreeding efficiency was evaluated by comparison of analogues obtained from inbred and outbreed selection. Inbreeding coefficient calculations carried out by the S.Rayt method in a generation dynamics.

The results. In Ukraine, the horse breeding develops mainly in three areas: working-using, breeding and sports.

From the total number of horses, around 80% - in farming sector, so the main focus of their use is still working-using. However, the growing interest of the human population to the horses of different breeds and types for sport, recreation and entertainment: agro-tourism, horse riding as a hobby, hippotherapy and others. With the increasing scope of export dietary horse meat, the kumys promotion in sanatoria-medical field, the relevance of draft horses breeding is returns.

Figures 1 and 2 were demonstrated the overall and breeding horse dynamics for the past 23 years. On January 01, 2017 the total number of horses in Ukraine amounted to 305,8 thousand heads. Breeding (accounted) horses amounted to 4,300 heads. In current unstable economic environment, some subjects of breeding no longer competitive, as compared with previous years, their number has decreased.

Accordingly, amount of breeding horses has reduced. The import of West European breeding horse through better selection and their sports training has increased.

The most widespread in Ukraine horses breed structure presented in Table 1.

1. The factory horses breeds reproductive structure distribution

Breeds	Horses factory		Breeding reproductors		Total
	n	%	n	%	
Ukrainian riding	502	*26,2*	344	*40,0*	846
Thoroughbred horse	610	*31,8*	69	*8,0*	679
Orlov's trotters	327	*17,0*	240	*27,9*	567
Russian trotters (Ukrainian trotters breeding group)	341	*17,8*	85	*9,9*	426
Novoaleksandrovsky draft horses	139	*7,2*	121	*14,1*	260

Various requirements for horse breeds needs to study the methods of breeding, sports and productive horses desired types obtaining, as well as methods, programs and business projects developing of competitiveness breeds in Ukraine maintaining taking into account social and economic conditions.

The main methods of breeding work, providing the genetic improvement of animal groups on the basis of individual differences within breeds are pure-breed breeding and crossbreeding, which involves the use interbreed differences. The optimal combination depends on the possibilities of use in a single complex. The major factors are:

- group of selection features;
- availability and suitability of horses breeds to involve in the selection process;
- availability of appropriate technology conditions for horse breeding;
- the terms of the source breeds genetic improvement providing;
- industry infrastructure and resources involved in the selection process.

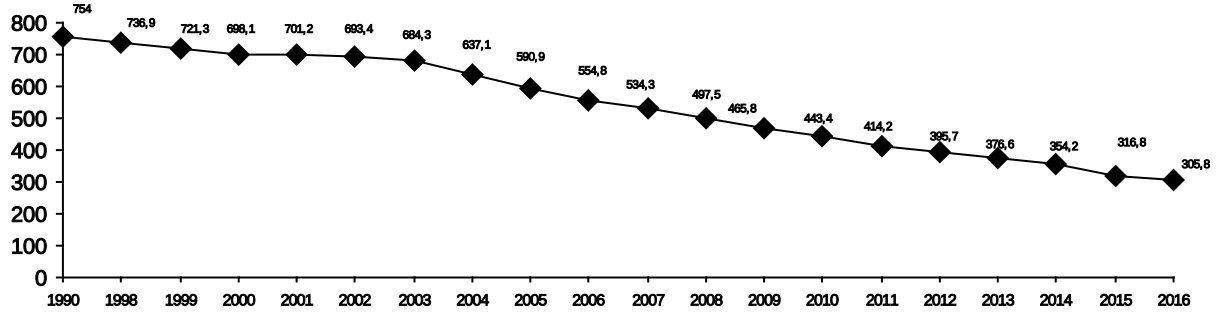

Fig. 1. The total number of horses in Ukraine dynamics (ths. anim.).

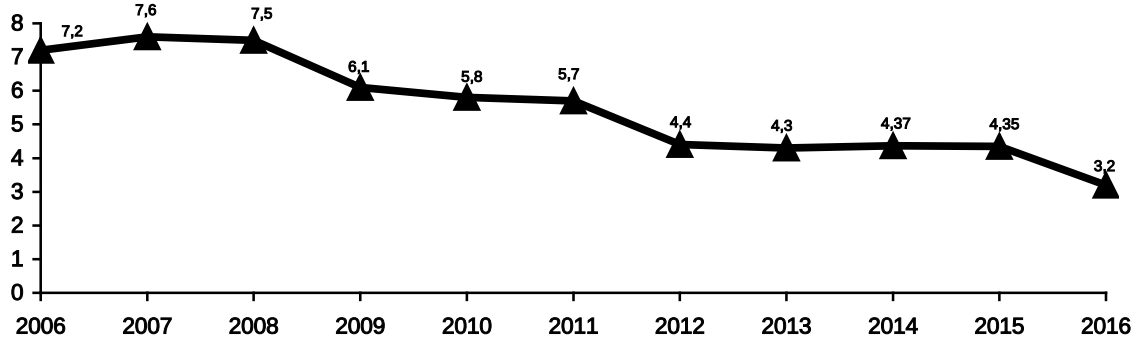

Fig. 2. The number of breeding horses in Ukraine dynamics (ths. anim.).

For selection and breeding work planning should be note that the use of pure-breed breeding with long reproduction period for the horses breeds improvement requires more time than the crossing. The horses breeds, which created only by pure-breed breeding, are closed, so in stud book not registered a mixed breeds. To such breeds includes Thoroughbred horse and Orlov's trotters. Thoroughbred horse breed has a specialization by liveliness and by this characteristic perform the intensive selection with its.

For Ukrainian riding, Russian trotters (Ukrainian trotters breeding group), Novoaleksandrovsky draft horses gene pool improving and enriching the interbreed crossing used to improve some traits according to selection of breed improvement.

Purebreed selection. The methods of thoroughbred horse breeding efficiency improving are priority and developed more detail due to originality and specialization of each breed and for genetic diversity maintaining needs. The special importance acquires the breeding system by lines and families, which is directed to search of successful combinations between the different genetic groups of animals. In this case, the pure-breeding system of the national breeds is based on extensive branching of genealogical groups and provides breeding work at least by 5 genealogical lines and 10 families. Such lines are available to provide the sufficient levels of heterozygosity in limited numbers of reproductive herds (Table. 2).

Such system of breeding works does not exclude the use in selection the animals from different geographical zones of Ukraine and foreign selection. The high efficiency of American and European selection animals using for thoroughbred horses breeding was proved, for Orlov's trotters breed - Russian selection animals. The effective means of heterozygosity maintaining in horses breeds are stallion's rotation between the Ukrainian studs.

For the factory horses breeds with a limited gene pool a remarkable influence on the evolution of genealogical lines have individual breeding value, individual's prepotencies, linear compatibility and parental pair's compatibility.

2. Genealogical structure of the main horses breeds

Breeds	Number of	Number	Number	Number of

	genealogical lines	of stallions sires	of families and nests	breeding mares
Ukrainian riding	8	68	31	533
Thoroughbred horse	8	44	26	251
Orlov's trotters	10	42	27	270
Russian trotters (Ukrainian trotters breeding group)	4	22	26	214
Novoaleksandrovsky draft horses	5	19	13	191

The priority role in all studied breeds of the famous sires in the selective effect formation was proved both for pure-breed breeding and crossing (especially with the use of imported gene pool). However, this selection strategy may be accompanied by considerable risk and the disappearance of local lines, as happened with the national populations of thoroughbred horse and Russian trotting breeds.

For the pure-breed horse breeding an important factor is the homozygosity growth degree control at the inbreeding application. According to many researchers data [6], the using of inbreeding coefficient of 3% or higher in selection process may occur the inbreeding depression. Considering the extensive coverage in scientific publications this fact we have not investigated, but the most selective effect to the horse breeds improvement by pure-breed methods was shown by cross lines with mild levels of inbreeding IV, V, VI on the famous ancestors using.

For the Thoroughbred horses improvement the most effective by the complex traits was outbreed (cross lines) type of selection, for Ukrainian riding , Russian and Orlov's trotters , Novoaleksandrovsky draft horses – the inbredline-crossing type. The best indicators were obtained from the moderate and complex inbreeding using. This fact is not contradicts to the classical model of cumulative positive impact of valuable inheritance accumulation from famous founders and advantages of heterozygous genotypes over homozygous. Characteristically, that inbredline-crossing type application in selection of horses by complex traits is effective as for exterior as productive (sports workability) characteristics (Table. 3).

Interbreed crossing. A lot of horse breeds in the world to improve by the interbreed crossing using. By many studies was shown that the crossing of any horses breed with the Thoroughbred horse to increase the liveliness and offspring movements productivity. Therefore during the past 25 years have been provide the experimental limited crossing of Thoroughbred horse breed blood refilling to Orlov's trotter breed for liveliness trotting gait improving. As a result of several successful combinations were obtained lively offspring, which, in turn, were used in reproduction. As a result, the 53.6% of the national Orlov's trotter population Orlov's trotter is represented by a mix with a Thoroughbred horse breeds (Table. 3).

3. Comparative evaluation of breeding Orlov's trotters breed mares depending on the Thoroughbred horse presence in the breed (M±m)

Characteristic	Genetic group				
	Purebred Orlov	Thoroughbred horse presence in the breed			
		1/32	1/16	1/8	1/4
n	**183**	**34**	**35**	**16**	**8**
Lively (min. sec.) aged: 2 years	2.32,7 ±0.09,4	2.33,4 ±0.07,3	2.39,9 ±0.01,1	2.41,0 ±0.04,2	2.25,4 ±0.02,6
3 years	2.20,5 ±0.05,3	2.19,7 ±0.04,2	2.18,4 ±0.07,2	2.21,5 ±0.01,6	2.17,1 ±0.00,9
4 years	2.15,3 ±0.04,8	2.16,8 ±0.05,3	2.12,4 ±0.04,6	2.15,0 ±0.01,6	2.12,6 ±0.02,8
The amount of winnings, points	392,3 ±56,7	370,6 ±41,9	322,2 ±60,0	305,0 ±222,1	-
Height, cm	161,0 ±0,25	159,8 ±0,37	161,5 ±0,77	163,5 ±1,05	160,7 ±1,30
Slanting body length, cm	165,0 ±0,32	163,6 ±0,54	164,5 ±1,05	165,8 ±1,21	166,7 ±2,10
Chest circumference, cm	186,6 ±0,49	184,8 ±0,76	186,6 ±1,38	188,5 ±0,38	186,4 ±1,73
Metacarpus circumference, cm	20,35 ±0,04	20,44 ±0,07	20,32 ±0,13	20,50 ±0,14	20,29 ±0,26
Number of productive years	4,92	3,18	4,26	5,06	3,63
Number of foals, heads	3,52	2,5	3,31	3,88	2,25
Number of foals by 1 productive year, heads	0,72	0,78	0,78	0,77	0,62

Crossing, as the table shows, to the prize horse's operability influenced and population heterozygosity increased. Thus, due to the crossing synthetic (used) horses populations of universal purpose creation and the inbreeding depression in breeds with limited gene pool avoidance are possible.

For Ukrainian riding and Ukrainian population of Russian trotter breeds improving mild crossing with output and improving breeds is allowed. For Ukrainian riding breed - with Thoroughbred horse, Thoroughbred Arabic, Trakenen, Hanover, Westphalia and other sports breeds of German origin, which are similar by the method of creation and origin. For Russian trotter breed - with American standartbred traditionally and with recently used French trotter. As mentioned above, by the programs of crossing with improving breeds the blood addition were predicted [7]. However, in practice, the breeders often exceed the allowable blood presence degree trying to improve sports or prize offspring workability quickly [8]. So, for the Ukrainian riding breed the German breeds uptake was observed, for the Russian trotter - American standartbred. However, special successes of these hybrids were not observed (tab. 4).

4. The sport operability (dressage) of different genetic horses groups evaluation

Breed	Number		Sports operability indicators			
	ind.	%	Perfor-mances amount	The average result, %	The perfor-mances activity coeffi-cient	Sports operability index, %
Ukrainian riding	80	44,4	24,02±1,86	59,27±0,62	2,24	13,77
Trakenen	21	11,7	10,95±1,52	60,84±0,91	0,93	10,12
Hannover	13	7,2	11,31±1,96	61,57±0,64	1,13	14,61
Holstein	8	4,4	15,88±2,81	61,26±1,12	1,52	17,43
Oldenburg	6	3,3	23,33±6,38	61,63±1,38	2,17	16,05
Westphalia	5	2,8	18,80±7,29	62,36±0,64	1,73	17,21
Hybrids	47	26,1	12,70±0,82	58,36±0,51	1,21	9,43
Total:	**180**	**100,0**	**18,14±0,57**	**59,40±0,91**	**1,70**	**13,03**

The greatest influence on current horses herd of Ukrainian riding horse has performed the crossing with Thoroughbred horse and Trakenen breeds as for exterior well as sports traits [9]. The Western European breeds stallions sires breeding using analysis for Ukrainian riding horse improving was demonstrated they positive influence to the offspring selection traits (tab. 5).

5. The breeding traits of 3-year-olds horse from various breeds stallions evaluation, (M ± m)

Breed of stallions	n	Breeding traits evaluation					
		Type and exterior, grade.	Height, cm	Chest circumference, cm	Metacarpus circumference, cm	The proportion of horses in sport	
						head	%
Ukrainian riding	324	3,79±0,02	162,9±0,44	185,8±0,66	20,17±0,07	107	33,0
Thoroughbred horse	69	3,77±0,03	161,8±0,70	184,2±1,38	20,15±0,13	21	30,4
Trakenen	40	3,71±0,05	161,6±1,76	181,1±3,23	19,99±0,29	19	47,5
Westphalia	5	3,71±0,06	163,0±2,78	186,0±3,05	20,40±0,19	1	20,0

Considering the limited number of high-quality stallions sires of Ukrainian warmblood breed and positive influence of Western selection sires to offspring, the further use of crossing will appropriate at high breeding values of sires and their compliance with Ukrainian riding horse breed type [9]. Considering the similarity of Western European breeding sports origin breeds, genealogy of which are based on genetic complexes of Thoroughbred horse, Trakenen, Holstein breeds, for

crossbreeding with Ukrainian riding horse breed the gene pool of these breeds was recommended without limitation, giving preference of typicality, exterior indicators and high sports qualities.

For crossbreeding with Ukrainian riding horse, except initial breeds, following breeds are allowed: Anglo-Arabian, Ahaltekynska, Oldenburg, Dutch warm-blooded, Belgian warm-blooded, Danish warm-blooded, French sell, Swedish warm-blooded, which registered in the relevant breeding unions [10].

For Russian trotting breed improving a traditionally used crossbreeding with the original - standartbred American breed originating from Thoroughbred horse and is the liveliest of all the trotting breeds [11]. The effectiveness of these crossings widely covered in scientific papers of foreign and Ukrainian researchers. However, due to crossing with standartbred trotters capture led led to standartbred sires nicknames saturation in Russian stud, often of low quality, which negatively affects to the prize workability, horses harness type and exterior quality worsens.

An alternative of Russian with standartbred trotters absorbing crossbreeding is the French trotter breed sires mild using, which is becoming a larger scale at the last decade of breeding work. The French trotter breed sires popularity for Ukrainian breeders related to their success on the worlds hippodromes [12].

The crossbreeding analysis was showed that French stallions offspring an average is more lively according to purebred peers, but to inferior to standartbred stallions offspring. Thus, the French trotter breed sires using can compensate of the standartbred American breed high quality sires lack and national selection trotters gene pool saturate by new breeding material.

6. Comparative characteristics of different genetic groups trotters

The offsprings groups	2 years		3 years		4 years	
	the average liveliness	**class of horses 2.20 (%)**	**the average liveliness**	**class of horses 2.15 (%)**	**the average liveliness**	**class of horses 2.10 (%)**
From Russian trotting purebred stallions (n=572)	2.42,8 ±0,08	*0,8*	2.27,3 ±0,24	*5,8*	2.24,3 ±0,14	*2,5*
From French trotting horses (n=82)	2.42,3 ±0,17	-	2.26,3 ±0,15	*5,8*	2.21,1 ±0,07	*12,3*
From American standartbred stallions (n=439)	2.37,5 ±0,09	*1,6*	2.22,3 ±0,11	*18,5*	2.16,3 ±0,19	*21,1*

The interbreed crossing of factory horses breeds with a limited gene pool effectiveness analysis was proved that the planned, science-based high breeding value imported gene pool using on the overall increasing in Ukraine of sports culture and prize horse breeding background will be able significantly improve the sports quality, liveliness, typical and exterior indicators, which ultimately will increase the realizable value of young animals and competitiveness of the national horse breeding at the international level. However, there is a real threat of genetic mixing, acquiring

the same features and the loss of originality domestic breeds, which requires the application of maintenance measures of the necessary heterozygosis level, originality of their type and adaptive ability preservation, which may be their advantage in the future.

Developed and implemented methods of national selection process managing, system of knowledge obtained as a result of long breeding and genetic research will allows to use the methods of intensive selection of factory horses breeds with a limited gene pool.

Conclusions:

1. Various requirements for horse breeds needs to study the methods of breeding, sports and productive horses desired types obtaining, as well as methods, programs and business projects developing of competitiveness breeds in Ukraine maintaining taking into account social and economic conditions. The optimal combination of horses breeding methods depends on the possibilities of their application in a single complex.
2. The priority in breeding work with factory breeds of horses given to purebred breeding, which is based on a branched genealogical structure (5-10 genealogical lines and related groups, 10-30 breeding families and nests). The predominant role of outstanding sires in the selection effect formation was proven. The expediency of thoroughbred breeds outbred breeding was established, for Ukrainian riding, Orlov's and Russian trotters, Novoaleksandrovsky draft horses – the moderate and distant inbreeding applying by the inbreedline-crossing type was established.
3. Planned, scientifically-based use of the imported gene pool of high breeding value by the overall increase of sports and prize horse breeding culture, will be able significantly improve the sports quality, liveliness, typeness and exterior indicators, which will ultimately increase the sales value of young animals and the competitiveness of domestic horse breeding at the international level. However, there is a real threat of genetic mixing, acquiring the same features and the loss of originality domestic breeds, which requires the application of maintenance measures of the necessary heterozygosis level, originality of their type and adaptive ability preservation, which may be their advantage in the future.

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