

INFLUENCE OF GENETIC FACTORS ON INDICATORS LIFETIME PRODUCTIVITY OF DAIRY CATTLE

L. M. Khmelnychy

Sumy National Agrarian University, st. Gerasim Kondratiev, 160, Sumy, 40021, Ukraine

Researches results of cows of the Ukrainian Red-and-White lifetime productivity dairy breed on traits of duration of economic use within the limits of an estimation of crossbred genotypes and genealogical formations are resulted. Reliable influence of the conditional share of Holstein breed heredity on the economic use duration and lifetime milk productivity of cows has been established. For the longest time in the herd, crossbred cows with Holstein bloodline of 25.0 % and crossbreeds with heredity of the parent breed up to 50.0 % were used. At the final stage of crossing in animals with blood ratio of 62.5-87.5 %, a noticeable reduction in the duration of economic use was observed. Animals with Holstein bloodlines of 75.0 and 87.5% were inferior to groups of crossbred cows with heredity of 25.0 and 50.0% with reliable difference of 590 and 633 ($P < 0.001$), 432 and 475 ($P < 0.001$) days, respectively.

At the same time, from cows with a share of Holstein blood of 87.5 %, the highest lifetime milk yield was obtained with an excess of cows groups of other genotypes by 1250-3260 kg of milk with reliable difference compared to crossbred genotypes with bloodness - 25.0 % ($P < 0.001$), 37.5 ($P < 0.001$), 50.0 ($P < 0.01$) and 62.5 % ($P < 0.05$). The hereditary influence of lines on the indicators of lifetime productivity in intralinear selection and in some variants of interlinear combinations was proved. The influence of genealogical formations on longevity indicators in in-line selection was evidenced by reliable difference between the extreme variants of the assessed lines on the basis of economic use (651 days; $P < 0.001$) and lifetime milk yield (14267 kg; $P < 0.001$). According to the results of interline selection in different variants of paternal and maternal lines combinations, significant variability of the offspring obtained from these variants was established, according to the estimated traits of duration of use and lifetime milk production. Cows obtained in all variants of interlinear selection of parental lines Enhancer, Hannover and Valiant with sires of maternal line S. Cavalier have always had high indicators of duration of economic use and lifetime milk productivity.

Key words: *Ukrainian Red-and-White, breed, cow, milk yield, line, lifetime productivity.*

At the present stage of dairy cattle selection, the duration of productive use of animals was directly related to the biologically possible longevity of each animal. Physiologically, under the condition of rational methods of keeping and proper feeding, cows are able to maintain a high level of productivity and reproductive ability up to 10–12 years of age.

The relevance of the issue regarding the productive longevity of cows of Ukrainian dairy breeds is now aggravated through the use, with further improvement of sires of the Holstein breed, since, as the practice of most countries in the world and domestic researchers testify, the use of the Holstein gene pool is accompanied by an increase in the exactingness of their high-blooded offspring in terms of feeding and keeping and, as a result, a decrease in the indi-

cators of economically useful traits, including productive use [3, 7].

The duration of productive use of dairy cattle, as a breeding trait, significantly affected the economic development of the industry [24]. Currently, the issue of longevity is a strategic issue. This was evidenced by numerous world studies. Traits of longevity of dairy cows are among the leading selection criteria, as they determine the profitability of the dairy industry [17, 18, 21]. Productive longevity of dairy cows was a complex integrated trait that depended on a number of genetic factors.

However, it was impossible to obtain a selection effect in a short period of time by the method of direct selection on the basis of longevity in dairy animals due to their low heredity. According to foreign researchers, longe-

Author information:

Khmelnychy Leontyi Myhailovych, doctor of agricultural sciences, professor, head of the department for breeding and selection of animals and water bioresources, e-mail: chmelnychy@ukr.net, <http://orcid.org/0000-0001-5175-1291>

vity varied from 0.03 to 0.07 [15, 16, 19, 22, 27].

Present moment, the heredity of cows of all created Ukrainian breeds of dairy cattle containing in its genotype many variants of conditional blood of the Holstein breed due to the widespread use over the past 30-40 years of pedigree sires of the North American and European selection. This was especially true of the Ukrainian Red-and-White dairy breed, as it was the first approved as selection achievement in 1993.

According to domestic researchers, indicators of the duration of cows productive use are determined by the genotype of animals, in particular their belonging to the breed and line, as well as depending on the share of heredity of Holstein breed [3, 4, 11, 12, 13, 14].

Further selection of the Ukrainian Red-and-White dairy breed, using animals of different genotypes in this process, required research to determine the dependence of lifetime traits on all possible genotypic factors, including the share of conditional bloodness of the improving breed and origin. In this regard, the aim of this study was to examine the duration of productive use and lifetime productivity in Holsteinized cows of different bloodlines and to identify hereditary factors that affected their longevity.

Materials and methods. The experimental basis of conducted research was the selection information of the pedigree farm "Piskivske" Bakhmatsky district of Chernihiv region. A retrospective assessment of cows of the Ukrainian Red-and-White dairy breed according to the traits of milk productivity within the genotypes and genealogical formations for recorded lactations was carried out by the indicators of the database of automated breeding records of the economy.

Within the genotypes, six groups of crossbred animals were formed, taking into account the conditional Holstein bloodlines: I group 1/4-blooded; II group - 3/8; III - 1/2; IV - 5/8; V - 3/4 and VI - 7/8-blooded. Biometric processing of the research results conducted according to the methods of E.K. Merkurieva [6] on a PC using software.

Research results. The herd of the pedigree farm PAE "Piskivske" was created according to the generally accepted scheme of reproductive crossing of aboriginal Simmental breed with sires of Holstein Red-and-White suit. The

use of crossbred sires of the Holstein breed and purebred Simmental sires at different stages of crossing added to the significant diversity of the genotypic composition of the breeding stock of animals.

Analyzing groups of crossbred cows of different genotypes by the economic use duration and number of lactations, it could be argued that conditional share of Holstein breed heredity naturally influenced these traits. This conclusion was confirmed by comparative analysis of the results of studies given in Table 1, showing that with the growth of the conditional proportion of bloodness in the crossbreeds of improving breed, period of their economic use decreased accordingly.

The longest used in the herd were crossbred cows with Holstein bloodline of 25.0 %, obtained at the first stage of creating the breed because of backcrossing, and crossbreeds with the heredity of the parent breed up to 50.0 %. Subsequently, at the final stage of crossing, in animals of the final genotypes with blood ratio of 62.5–87.5 %, a noticeable reduction in the duration of economic use was observed. Thus, high-blooded animals with conditional Holstein blood ratio of 75.0 and 87.5% were inferior to groups of crossbred cows with a heredity of 25.0 and 50.0 % with reliable difference by 590 and 633 ($P < 0.001$) and 432 and 475 ($P < 0.001$) days, respectively.

Comparison of the number of lactations used more clearly testified to the dependence of their value on the share of heredity of improving breed. If we conditionally divide the six most common crossbred genotypes of animals that we evaluate into two groups, then we get one with a low share of Holstein heredity – 1/4; 3/8 and 1/2, another high – 5/8; 3/4 and 7/8.

Then already among the first group of low-blooded cows, the reliable difference was found in comparison between animals with one-fourth of the blood and crossbreeds with 3/8 and 1/2 parts, which was 0.4 ($P < 0.05$) and 0.5 ($P < 0.001$) lactations, respectively. With an increase in the conditional share of the improving breed by 12.5 %, the duration of lactation use decreased in an arbitrary distribution between genotypes by 0.1–0.8 lactations. The two groups of cows with the highest Holstein blood, 75.0 and 87.5 %, reduced their productive use to 3.3 and 3.2 lactations. The difference between

Table 1. Lifetime productivity and duration of use of cows of different genotypes of Ukrainian Red-and-White dairy breed

Genotype (conditional bloodness for Holstein)	n	Duration of use		Lifetime productivity			Milk yield for one day of life, kg
		economic, days	lacta- tions	milk yield, kg	% of fat	kg of fat	
1/4 (25,0 %)	13 3	2664±80,2	4,8±0,12	25574±842,1	3,83±0,017	977±52,3	9,6±0,27
3/8 (37,5 %)	11 9	2506±92,1	4,4±0,11	25310±997,3	3,81±0,015	964±59,3	10,1±0,35
1/2 (50,0 %)	17 1	2460±75,3	4,3±0,09	26322±768,2	3,80±0,014	1001±48,7	10,7±0,33
5/8 (62,5 %)	16 6	2376±71,0	4,1±0,12	27086±804,4	3,78±0,016	1023±50,1	11,4±0,31
3/4 (75,0 %)	19 4	2074±68,3	3,3±0,11	27584±677,6	3,79±0,012	1045±44,2	13,3±0,28
7/8 (87,5 %)	28 7	2031±62,5	3,2±0,09	28434±532,2	3,78±0,009	1075±39,7	14,0±0,21

crossbreed genotypes with blood 5/8 and 3.4 was the highest (0.8 lactations) and highly reliable at $P < 0.001$ ($t_d = 4.91$). The economic importance of indicators for evaluating animals in terms of lifetime productivity eventually moved to the rank of traits for determining breeding value, therefore, in some countries of Europe and North America, the duration of cows economic use was included as a selection trait in the cattle breeding system [20, 23, 25, 26], since the reduction in the productive longevity of cows had a negative effect on the efficiency of selection due to the slowdown in the rate of herd reproduction and intensity of selection in it.

Evaluating the lifetime productivity of cows of experimental genotypes by the amount of milk yield, a general conclusion can be drawn, that indicate on the existence of a curvilinear relationship between the conditional bloodness by the improving breed and milk yield for productive life. It consisted in the fact that if at the first stages of crossing with absorption of the aboriginal blood by Holstein breed in 3/8-blooded crossbreeds, the lifetime milk yield decreased, then at the final stage, due to the growing of genetic potential in high-blooded genotypes, the increase in the heredity of the Holstein breed did not cause them a decrease in lifetime milk yield. On the contrary, from the group of cows with a conditional proportion of 7/8 Holstein blood, the highest lifetime milk

yield was obtained with an excess groups of cows of other genotypes by 1250-3260 kg of milk with reliable difference compared to crossbreed genotypes 1/4 ($P < 0.001$), 3/8 ($P < 0.001$), 1/2 ($P < 0.01$) and 5/8 ($P < 0.05$).

The milk fat content of crossbreed cows of different genotypes, with a change in the shares of heredity of the original Simmental and Holstein breeds, experienced some influence of improving breed. Between the fat content in the milk of cows with Holstein heredity of 25 % and high-blooded animals (87.5 %), an insignificant but reliable difference was established - 0.05 % ($P < 0.01$).

A slight decrease in milk fat content in high-blooded cows was compensated by higher rates of milk fat yield, although the existing difference of 30-111 kg in favor of 7/8-blooded crossbreeds was not reliable.

As a certain integrated indicator that best characterized the genetic potential of animals, regardless of economic use and lifetime productivity, there was milk yield of cows for one day of their life. In our studies, cows with Holstein heredity of 87.5 % differed from other animals of crossbred genotypes by the highest milk yield per day of life, which was 14 kg of milk. Their excess on this trait was reliably confirmed in all comparisons and ranged from 0.7 kg ($P < 0.05$) compared to three-quarter-blooded animals, and to 4.4 kg ($P < 0.001$) for one-quarter-blooded

crossbreeds.

Good conformation-constitutional development and strength of the animal, the functioning of all its organs and systems of vital activity will be prerequisite for the corresponding intravital and lifetime productivity of animals. Lifetime productivity and longevity, along with the impact on economic performance, are closely related to the selection process, since for both production and livestock breeding, animals that successfully combine these two traits are most valuable. The high lifelong productivity of cows reflected the breeding value, and with long-term economic use, more descendants were obtained from them, thereby increasing the proportion of animals with valuable genotypes in the herd. From the foregoing, the rationale for research will be motivated in the aspect of the influence of change in the conditional proportion of Holstein thorough-bredness on the duration of the economic use of highly productive cows.

Analysis of indicators of the duration of use and traits of milk productivity of high-yielding cows for higher lactation, which are given in Table 2, in some way confirmed the justification for the positive impact of the body vital activity of highly productive animals on the extension of their productive use. For the longest time, low-blooded animals (5.1 lactations) obtained from backcrossing with a Holstein inheritance of 25.0 % were used, exceeding the average use of a group of homogenous cows by 0.3 lactations (see Table 1). High-blooded crossbreeds with Holstein heredity of 87.5 % used 3.9 lactations, which was reliably higher than in monogenous animals by 0.7 lactations ($P < 0.001$). Groups of crossbreed genotypes with conditional blood from 37.5 to 75.0 % with increasing average productivity for higher lactation from 5,335 to 6,758 kg of milk did not differ by number of calving and were used during 4.3-4.4 lactations.

According to the milk yield for one day of life, high-yield cows with Holstein heredity of 87.5 % exceeded, with a highly reliable difference at $P < 0.001$, hybrid genotypes with conditional bloodness from 25.0 to 62.5 % per 1.9-4.8 kg of milk.

Thus, summing up the research findings of the relationship between the share of conditional bloodness of other animals. At the same time, valuable properties were transformed into a

tional Holstein heredity and traits of lifetime productivity, we can conclude that a further increase in the inheritance of the Holstein breed in the array of Ukrainian Red-and-White dairy will be accompanied by decrease in the duration of use of cows. In this regard, it was possible to recommend farms to use at this stage of breeding the sires of Ukrainian selection, that is, crossbreeds of the Holstein breed, with correspondingly high pedigree value, preferably evaluated according to the conformation type of their daughters.

However, in the absence of domestic breeding of sires, the prospect of further use of the gene pool of the Holstein breed of foreign selection will require the creation of conditions on farms that would contribute to the maximum realization of the genetic potential of high-blooded genotypes, which in turn, if not stop the reduction in the duration of the productive use of cows, then somewhat slow down this process.

The scientific literature has repeatedly reported on the effectiveness of both intra-line breeding and cross-lines. The long-term practice of livestock science testified about the selection benefits within the line breeding. Structuring the breed into separate lines that differ in the development of economically useful traits, that is, they are hereditarily controlled by different genotypes, respectively, will make it possible to create within them animals with a sufficiently high hereditary resistance.

Due to the abundance of genes that contributed to both the development of economically useful traits and the growth of homozygosity to stage that will not lead to inbreeding depression, while maintaining a sufficient level of variability in the breed [2].

In addition, with the improvement of breeds and types of dairy cattle, it is not possible to concentrate in one animal all the valuable qualities that characterize the breed. Therefore, during the selection process, various positive economically useful traits accumulated in individual lines, which form the structure of the breed, giving it the plasticity necessary for further improvement. In the process of its further development, the line, in addition to spreading the inheritance type traits of the ancestor, retained and combined with him the positive group of not one ancestor, but also the best dams with whom he mated. This process led to

the progress of the line, the main property of which was the ability in each subsequent generation to produce producers who, in their qualities, are not inferior to the ancestors.

Therefore, intraline breeding should ensure genetic progress, but with strict adherence to the system of selection, matching and evaluation of animals by pedigree value. It is believed that the effectiveness of linear breeding will depend on the number of generations of its successors and the presence of leader sire in it in order to ensure progressive development within four to six generations [1, 8].

On the other hand, there is a theoretical basis which indicated that the cross of genealogical formations, on the contrary, due to the growth of heterozygosity, will lead to an increase in the indicators of viability, reproduction and productivity in the offspring [5]. There are

also separate scientific studies showing that not every interline selection will provide the best results [9, 10]. Therefore, in practical selection and breeding work with a herd, it will be necessary to look for successful interline combinations, since unsystematic crossing of lines did not always contribute to the consolidation of individual traits and, instead of the expected desired effect, led to a deterioration in performance indicators.

Taking into account the important selection aspect of intra- and inter-line breeding, it was considered appropriate to study the effectiveness of the combination of lines in the breeding of the Ukrainian Red-and-White dairy breed of the controlled herd on the basis of the duration of use and lifetime productivity (Table 3).

Summarizing the results of the evaluation

Table 2. Duration of use and milk productivity of highly productive cows of different genotypes for higher lactation

Genotype (conditional bloodness for Holstein)	n	Duration of use		milk yield, kg	% of fat	Kg of fat	Milk yield for one day of life, kg
		economic, days	lactations				
1/4 (25,0%)	24	2798±76,8	5,1±0,21	5299±140,2	3,82±0,021	202,4±3,51	17,4±0,32
3/8 (37,5%)	35	2516±78,5	4,4±0,19	5335±157,4	3,79±0,022	202,2±4,01	17,5±0,43
1/2 (50,0%)	39	2465±84,6	4,3±0,15	5896±192,6	3,80±0,021	224,0±3,98	19,3±0,25
5/8 (62,5%)	47	2506±80,1	4,4±0,12	6218±204,3	3,81±0,020	236,9±4,12	20,3±0,27
3/4 (75,0%)	49	2457±74,5	4,3±0,11	6595±197,2	3,78±0,022	249,3±3,65	21,6±0,30
7/8 (87,5%)	38	2304±88,4	3,9±0,09	6758±181,6	3,79±0,023	256,1±2,97	22,2±0,28

of cow's offspring obtained during the intraline selection of eight genealogical formations of the pedigree farm "Piskivske", the reliable effect of lines inheritance on lifetime productivity was established. In the rank of assessing the trait of economic use duration, the first position was taken by the cow's offspring of the well-known genealogical line in the Holstein breed Reflection Sovereign 0198998. Which, in confirmation of its with reliable difference of 328-651 days ($P < 0.01-0.001$), was superior to the progeny of other lines, with the exception of Stendout Cavalier and Hannover.

The genealogical formations of S. Cavalier 1620273 and Hannover 1629391 are pedigree lines in the Ukrainian Red-and-White dairy breed, the offspring of which took the second and third positions in the evaluation rating based on the duration of economic use, respectively.

Descendants of the R. Sovereign line also had the highest duration of lactation use (5.2) with exceeding the offspring of four lines Valiant, Pawnee Farm Arlinda Chief, Seiling Triune Rocket, Roseif Citation) by 1.1-1.8 lactations with a reliability at $P < 0.01-0.001$.

Table 3. Duration of use and lifetime productivity of cows of the Ukrainian Red-and-White dairy breed at intraline selection

Line	n	Duration of use	Productivity
------	---	-----------------	--------------

				lifetime milk yield, kg	% of fat	kg of fat	milk yield for one day of life, kg
		economic, days	lactations				
Valiant 1650414	128	2190±61,2	4,0±0,28	22937±745,3	3,78±0,005	867,0±22,61	10,4±0,55
R. Sov- ereign 0198998	69	2797±84,2	5,2±0,32	28860±969,4	3,79±0,018	1093,8±34,22	10,3±0,69
Enhanc- er 343514	93	2469±76,4	4,6±0,33	29049±869,2	3,77±0,016	1095,1±27,50	11,8±0,58
P.F.A. Chief 1427381	72	2181±77,5	3,5±0,41	20888±868,7	3,78±0,011	789,6±31,21	9,6±0,72
Hanno- ver 1629391	102	2618±58,4	4,8±0,30	28363±692,5	3,79±0,016	1075,0±24,34	10,8±0,61
S.T. Rocket 252803	56	2387±98,5	4,1±0,27	22619±961,6	3,80±0,019	859,5±36,41	9,5±0,76
R. Cita- tion 267150	92	2146±78,7	3,4±0,30	17554±842,5	3,83±0,017	672,3±35,82	8,2±0,63
S. Cava- lier 162027 3	66	2632±81,2	4,8±0,35	31821±829,4	3,80±0,019	1209,2±37,15	12,1±0,71

The most important of the traits that characterize lifetime productivity - milk yield of cows for life. On this basis, the emphasis in the ranking of the championship has shifted somewhat. The first position was occupied by cows belonging to the pedigree line of S. Cavalier with a lifetime milk yield of 31.821 kg, the second – by the descendants of the next breeding line of Enhancer (29.049 kg) and only the third was occupied by the offspring of genealogical line of Reflection Sovereign (28.860 kg). For lifetime milk yield, cows of the S. Cavalier purebred line with a reliable difference exceeded the offspring of all evaluated lines without exception with a difference from 2772 (P<0.05), compared with the descendants of the Enhancer line, to 14267 kg of milk (P<0.001) - compared with the progeny of the R. Citation line.

The variability of fat content in milk of cows of the evaluated lines varied in the range of 3.77-3.83 %, but the interlinear difference was unreliable. By the lifetime yield of milk fat, the descendants of S. Cavalier's line were the best. At an average value of 1209.2 kg, they ex-

ceeded the cows of other genealogical formations with different levels of reliability, from 134.2 kg (P <0.05; Hannover line) to 536.9 kg (P <0.001; R. Citation line). The milk yield per day of life was also higher in the offspring of S. Cavalier's line sires and amounted to 12.1 kg. Reliable difference was found only in comparisons with animals of the P.F.A. Chief (2.5 kg; P <0.05), S.T. Rocket (2.5 kg; P <0.05) and R. Citation (4.11 kg; P <0.001). Analysis of interlinear selection (Table 4) in different variants of combinations of paternal and maternal lines showed significant variability of the offspring obtained from these variants of duration of use and lifetime milk productivity.

The use of breeding sires of the Enhancer purebred line proved to be more successful in combination with the cows of S. Cavalier and Hannover pedigree lines than with the cows of Valiant genealogical line. Due to longer use and high productivity, the lifetime milk yield of their offspring was higher compared to the descendants obtained from an unsuccessful combination of Enhancer's sires of parent line with

cows from bulls of the maternal Valiant line by 11.102 and 13.058 kg of milk ($P < 0.001$), respectively.

From two variants of sires selection in the line of R. Citation with maternal S.T. Rocket and R. Sovereign, one was slightly better than the other with an advantage by lifetime milk yield of 1401 kg of milk, but the difference was unreliable. Analysis of variants of interlinear selection the offspring of R. Sovereign's paternal line with daughters of sires of maternal lines Hannover, Valiant, S.T. Rocket and P.F.A. Chief testified that the most effective was the combination of sires of the successors of the line R. Sovereign with cows of the line Hannover and S.T. Rocket. The offspring obtained from the cross of these lines, with almost the same duration of use, were significantly better in terms of lifetime productivity compared to the daughters of sires of the Valiant lines and, especially, P.F.A. Chief. The reliable difference in their favor for lifetime milking was 5,040 and 9.385 ($P < 0.001$) and 3.479 ($P < 0.01$) and 7.824 ($P < 0.001$) kg of milk, respectively.

When using interlinear cross on the sires parent side of the Hannover pedigree

Table 4. Duration of use and lifetime productivity of cows in interlinear selection

Line of sire	Line of dam	n	Duration of use		Productivity			milk yield for one day of life, kg
			economic, days	lactations	lifetime milk yield, kg	% of fat	kg of fat	
Enhancer 343514	S. Cavalier	41	2602±60,1	4,8±0,17	31013±675,3	3,79±0,012	1175±23,7	11,9±0,24
	Hannover	27	2548±89,5	4,6±0,21	32969±945,4	3,78±0,015	1246±33,1	12,9±0,51
	Valiant	32	2030±84,6	3,1±0,22	19911±874,2	3,82±0,013	761±29,5	9,8±0,43
R. Citation 267150	S.T. Rocket	20	2449±92,2	4,3±0,29	20734±919,7	3,82±0,017	792±31,8	8,5±0,49
	R. Sovereign	22	2330±94,3	4,0±0,31	22135±944,2	3,77±0,016	834±32,3	9,5±0,52
R. Sovereign 0198998	Hannover	28	2569±84,3	4,6±0,32	26134±843,5	3,81±0,014	996±34,1	10,2±0,35
	Valiant	23	2244±88,3	3,9±0,24	21094±925,3	3,79±0,013	799±36,2	9,4±0,43
	S.T. Rocket	36	2433±77,5	4,5±0,18	24573±975,4	3,78±0,011	929±28,7	10,1±0,32
	P.F.A. Chief	31	1994±62,8	3,0±0,21	16749±899,7	3,77±0,013	631±30,5	8,4±0,54
Hannover 1629391	S. Cavalier	21	2772±98,3	5,2±0,52	31247±901,1	3,79±0,013	1184±33,6	11,3±0,61
	R. Sovereign	23	2084±95,4	3,3±0,51	16589±814,8	3,82±0,014	634±34,7	8,0±0,51
	Valiant	32	2221±82,3	3,7±0,35	18212±811,1	3,81±0,012	694±29,4	8,2±0,42
	R. Citation	19	1922±92,7	2,8±0,29	15568±928,4	3,80±0,012	592±41,2	8,1±0,41
Valiant 1650414	S.T. Rocket	18	2340±96,3	4,0±0,51	22464±971,8	3,77±0,015	847±40,5	9,6±0,62
	Hannover	34	2031±84,1	3,1±0,34	15523±768,2	3,85±0,017	598±30,3	7,6±0,68
	S. Cavalier	26	2796±82,7	5,2±0,28	32482±838,5	3,81±0,014	1238±32,8	11,6±0,81
S.T. Rocket 252803	Hannover	21	2252±88,2	3,8±0,31	19592±825,7	3,75±0,013	735±36,9	8,7±0,62
	R. Sovereign	48	2188±65,8	3,5±0,28	21005±703,6	3,78±0,012	794±24,5	9,6±0,27

Valiant	29	2194±85,9	3,6±0,43	20624±876,2	3,87±0,015	798±35,2	9,4±0,53
---------	----	-----------	----------	-------------	------------	----------	----------

line, the combination with S. Cavalier's purebred line was the most successful by the duration of use (2.772 days and 5.2 lactations) and traits of lifetime milk yield (31.247 kg) and milk fat (1.184 kg). The progeny from this combination exceeded with reliable difference the offspring from other crossed variants in terms of the duration of economic use by 551-850 days ($P<0.001$), by the number of lactations used - by 1.5-2.4 ($P<0.05-0.001$), for lifetime milk yield - by 13035-15,679 kg ($P<0.001$), milk fat - by 490-592 kg ($P<0.001$) and milk yield in one day of life - by 3.1-3.3 kg ($P<0.001$).

Comparing the offspring obtained in the variants of interline selection from the maternal side with the Valiant parent line, it should be noted that the highest indicators of lifetime milk production were obtained in selection with the S. Cavalier line (32.482 kg of milk and 1.238 kg of milk fat), and the lowest - from combinations with sires of the Hannover line (15.523 and 598 kg).

It is worth noting that cows obtained in all variants of interline selection of parent lines Enhancer, Hannover and Valiant with sires ma-

ternal S. Cavalier have always had high rates of duration of economic use and lifetime milk productivity.

Conclusions. The established reliable influence of the share of conditional bloodlines of the Holstein breed on the indicators of lifetime productivity of cows of crossbred genotypes indicated about the need for appropriate selection and economic measures to stop this process both at the genetic and paratype levels.

Reliable variability of lifetime productivity indicators under the influence of genealogical formations confirmed the expediency of linear breeding in selection and pedigree work both with this herd and with the breed as a whole. Favorable and unsuccessful combinations identified in individual variants of interline selection indicate the need for a systematic assessment in the pedigree herds when selecting sires of the corresponding genealogical formations. Re-applying the most effective options and abandoning the unsuccessful ones will help increase the genetic potential of dairy cattle productivity.

References

- Boiko, Yu. M., 2013. Perspektyva selektsii khudoby ukrainskoi buroi molochnoi porody v aspekti liniino-rozvedennia z vrakhuvanniam svitovykh tendentsii tryvalosti linii u pokolinniakh [Perspective of the cattle selection of Ukrainian Brown dairy breed in the aspect of linear cultivation taking into account world tendencies of lines duration in generations]. *Visnyk Sumskoho NAU. Seriya «Tvarynnystvo»*, issue 1(22), pp. 20–26.
- Burkat, V. P. and Polupan, Yu. P., 2004. Rozvedennia tvaryn za liniiami: henezys poniat i metodiv ta suchasnyi selektsiinyi kontekst [Breeding animals by lines: genesis of concepts and methods and modern breeding context]. Kyiv: Ahrarna nauka.
- Danylenko, V. P., and Rudyk, I. A., 2012. Do pytannya efektyvnosti vykorystannia molochnykh porid u hospodarstvi [To the question of the effective use of dairy breeds in the economy]. *Rozvedennia i henetyka tvaryn*, issue 46, pp. 63–66.
- Kalchuk, L. A. and Pelekhatyi, M. S., 2001. Zviazok molochnoi produktyvnosti z pokaznykamy vidtvornoizdatnosti ta hospodarskoho vykorystannia u koriv chorno-riaboi porody [The relationship of milk productivity with indicators of reproductive ability and economic use in Black-and-White cows]. *Naukovo-tekhnichnyi biuleten. Kharkiv*, issue 80, pp. 64–67.
- Kononenko, S. I. and Shostak, V. A., 2012. Razvedenie i sovershenstvovanie zhivotnykh novogo regional'nogo tipa krasnogo molochnogo skota [Breeding and improvement of animals of new regional type of Red dairy cattle]. *Rozvedennia i genetika tvaryn*, issue 46, pp. 24–25.
- Merkur'eva, E. K., 1977. Geneticheskie osnovy selektsii v skotovodstve [Genetic bases of selection in animal husbandry]. Moskva: Kolos.
- Rudyk, I. A., Kiva M. S., Khomiak, O. A., and Stavetska, R. V., 2001. Vplyv henotypu i seredivyshcha na rist, rozvytok ta tryvalist vykorystannia tvaryn ukrainskykh chervono-riaboi ta chorno-riaboi porid [The influence of genotype and environment on the growth, development and duration of animals use of Ukrainian Red- and Black-and-White breeds]. *Naukovo-tekhnichnyi biuleten. Kharkiv*, issue 80, pp. 105–107.
- Stavetska, R. V. and Rudyk, I. A., 2010. Dynamika rozvytku linii molochnoi khudoby [Dynamics of dairy cattle lines development]. *Zbirnyk naukovykh prats. Seriya «Tekhnolohiia vyrobnytstva i pererobky produktiv tvarynnystva»*. Kamianets-Podilskyi, issue 18, pp. 197–200.
- Khmelnychyi, L. M. and Vechorka, V. V., 2010. Efektyvnist' vnutrishn'o liniynoho rozvedennia ta poyednuvanosti liniy v selektsiyi holshtyns'koyi khudoby [Efficiency of intralinear breeding and combining lines in the Holstein cattle selection]. *Visnyk Sumskoho NAU. Seriya «Tvarynnystvo»*, issue 18, pp. 149–153.
- Khmelnychyi, L. M., and Salohub, A. M., 2012. Efektyvnist poiednannia henealohichnykh formuvan v selektsii molochnoi khudoby [Efficiency of combination

- of genealogical formations in dairy cattle breeding]. *Zbirnyk naukovykh prats. Seriya "Tekhnologhiia vyrobnytstva i pererobky produktii tvarynnystva"*. Kamianets-Podilskyi, issue 20, pp. 285–287.
- Hmel'nychij, L. M., 2018. Pozhiznennaja produktivnost' korov ukrainskoj krasno-pestroj molochnoj porody v zavisimosti ot variantov podbora [Lifetime productivity of cows of the Ukrainian Red-and-White dairy breed depending on selection options]. *Zootehnie i Biotehnologii agricole materialele Simpozionului Stiintific International „85 ani ai Facultatii de Agronomie – realizari ei perspective”, dedicat aniversarii a 85 de ani de la fondarea Universitatii Agrare de Stat din Moldova*. Chieinru, 52(2). pp. 309–314.
- Khmelnichyi, L. M. and Bardash, D. O., 2019. Longevity indicators of cows of the Ukrainian Red-and-White dairy breed depending on the share of Holstein heredity [Pokaznyky dovolittia koriv ukrainskoi chervono-riaboi molochnoi porody zalezhno vid chastky spadkovosti holshtynskoi porody]. *Visnyk Sumskoho natsionalnoho ahrarnoho universytetu. Seriya "Tvarynnystvo"*, issue 4(39), pp. 13–19. doi: <https://doi.org/10.32845/bsnau.lvst.2019.4.2>.
- Khmelnichyi, L. M., Suprun I. O. and Bardash, D. O., 2021. Lifetime productivity of cows of the Ukrainian Red-and-White dairy breed with different selection options [Dovichna produktyvnist koriv ukrainskoi chervono-riaboi molochnoi porody za riznykh variantiv pidboru]. *Visnyk Sumskoho NAU. Seriya «Tvarynnystvo»*, issue 1(44), pp. 29–35. DOI: <https://doi.org/10.32845/bsnau.lvst.2021.1.4>
- Khmelnichyi, S. L., Martynova, Yu. V., Mykytiuk, P. P., Kryvchenko, T. O., Miadelets, V. V., Naumenko, M. V., 2021. Dovolittia koriv molochnoi khudoby zalezhno vid metodiv rozvedennia [Longevity of dairy cows depending on breeding methods]. *Visnyk Sumskoho natsionalnoho ahrarnoho universytetu, seriya «Tvarynnystvo»*, issue 1(44), pp. 103–109.
- Antonia, B. Samorì, Rita Rizzi, Attilio Rossoni & Alessandro Bagnato. 2010. Genetic parameters for functional longevity, type traits, somatic cell scores, milk flow and production in the Italian Brown Swiss. *Italian Journal of Animal Science*. 2010; volume 9:e28 : 145–152.
- Elisandra, L. Kern, Jaime A. Cobuci, Cláudio N. Costa, Concepta M. McManus, Gabriel S. Campos, Tatiana P. Almeida, Rafael V. Campos. 2014. Genetic association between herd survival and linear type traits in Holstein cows under tropical conditions. *Italian J. Animal Science*. 13:3419.
- Gutierrez, J. P. & Goyache, F., 2002. Estimation of genetic parameters of type traits in Austriana de los Valles beef cattle. *J. Anim. Breed. Genet.* 119: 93–100.
- Jovanovac, S., N. Raguž, J. Sülkner and G. Mészáros. 2013. Genetic evaluation for longevity of Croatian Simmental bulls using a piecewise Weibull model. *Arch. Tierzucht* 56: 89–101.
- Kern, E. L., Cobuci, J. A., Costa, C. N., McManus, C. M., and Neto, J. B. 2015. Genetic association between longevity and linear type traits of Holstein cows. *Sci. agric. (Piracicaba, Braz.)* 72: 3.
- Madgwick, P. A., Gaddard, M. E. 1989. Genetics and phenotypic parameters of longer vity in Australian dairy cattle. *Dairy Sc.* 72(10): 2624–2632.
- Meszaros, G., Fuerst, C. H., Fuerst-Waltl, B., Kadlecik, O., Kasarda, R. and Sülkner, J. (2008). Genetic evaluation for length of productive life in Slovak Pinzgau cattle. *Archives of Animal Breeding/Archiv Tierzucht-Index*, 5: 438–48.
- Novotná, L., Frelich, J., Beran, J., Zavadilová, L. 2017. Genetic relationship between type traits, number of lactations initiated, and lifetime milk performance in Czech Fleckvieh cattle. *Czech J. Anim. Sci.*, 62: 501–510.
- Kulak, K. K., Dekkers, I. C. M., McAllister, A. J., [et al.]. 1977. Relationships of curly performance traits to lifetime profitability in Holstein cows *Can. J. Anim. Sci.* 77: 617–624.
- Sewalem, A., Miglior, F., Kistemaker, G. J., 2010. Analysis of the relationship between workability traits and functional longevity in Canadian dairy breeds. *J. Anim. Sci.*, 93:4359–4365.
- McAllister, A. J., Lee, A. J., Batra, B. [et al.]. 1994. The influence of additive and nonadditive gene action on lifetime jilids and profitability of dairy cattle. *J. Dairy Sci.* 77(8): 2400–2414.
- Zarnseki, A., Jamrozik, J., Mroziec, S. 1991. Wplejnej laktacji, wieku i sezonu ocielenia na uzytkowosc mleczna krow w obredie stad. *Rock. nauk rol.* 3: 251–268.
- Zavadilová, L. and M. Jitřková. 2012. Genetic correlations between longevity and conformation traits in the Czech Holstein population. *Czech J. Anim. Sci.*, 57(3): 125–136.

Використана література

- Бойко Ю. М. Перспектива селекції худоби української бурої молочної породи в аспекті лінійного розведення з врахуванням світових тенденцій тривалості ліній у поколіннях. Вісник Сумського національного аграрного університету. Серія «Тваринництво». Суми. 2013. Вип. 1 (22). С. 20–26.
- Буркат В. П., Полупан Ю. П. Розведення тварин за лініями: генезис понять і методів та сучасний селекційний контекст. К. : Аграрна наука, 2004. 68 с.
- Даниленко В. П., Рудик І. А. До питання ефективності використання молочних порід у господарстві. Розведення і генетика тварин. Міжвідомчий тематичний науковий збірник. 2012. Вип. 46. С. 63–66.
- Кальчук Л. А., Пелехатий М. С. Зв'язок молочної продуктивності з показниками відтворної здатності та господарського використання у корів чорно-рябої породи / Л. А. Кальчук, // науково-технічний бюлетень. 2001. № 80. С. 64–67.
- Кононенко С. И., Шостак В. А. Разведение и

- совершенствованиє животных нового
регионального типа красного молочного скота.
Разведения і генетика тварин. 2012. Вип. 46. С.
24-25.
- Меркурьева Е. К. Генетические основы селекции в
скотоводстве / Меркурьева Е. К. М.: Колос, 1977.
240 с.
- Рудик І. А., Ківа М. С., Хом'як О. А., Ставецька Р.
В. [та ін.]. Вплив генотипу і середовища на ріст,
розвиток та тривалість використання тварин
українських червоно-рябої та чорно-рябої порід.
Науково-технічний бюлетень. 2001. №80. С. 105-
107.
- Ставецька Р. В., Рудик І. А. Динаміка розвитку
ліній молочної худоби. Збірник наукових праць.
Серія "Технологія виробництва і переробки
продукції тваринництва". Кам'янець-
Подільський, 2010. Вип. 18. С.197-200.
- Хмельничий Л. М., Вечорка В. В. Ефективність
внутрішньолінійного розведення та поєднуваності
ліній в селекції голштинської худоби. Вісник
Сумського НАУ. Серія "Тваринництво" Суми.
2010. Вип. 12 (18). С. 149-153.
- Хмельничий Л. М., Салогуб А. М. Ефективність
поєднання генеалогічних формувань в селекції
молочної худоби. Збірник наукових праць
Подільського держ. аграрно-технічного
університету. Серія "Технологія виробництва і
переробки продукції тваринництва". Кам'янець-
Подільський. 2012. Вип. 20. С. 285-287.
- Хмельничий Л. М. Пожизненная продуктивность
коров украинской красно-пестрой молочной
породы в зависимости от вариантов подбор.
Zootehnie ei Biotehnologii agricole materialele Sim-
pozionului Etiinofic Internaoional „85 ani ai Fac-
ultatii de Agronomie – realizrri ei perspective”, ded-
icat aniversrii a 85 de ani de la fondarea Universi-
tatii Agrare de Stat din Moldova. Chieinru, 2018.
Vol. 52(2). P. 309-314.
- Kern, E. L., Cobuci, J. A., Costa, C.N., McManus, C.
M., and Neto, J. B. 2015. Genetic association be-
tween longevity and linear type traits of Holstein
cows. Sci. agric. (Piracicaba, Braz.) 72:3.
- Madgwick P. A. Genetics and phenotypics parameters
of longer vity in Australian dairy cattle / P. A.
Madgwick, M. E. Gaddard // Dairu Sc. – 1989. – v.
72. – № 10. – P. 2624-2632.
- Meszaros, G., Fuerst, C.H., Fuerst-Waltl, B.,
Kadleink, O., Kasarda, R. and Sülkner, J. (2008) Ge-
netic Evaluation for Length of Productive Life in
Slovak Pinzgau Cattle. Archives of Animal Breed-
ing/Archiv Tierzucht-Index, 5, 438-48.
- Novotne L., Frelich J., Beran J., Zavadilov L. (2017):
Genetic relationship between type traits, number of
lactations initiated, and lifetime milk performance in
Czech Fleckvieh cattle. Czech J. Anim. Sci., 62: 501-
510.
- Relationships of curly performance traits to lifetime
- Хмельничий Л. М., Бардаш Д. О. Показники
довголіття корів української червоно-рябої
молочної породи залежно від частки спадковості
голштинської породи. Вісник Сумського НАУ.
Серія «Тваринництво». 2019. Вип. 4(39). С.13-19.
DOI: <https://doi.org/10.32845/bsnau.lvst.2019.4.2>
- Хмельничий Л. М., Супрун І. О., Бардаш Д. О.
Довічна продуктивність корів української
червоно-рябої молочної породи за різних
варіантів підбору. Вісник Сумського НАУ. Серія
«Тваринництво». 2021. Вип. 1(44). С.29-35. DOI:
<https://doi.org/10.32845/bsnau.lvst.2021.1.4>
- Хмельничий С. Л., Мартинова Ю. В., Микитюк П.
П., Кривченко Т. О., Мяделець В. В., Науменко М.
В. Довголіття корів молочної худоби залежно від
методів розведення. Вісник Сумського
національного аграрного університету : науковий
журнал. Сер. «Тваринництво». 2021. Вип. 1 (44).
С. 103-109.
- Antonia, B. Samorj, Rita Rizzi, Attilio Rossoni &
Alessandro Bagnato (2010) Genetic Parameters for
Functional Longevity, Type Traits, Somatic Cell
Scores, Milk Flow and Production in the Italian
Brown Swiss. Italian Journal of Animal Science
2010; volume 9:e28: 145-152.
- Elisandra, L. Kern, Jaime A. Cobuci, Cludio N. Cos-
ta, Concepta M. McManus, Gabriel S. Campos, Tati-
ana P. Almeida, Rafael V. Campos. 2014.
- Genetic association between herd survival and linear
type traits in Holstein cows under tropical conditions.
Italian J. Animal Science.13:3419.
- Gutierrez, J.P. & Goyache, F., 2002. Estimation of
genetic parameters of type traits in Austriana de los
Valles beef cattle. J. Anim. Breed. Genet. 119: 93-
100.
- Jovanovac, S., N. Raguh, J. Sülkner and G. Mészáros.
2013. Genetic evaluation for longevity of Croatian
Simmental bulls using a piecewise Weibull model.
Arch. Tierzucht 56: 89-101.
- profitability in Holstein cows / K. K. Kulak, I. C. M.
Dekkers, A. J. McAllister [et al.] // Can. J. Anim. Sci.
– 1977. – 77. – P. 617-624.
- Sewalem, A., Miglior, F., Kistemaker, G.J., 2010.
Analysis of the relationship between workability
traits and functional longevity in Canadian dairy
breeds. J. Anim. Sci., 93:4359-4365.
- The influence of additive and nonadditive gene action on
lifetime jillds and profitability of dairy cattle / A. J.
McAallister, A. J. Lee, B. Batra [et al.] // J. Dairy Sci. –
1994. – 77. – № 8. – P. 2400-2414.
- Zarnseki A. Wplejnej laktacji, wieku i sezonu ociele-
nia na uzytkowosc mleczna krow w obredie stad / A.
Zarnseki, J. Jamrozik, S. Mroziec // Rock. nauk rol.
B. – 1991. – № 3. – P. 251-268.
- Zavadilov L. and M. Ътпков. 2012. Genetic cor-
relations between longevity and conformation traits in
the Czech Holstein population. Czech J. Anim. Sci.,
57(3): 125–136.

Наведено результати досліджень корів української червоно-рябої молочної породи за ознаками тривалості господарського використання та довічної продуктивності у межах оцінки помісних генотипів та генеалогічних формувань. Встановлено достовірний вплив умовної частки спадковості голишинської породи на тривалість терміну господарського використання та довічну молочну продуктивність корів. Найдовше у стаді використовувалися помісні корови з кровністю голишина 25,0% та помісі зі спадковістю батьківської породи до 50,0%. На заключному етапі схрещування, у тварин з кровністю 62,5-87,5%, спостерігалось відчутне скорочення тривалості господарського використання. Тварини з кровністю голишина 75,0 та 87,5% поступалися групам помісних корів зі спадковістю 25,0 та 50,0% з достовірною різницею відповідно на 590 і 633 ($P<0,001$) та 432 і 475 ($P<0,001$) днів. Разом з тим, від корів з часткою крові голишина 87,5% було отримано найвищий довічний надій з перевищенням груп корів решти генотипів на 1250-3260 кг молока з достовірною різницею у порівняннях з помісними генотипами з кровністю 25,0% ($P<0,001$), 37,5 ($P<0,001$), 50,0 ($P<0,01$) і 62,5% ($P<0,05$). Доведено спадковий вплив ліній на показники довічної продуктивності при внутрішньолінійному підборі та в окремих варіантах міжлінійних поєднань. Про вплив генеалогічних формувань на показники довголіття при внутрішньолінійному підборі свідчить достовірна різниця між крайніми варіантами оцінюваних ліній за ознаками господарського використання (651 день; $P<0,001$) та довічного надою (14267 кг; $P<0,001$). За результатами міжлінійного підбору у різних варіантах поєднань батьківських та материнських ліній встановлено істотну мінливість потомства, отриманого від цих варіантів, за оцінюваними ознаками тривалості використання та довічної молочної продуктивності. Корови отримані в усіх варіантах міжлінійного підбору батьківських ліній Ингансера, Хановера та Валіанта з бугаями материнської Т. Кавалера завжди відрізнялися високими показниками тривалості господарського використання та довічної молочної продуктивності.

Ключові слова: українська червоно-ряба, порода, корова, надій, лінія, довічна продуктивність.