ORIGINAL ARTICLE

Linebreeding as a system of stock breeding to improve the productive qualities of horses of the Kushum breed

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Abstract

Possessing high meat and dairy productivity and good reproductive and adaptive qualities to year-round grazing, the Kushum breed plays an exceptional role in the improvement of productive qualities in horse herding in Kazakhstan and the former Soviet republics. The aim of the study was to develop breeding methods for creating new highly productive breeding lines for the Kushum breed horses. The leading method was linebreeding, which is based on the systematic use of remarkable animals, the offspring of which will accumulate and develop all the desired qualities and traits. The practical significance of the study lies in the fact that new highly productive breeding lines of the Kushum horse have been created. On this basis, a new intra-breed type of horses with increased live weight, high productivity and adaptive qualities for winter grazing in the Republic of Kazakhstan was created. The results of the study were introduced in farms engaged in breeding Kushum horses. Highly productive stallions of the Kushum breed of new genotypes are sold in horse breeding farms of the republic. These studies are used in the development of a comprehensive plan for selection and breeding work and a scientifically grounded system for conducting productive horse breeding in the Republic of Kazakhstan. The scientific novelty of the study lies in the creation of new highly productive breeding lines of stallions of the Kushum breed Krepysh and Grom, as well as in substantiating the creation of the Samotsvet line with high adaptive qualities.

KEYWORDS
breeding, breeding line, horse herding, husbandry, live weight, measurements

1 | INTRODUCTION

The linebreeding method is based on the systematic use of remarkable animals when the desired quality traits accumulate and develop in the offspring. Therefore, the line usually gets its name by the name of the ancestor, from whom it originates, and in each subsequent generation, its descendants naturally lose their resemblance to the ancestor due to the further development of desirable qualities. Housing, feeding and selection conditions are essential for linebreeding and are the determining cause of the variability sought in the lines (Popescu et al., 2019). A special role in the evolutionary development of the line is assigned to the correct selection of parental pairs. The wide distribution of valuable lines with high genetic potential contributes to the progress of the breed and raises its general level (Folla et al., 2020). In addition, the selection of lines facilitates orientation in the breed and allows to maintain its optimal structure and to avoid unsystematic, inbred mating (Koveshnikov & Slotina, 2021; Nguyen et al., 2020; Toktabay & Nugumarova, 2022). Linebreeding theory was developed after clarifying the role of remarkable ancestors, possessing prepotency and producing excellent offspring.

Possessing high meat and dairy productivity and good reproductive and adaptive qualities to year-round grazing, the Kushum breed plays an exceptional role as an improver of productive qualities in horse herding in Kazakhstan and the former Soviet republics (Nguyen et al., 2020). Describing the Kushum horse breed of Western Kazakhstan A.R. Akimbekov (2013) writes that 'the genetic potential for live weight of mares of the Kushum breed reaches 575 kg, and stallions 711 kg'. These data indicate the potential for further improvement of the breed on such an economically useful trait as live "weight", which gives breeders the opportunity to further increase live weight, carcass weight and slaughter yield of meat (Mylostyvyi et al., 2021). In order to meet the ever-increasing ecological, social and market requirements, the Kushum horse must constantly improve in the direction of increasing its massiveness, improving its performance, improving breeding, productive and adaptive qualities, which, when crossed with local horse breeds, provide animals with high productivity and adaptability to the harsh grazing conditions (Basybekov et al., 2018). In this regard, the development of breeding methods for the further improvement of the breeding and productive qualities of the Kushum breed in conditions of year-round grazing is of scientific and practical importance (Putnová & Štohl, 2019).

The scientific novelty of the study lies in the creation of new highly productive breeding lines of stallions of the Kushum breed Krepysh and Grom, as well as in substantiating the creation of the Samotsvet breeding line with high adaptive qualities. The lines Krepysh and Grom were approbated by the Ministry of Agriculture of the Republic of Kazakhstan and approved in 2011 by the Republican State Enterprise 'National Institute of Intellectual Property' of the Republic of Kazakhstan with the issuance of patents for a new selection invention (Breeding line 116 Grom..., 2008). The practical significance of the study lies in the fact that new highly productive breeding lines of the Kushum horse have been created, on the basis of which a new intra-breed type of horses with increased live weight, high productive and adaptive qualities for winter grazing in the Republic of Kazakhstan was created. The research results have been introduced to the breeding farms for Kushum horses. Highly productive stallions of the Kushum breed of new genotypes are sold in horse breeding farms of the republic. The findings are used in the development of a comprehensive plan for selection and breeding work and a scientifically grounded system for conducting productive horse breeding in the Republic of Kazakhstan. The aim of the study was to develop breeding methods for creating new highly productive breeding lines for the Kushum horses. In this regard, the following tasks were identified:

1. Evaluation of breeding and productive qualities of horses of the Kushum breed in the context of breeding lines.
2. Determination of the economic efficiency of linebreeding.

2 | MATERIALS AND METHODS

The stockbreeding was carried out in the Aktobe region of the Republic of Kazakhstan in the Mugalzhar stud farm, its subsidiary breeding farms TS-AGRO LLP and the Zhan-Kanat-S farm, ASHOS LLP and Koktas JSC in the period of 1992–2010. The study flow diagram is shown in Figure 1. The development of the genealogical structure of the linebreeding, the dynamics of the main breeding traits: size, type, exterior, adaptability to the conditions of year-round grazing, meat and milk productivity and reproductive abilities of the Kushum horses were studied. The typicality of horses was assessed by a commission according to the severity of the desired type, conformational features—by the method of describing the advantages and disadvantages of individual body parts (Slagboom et al., 2020).
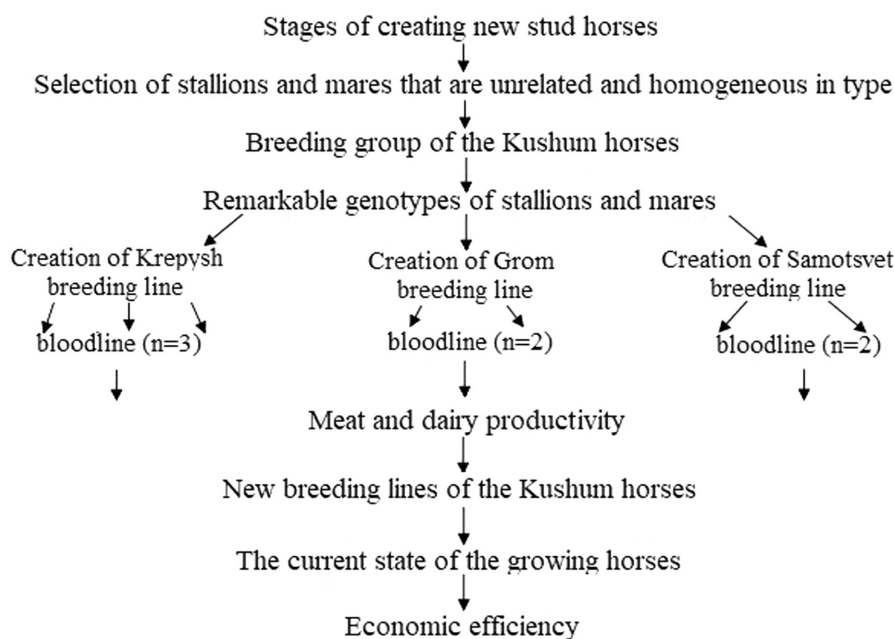

FIGURE 1 Study flow diagram

Stud horses by the quality of their offspring were assessed by the ranking method. The assessment of the pronouncement of economically useful traits in various groups of animals was carried out according to the generally accepted methods of genetic-statistical and zootechnical analysis: the arithmetic means, the value of the standard deviation, limits, coefficients of variation, reliability, coefficients of genetic similarity, inbreeding, etc. (Elías et al., 2011). When forming the genealogical structure of the breed at various stages, the following were calculated: the coefficient of genetic similarity and the coefficient of close breeding of the Krepysh, Grom and Samotsvet breeding lines. The productivity of growing horses was studied by carrying out control slaughter at the age of 18, 30 months, according to the VNIIK (All-Russian Research Institute of Horse Breeding) method, 1974 (Methods for determining…, 1974). For slaughter, three heads were selected from each group at different age periods. All animals were weighed on a weighing platform. The fatness of animals to be slaughtered was determined by GOST No. 20079–74 (1975). A study was approved by Ethical Committee on Animal Experiments of the Republic of Kazakhstan.

When carrying out control slaughter, the following indicators were taken into account: pre-slaughter live weight (after fasting), carcass weight and slaughter yield. The milk productivity of mares was determined by the calculation based on control milking (Askarov et al., 2020). Fertility of mares in 2007–2009 was studied according to the materials of the primary zootechnical accounting (breeding records, summary statements on mating and foaling results) (Instructions for grading horses…, 2014). The adaptive qualities of horses were studied by the dynamics of live weight in different periods of winter grazing and fertility indicators. When breeding the Kushum horse, stock breeding in the Aktobe region was carried out with several unrelated groups of horses dating back to the Russian Don, Budyonny and thoroughbred riding stallions from the breeding farms of the Russian Federation and the Republic of Kazakhstan. In order to substantiate the planning of stock breeding to create new breeding lines, the genealogical lines and related groups in their historical development in the context of generations were studied, and the influence of the ancestors and their successors on the quality of the broodstock was determined. At the same time, it was found that in the formation of valuable groups of horses of massive, basic and riding types, the offspring of stallions was of decisive importance: 118 Krepysh 33–64, 116 Grom 98–58, 134 and Samotsvet 77–73, which stand out for their best qualities in the product composition of Kushum horses. In this regard, new breeding lines of stallions Krepysh, Grom and Samotsvet were laid and a target standard for these lines was developed.

All ancestors were obtained from reproductive breeding of 2nd or 3rd generations. The ancestors of the created breeding lines: red stallion 118 Krepysh No. 33, born in 1964, dark chestnut stallion 116 Grom 98, 1958, red stallion 134 Samotsvet No. 77, born in 1973, born and raised in the Mugalzhar stud farm. At the age of eight, Krepysh had a height at the withers—of 157 cm, an oblique body length—of 163 cm, a chest circumference—of 195 cm, a pastern circumference—of 20.5 cm and a live weight of 596 kg. The adaptive

qualities to the harsh herd and natural conditions were confirmed by high reproductive ability. For 11 years of breeding use, the fertility rate of mares assigned to Krepysh was 96.0%. Grom was a large stallion for that time (157–158–180-21 cm and 504 kg) of strong constitution, a saddle-harness type. For 14 years of breeding, Grom has produced a very valuable group of stud stallions and mares of predominantly massive and basic types. The pregnancy rate of mares assigned to Grom was 85.6%. The red stallion Samotsvet was distinguished by its high growth (163 cm), chest circumference (190 cm) and live weight (543 kg). For 8 years of breeding use, the fertility rate of mares assigned to Samotsvet was 86.8%. The Krepysh line formed 3 branches through the stallions Kredit, Karbid and Kremplin.

In the work on the creation of the Krepysh breeding line, intrastrain selection and unrelated pairing with emerging lines and other related groups were used. Line crossing was used equally. Sons (n = 5) of the Krepysh breeding line being created, which have an average live weight of 573.2 kg, were obtained by unrelated pairings. Out of 7 grandchildren, 2 heads with an average live weight of 586.0 kg were obtained by close breeding, and 5 grandchildren with an average live weight of 576.6 kg were obtained from unrelated mating, that is, inferior to inbred ones by 9.4 kg. Out of 6 great-grandchildren, 2 heads with an average live weight of 630.5 kg were obtained by close breeding and 4 head from outbreeding, with an average live weight of 576.5 kg, that is, are inferior to inbred ones by 54.0 kg in statistically significant value (td = 3.2). Of the 7 great-great-grandchildren, 4 were obtained by moderate inbreeding, with an average live weight of 596.2 kg, and 3 heads were obtained from outbreeding, with an average live weight of 588.3 kg.

The Grom's breeding line has 3 branches the Granata, Gaz and Gromoboy stallions. The sons and grandsons of the stallion Grom with a live weight of 522.5 and 543.6 kg, respectively, were obtained by the outbreeding method. Out of 5 great-grandchildren, 4 were obtained by the outbreeding method with an average live weight of 574.2 kg and 1 moderately close breeding, with a live weight of 563.0 kg and is inferior to outbred ones by 11.2 kg. Out of 5 great-great-grandchildren of Grom with an average live weight of 592.6 kg, 3 heads were obtained by moderate close breeding with an average live weight of 606.6 kg and 2 heads were outbred with an average live weight of 571.5 kg, that is, inferior to inbred by 35.1 kg (6.1%), td = 1.6. The average live weight of great-great-great-grandchildren (n = 5) is 589.9 kg, of which inbred—and 2 heads with a live weight of 596.0 kg, outbred—3 heads with a live weight of 585.0 kg, that is, they are inferior to inbred by 21.6 kg (3.7%).

The Samotsvet's line has 2 branches and spread through the stallions Samal and Sayys. The analysis of the methods and results of the selection of pairs in obtaining the successors of the Samotsvet showed that adult sons (n = 2), grandchildren (n = 2) and great-grandchildren (n = 2) with live weight, respectively: 557.5; 579.0 and 582.5 kg were obtained by the outbreeding method, while stallions obtained in a cross with the Grom's breeding line have a relatively high live weight. So, for sons (n = 1)—565.0 kg, for grandchildren (n = 1)—583.0 kg and for great-grandchildren (n = 2)—582.5 kg. Evaluation of stallions for the quality of the offspring is the most

important element of breeding work. The rank correlation simplifies the breeding technique for a complex of traits, provides an objective assessment of the offspring of stud horses in comparison with peers and allows identifying hereditary capacity at an earlier age.

3 | RESULTS AND DISCUSSION

3.1 | Measurements and live weight of new breeding lines of the Kushum horse breed

The studies carried out on the creation of breeding lines of the Kushum horses in the context of generations have shown that the main condition for the progressive development of lines is the transfer from generation to generation of the ability to produce highly productive offspring (Table 1). From 1965 to 2010, in the breeding of Kushum horses, a significant improvement in economically useful traits was achieved; this can be determined by comparing the average data of measurements and live weight of Kushum stallions and mares of the original genealogical and new breeding lines (Rzabaev, 2011; Rzabaev & Rzabaev, 2005).

The average stallions of the Krepysh line exceed those of Kaskad II (1965) in height at the withers by 2.6 cm, oblique body length by 1.2 cm, chest circumference by 13.0 cm and in live weight by 63.3 kg (11.7%). Mares of the Krepysh line surpass the broodmares (n = 13) of the original genealogical group of Kaskad II (1965) in height at the withers by 3.3 cm, oblique body length by 0.9 cm, chest circumference by 6.4 cm and live weight by 44.6 kg (9.3%). Stallions of the Grom line surpass the indicators of the original Garpun (1965) in height at the withers by 4.8 cm, in body length by 7.8 cm, chest circumference by 21.8 cm and live weight by 121.2 kg (25.3%). Mares of the Grom line surpass the broodmares of the original genealogical line of Garpun (1965) in height at the withers by 4.6 cm, oblique body length by 2.4 cm, chest circumference by 7.3 cm and live weight by 49.0 kg (10.4%).

3.2 | Evaluation of stud horses for the quality of offspring and reproductive ability of horses

The results of evaluating the stallions of the created breeding lines by sire proving with the ranking method, starting from the rates of 1991 indicate that the stallions of the created lines are characterized by good indicators of the average rank sum (8.0–9.2). Of the 21 heads of Kushum stallions evaluated by the sire proving, 66.6% correspond to the 1st and 2nd ranks, 28.6% to the 3rd rank and only 2 heads to the 4th rank (4.8%). The distribution of stallions of different lines by the rank sum shows that stud horses of the Krepysh line differ in relatively better indicators of the rank sum, where 36% of the estimated livestock by the sum of ranks 8–8.6; 8.7–9.0—54.5% and the rank sum 9.1–9.2—only 9.1%. Grom Line, respectively: 42.8%; 42.8% vs. 14.4%. In the Samotsvet line, the rank sum indicators were as follows: 8.0–8.6—33.3%, 8.7–9.0—33.3%, and 9.1–9.2—33.3%.

The reproductive abilities of the Kushum horses were evaluated by the fertility of mares and the foaling. The results of mating and foaling of mares of the Kushum breed for 2007–2009 indicate that the fertility of mares is directly dependent on paratypical factors. Thus, the difficult wintering in 2007 had a noticeable effect on the fertility rates of mares (86.8%). Under favourable conditions in 2008 and 2009, a high rate of foaling was obtained (96.5%–97.1%). On average, over 3 years, the percentage of successful foaling is 93.8%, and the pregnancy rate is 95.3%. These data indicate the high fertility of mares of the Kushum breed and the high reproductive ability of stallions created by the breeding lines of Krepysh, Grom and Samotsvet. In order to study the meat qualities of young stock, 3 heads of stallions of the Krepysh and Grom lines were slaughtered at 18 and 30 months of age, after the autumn fattening in November 2007. For slaughter, animals close to the average for the considered groups were selected. The assessment of the meat productivity of the stallions from the breeding lines of Krepysh and Grom is given in Table 2.

TABLE 1 Dynamics of average measurements and live weight of stallions and mares of the created Kushum breed lines, M±m

| Line | n | Measurements, cm | | Circumference | | Live weight, kg |
		Height at withers	Oblique body length	Chest	Pastern	
Stallions						
Kaskad II (initial),1965	1	158.0	163.0	186.0	21.0	541.0
Krepysh (bred), 2010	9	160.6 ±0.79	164.2 ±0.54	199.0 ±1.14	20.8 ±0.18	604.3 ±7.06
Garpun (initial), 1965	1	154.0	156.0	176.0	19.0	479.0
Grom (bred), 2010	6	158.8 ±0.44	163.8 ±0.44	197.8 ±1.50	20.6 ±0.18	600.2 ±11.7
Mares						
Kaskad II (initial),1965	13	151.7 ±0.99	157.7 ±0.63	181.4 ±1.82	19.5 ±0.20	479.2 ±14.5
Krepysh (bred), 2010	80	155.0 ±0.18	158.6 ±0.19	187.8 ±0.38	19.1 ±0.03	523.8 ±2.5
Garpun (initial), 1965	18	150.3 ±0.62	156.0 + 0.90	179.9 ±1.36	18.8 ±0.15	471.1 ±9.40
Grom (bred), 2010	61	154.9 ±0.26	158.4 ±0.30	187.2 ±0.47	19.1 ±0.03	520.1 ±2.6

TABLE 2 Results of the control slaughter of Kushum colts

Age	Line	n	Live weight before fasting, kg	Pre-slaughter live weight after fasting, kg	Carcass weight, kg	Slaughter yield, %
18 Months	Krepysh	3	353.0	335.4	186.1	55.5
	Grom	3	351.0	333.4	184.0	55.2
30 Months	Krepysh	3	435.0	413.3	238.0	57.6
	Grom	3	429.0	409.7	234.5	57.3

In terms of the absolute carcass weight and slaughter yield, both 18- and 30-month-old colts of the Krepysh and Grom lines are characterized as animals of high meat productivity. Lifetime assessment of the meat content in colts of various lines of the Kushum breed, carried out by the method of Yu.N. Barmintsev, showed that the estimated carcass weight of stallions of the Krepysh and Grom lines almost coincides with experimental slaughter (Barmintsev et al., 1974). For 1.5-year-old stallions of the Krepysh, Grom and Samotsvet lines, the calculated carcass weight was as follows: 185.5; 184.7 and 185.8 kg, and for 2.5-year-olds, respectively: 238.6; 235.9 and 237.3 kg, which testifies to the high meat yield of young animals of the considered breeding lines.

Milk productivity of mares from the breeding lines of Krepysh and Grom was studied in conditions of open grazing. For the experiment, 3 mares were selected, typical for breeding lines of Krepysh and Grom. The milk productivity of mares was determined by the actual milk yield by carrying out the control milking every 10 days. According to the control milking, the gross milk yield was calculated for mares of various lines for 105 days of lactation. The milk productivity of mares of the Grom's breeding line for 105 days of lactation averages 1643.8 + 3.86 litres, and of Krepysh—1660.0 + 5.3 litres. The daily milk yield of the mares of the Grom's breeding line is 15.6 litres, and of Krepysh—15.8 litres, that is, mares of both strains according to the assessment of milk productivity (according to prof. K. Duisembaev) have 9 points and, thus, exceed the standard of the elite class by 1 point (Duisembaev, 2004). The milk and meat productivity of animals was also studied on other horse breeds, in particular, when creating a breeding type of Kazakh breed like Jabe in the North-East of Kazakhstan, proving the advantage of linebreeding in order to increase meat and milk yield in herd horse breeding (Kazagromarketing, analytics and…, 2011).

3.3 | The current state of the production and young stock of new breeding lines

At present, there are more than 262 heads in the brood herds of purebred Kushum mares, including 213 heads of elite class (81.3%), of the first class—33 heads (12.6%), of the second class—16 heads (6.1%). All main stallions of the basic holdings (n = 20) are purebred and elite. As a result of the scientifically grounded selection work, Kushum horses of basic farms are mainly represented by animals of massive (80.7%), basic (15.5%) and saddle (3.8%) types. The largest number of stallions belongs to the Krepysh line—10 heads (50.0%),

Grom—6 heads (30.0%) and Samotsvet—4 heads (20.0%). Adult mares (n = 187) of the Kushum breed are distinguished by good measurements and live weight (154.8–158.2-186.8-19.0 cm and 517.3 kg), and live weight exceeds the requirements of the elite class by 37.3 kg (7.8%). The numerical superiority in terms of the brood stock is the line of the stallion Krepysh—127 head. (48.5%), incl. elite—104 head (81.9%), Grom—91 head (34.7%), incl. elite—76 head (83.5%), then Samotsvet lines—44 head (16.8%) and incl. elite—33 heads (75.0%). To further improve the Kushum horse breed and improve breeding and productive qualities, breeding work is carried out to increase the number of stallions and mares of the elite class. Table 3 shows measurements and live weight of adult elite stallions and mares of the breeding lines of Krepysh, Grom and the emerging breeding line of Samotsvet.

Animals of the new breeding lines of Krepysh, Grom and the created line of the Samotsvet in terms of measurements and live weight significantly ($p > 0.999$) exceed the requirements of the elite class breed. Stallions of the Krepysh breeding line have very good growth, an elongated oblique body length, a larger chest circumference, pastern circumference, a high live weight and massiveness. Mares of the Krepysh line have excellent height, an elongated body, a good chest, pastern circumference, full-bodied and massiveness. Stallions of the Krepysh line in terms of measurements and live weight exceed the requirements of the elite class, respectively: by 3.6–5.2 -12.0-0.8 cm and by 84.3 kg (16.2%), their massiveness is 10.6% higher; and mares respectively: 2.0–2.6-4.8-0.57 cm and 43.8 kg (9.1%), the massiveness is 8.3% higher. Stallions and mares of the Grom breeding line are characterized by good growth, an elongated body, chest circumference, good pastern circumference and high body weight. Stallions and mares of the line are massive (150.0–140.6) of the productive direction as a result of compensatory selection of massive mares of the Krepysh line to stallions of the Grom line. Stallions and mares of the Grom line in live weight exceed the requirements of the elite class by 80.2 kg (15.4%) and 40.1 kg (8.3%), respectively, in terms of massiveness by 13.8% and 7.3%.

Stallions and mares of the emerging breeding line of Samotsvet as a result of the selection of low-legged and broad-bodied mares of other related groups (Dikhan, Zolotoy, and mares from backcrossing) to tall stallions of the Samotsvet line are characterized as animals of good growth, elongated body, good chest and pastern circumference and are distinguished by their massiveness and sturdy constitution. Stallions and mares of the Samotsvet line in terms of live weight exceed the requirements of the elite class, respectively: by 61.0 kg (11.7%) and 35.3 kg (7.3%), and by 8.4% and 6.0% in terms

TABLE 3 Measurements and live weight of stallions and mares of new breeding lines

Indicator	Stud stallions			Mares		
	M ± m	Cv, %	Elite class requirements	M ± m	Cv, %	Elite class requirements
Krepysh line 33–64						
Number of animals	9			80		
Height at the withers, cm	160.6 ± 0.79	1.47	157.0	155.0 ± 0.18	1.06	153.0
Oblique body length, cm	164.2 ± 0.54	0.99	159.0	158.6 ± 0.19	1.09	156.0
Chest circumference, cm	199.0 ± 1.14	1.72	187.0	187.8 ± 0.38	1.83	183.0
Pastern circumference, cm	20.8 ± 0.18	2.56	20.0	19.1 ± 0.03	1.23	18.5
Live weight, kg	604.3 ± 7.06	3.5	520.0	523.8 ± 2.5	4.28	480.0
Massiveness index	147.4		136.8	141.6		133.3
Grom line 98–58						
Number of animals	6			61		
Height at the withers, cm	158.8 ± 0.44	0.67	157.0	154.9 ± 0.26	1.31	153.0
Oblique body length, cm	163.8 ± 0.44	0.65	159.0	158.4 ± 0.30	1.46	156.0
Chest circumference, cm	197.8 ± 1.50	1.86	187.0	187.4 ± 0.47	1.96	183.0
Pastern circumference, cm	20.6 ± 0.18	2.18	20.0	19.1 ± 0.03	1.38	18.5
Live weight, kg	600.2 ± 11.72	4.78	520.0	520.1 ± 2.63	3.95	480.0
Massiveness index	150.0		136.8	140.6		133.3
Samotsvet line 77–73						
Number of animals	2			23		
Height at the withers, cm	159.5 ± 0.35	0.31	157.0	154.9 ± 0.19	0.60	153.0
Oblique body length, cm	163.5 ± 0.35	0.31	159.0	158.4 ± 0.4	1.20	156.0
Chest circumference, cm	196.5 ± 0.35	0.25	187.0	186.3 ± 0.52	1.33	183.0
Pastern circumference, cm	21.0 ± 0.00	0.00	20.0	19.0 ± 0.04	1.10	18.5
Live weight, kg	581.0 ± 4.24	1.03	520.0	515.3 ± 3.3	3.07	480.0
Massiveness index	145.2		136.8	139.3		133.3

of massiveness. The low values of the coefficient of variation for measurements and live weight of horses of these lines indicate their uniformity in terms of body type in the section of lines. In terms of the quantitative and qualitative composition, the lines of Krepysh and Grom meet the requirements for the approbation of the breeding lines. When approbating new breeding lines of stallions Krepysh and Grom, the expert commission of the Ministry of Agriculture of the Republic of Kazakhstan (2010) gave a positive conclusion. The creation of the above breeding lines contributed to an increase in the productive qualities of the breed, as evidenced by the characteristics of adult horses of the Kushum breed of the original group in comparison with the modern breeding group (Table 4), while the improvement of the modern population of stallions by measurements is, respectively: by 3.8–2.7-16.0-0.1 cm and live weight of 91.8 kg (18.4%), td = 2.5, and in mares, respectively: 4.3–1.8-7.9-0.1 cm and live weight 44.3 kg (9.4%), td = 15.8; stallion massiveness index is 12.6 more %.

Stallions of the Kushum breed from 1.5–3.5 years old (n = 149) are distinguished by very good measurements, live weight and massiveness meet the requirements of the elite class. Mares (n = 187) of the breed are distinguished by very good indicators of measurements, live weight, massiveness and exceed the requirements of

the elite class, in particular, in terms of live weight of a 1.5-year-old filly (n = 57)—by 13.6 kg (4.1%), 2.5-year-old (n = 35)—by 19.3 kg (4.7%), 3-year-olds (n = 49)—by 12.0 kg (2.8%) and 3.5-year-old (n = 46)—by 19.6 kg (4.3%). The main way of raising the Kushum horses in the conditions of the Aktobe region is year-round grazing. Economic efficiency was determined by the actual costs of growing and selling 30-month-old foals for meat (Table 5) (according to the branch of KazAgroMarketing JSC in the Aktobe region) (Assanbayev et al., 2013).

Due to the high demand in the market for elite stallions of the Kushum breed, used as improvers in horse breeding farms, most of them are sold for breeding purposes in various regions of Kazakhstan. From 2006 to 2009, 82 heads of 2.5- and 3-year-old elite young animals of the Kushum breed were sold for breeding for 2645.2 thousand roubles, at a cost price of 770.0 thousand roubles. Net profit from the sale of Kushum young stock amounted to 1875.2 thousand roubles. The use of selection and genetic methods (selection and linebreeding) in horse herding can significantly increase the breeding and productive qualities of horses, without changing the technology of growth and management (Gurgul et al., 2019; Labitzke et al., 2013; Orlando, 2020).

TABLE 4 Average measurements and live weight of stallions and mares of the Kushum breed in comparison with the original group, M±m

		Measurements, cm					
				Circumference			
Groups	n	Height at withers	Oblique body length	Chest	Pastern	Live weight, kg	Mass index
Stallions							
Initial group, 1975	6	156.0 ± 1.71	161.3 ± 1.12	182.3 ± 3.12	20.6 + 0.01	508.3 ± 35.9	133.7
Current group, 2010	17	159.8 ± 0.49	164.0 ± 0.33	198.3 ± 0.83	20.7 ± 0.12	600.1 ± 5.9	146.3
Mares							
Initial group, 1975	183	150.5 ± 0.20	156.4 ± 0.27	178.9 ± 0.39	18.9 + 0.04	473.0 ± 2.29	140.1
Current group, 2010	187	154.8 ± 0.13	158.2 ± 0.16	186.8 ± 0.27	19.0 ± 0.02	517.3 ± 1.7	139.8

TABLE 5 Economic effectiveness of selling young horses of various lines

		Line			
Indicator	Units	Krepysh	Grom	Samotsvet	Non-line bred
The cost price for 1 head of 2.5 years.	thous. RUB	8.7	8.7	8.7	8.7
Live weight of 1 head	kg	455.2	449.7	453.2	386.5
Purchase price for 1 kg of live weight	RUB	67	67	67	67
Revenues from sales	thous. RUB	30.5	30.1	30.4	25.9
Profit	thous. RUB.	22.3	21.4	21.7	17.5
Profitability	%	256	251	249	198
Profit growth versus non-line bred	thous. RUB	4.8	3.9	4.2	–

4 | CONCLUSIONS

As a result of many years of scientifically grounded selection and breeding work with the Kushum horses with year-round grazing and linebreeding, highly productive stallion lines have been created for the first time: 118 Krepysh 33–64, 116 Grom 98–58 and a 134 Samotsvet 77–73 line. Representatives of these lines are distinguished by high live weight and good adaptive qualities: stallions of the Krepysh line—604.3 kg, mares—523.8 kg; the stallions of Grom line—600.2 kg and mares—520.1 kg; and the Samotsvet line, respectively: 581.0 and 515.3 kg. Work on the creation of new breeding lines was based on the rational alternation of related and unrelated mating. When creating the Krepysh breeding line, from the second generation of successors, moderate and moderately complex inbreeding was used, where good results were obtained in live weight (586.0–630.5 kg). Outbreeding stallions, as a result of successful crosses, also had a good body weight (573.2–588.3 kg). Moderate and distant close breeding, starting with great-great-grandchildren (563–606 kg) and outbreeding with the genealogical lines of stallions Zolotoy, Stroyniy (522–585 kg) and Krepysh's breeding line 33–64, also played a positive role in obtaining worthy successors of the Grom line. (562–585 kg). Sons, grandchildren and great-grandchildren of the created Samotsvet breeding line were obtained by outbreeding and are characterized by good live weight (557.5–582.5 kg). Further improvement of the breeding lines should be carried out along the path of consolidating the heredity of the remarkable successors of the ancestors

with the use of moderate and complex inbreeding and a sufficient level of genetic similarity.

In terms of the absolute weight of the carcass and the slaughter yield, both 18- and 30-month-old stallions of the Krepysh and Grom lines are characterized as animals of high meat productivity. Carcasses weighing 186.1 kg with a slaughter yield of 55.5% were obtained from 18-month-old stallions of the Krepysh line and 184.0 kg with 55.2% yield from the Grom line, respectively. With age, the carcass weight and slaughter yield increased to 238.0–234.5 kg and 57.6–57.3%, respectively. The daily milk productivity of mares of the Grom line is 15.6 litres, and of Krepysh—15.8 litres, and they are characterized as heavy milk producers (9 points). Adult stallions of the Krepysh line are large (160.6–164.2-199.0-20.8 cm and 604.3 kg), in terms of live weight they exceed the requirements of the elite class by 84.3 kg (16.2%). The modern composition of elite mares of the Krepysh line is distinguished by high indicators of measurements and live weight (155.0-158.6-187.8-19.1 cm and 523.8 kg) and in terms of live weight exceed the requirements of the elite class by 43.8 kg (9.1%). Elite stallions and mares of the Grom breeding line are also characterized by high measurement indicators and live weight: stallions are 158.8–163.8-197.8-20.6 cm and 600.2 kg, and in mares, respectively: 154.9-158.4-187.4-19.1 cm and 520.1 kg. Stallions and mares of the Grom's line in live weight exceed the requirements of the elite class by 80.2 kg (15.4%) and 40.1 kg (8.3%), respectively. Stallions and mares of the emerging Samotsvet line are characterized as animals of excellent growth (159.5–154.9 cm), elongated body (163.5–158.4 cm), good chest

circumference (195.6–186.3 cm) and pastern circumference (21.0–19.0 cm). In terms of live weight, they exceed the requirements of the elite class by 61.0 kg (11.7%) and 35.3 kg (7.3%), respectively.

The creation of new breeding lines contributed to an increase in the breeding and productive qualities of the breed, and the genetic improvement of the modern livestock in comparison with the original group (1975) is, respectively: by 3.8–2.7-16.0-0.1 cm and live weight by 91.8 kg (18.4%), and in mares, respectively: by 4.3–1.8-7.9-0.1 cm and live weight by 44.3 kg (9.4%), td = 15.8. The breeding of stallions is characterized by high economic efficiency. Profit from the sale of 30-month-old stallions for meat was higher in the Krepysh line by 24 thousand tenges (4.8 thousand roubles), in the Grom line, respectively, by 19.5 (3.9) and Samotsvet—21 thousand tenge (4.2 thousand roubles) in comparison with non-line bred. Production suggestions: in order to increase the productivity potential of horses of the Kushum breed, stallions of the Krepysh, Grom and Samotsvet lines should be used intensively; for purebred breeding of the Kushum horse, use moderate and complex inbreeding for an optimal level of homozygosity; for heterogeneous selections, it is preferable to use the following: inbred line crossing, bottom crossing and top crossing, which provide higher heterozygosity against the background of the accumulation of names of valuable ancestors in the bloodline; on the basis of new breeding lines, create highly productive breeding and intra-breed types of Kushum horses, distinguished by a massive body and good adaptability to year-round grazing.

AUTHOR CONTRIBUTIONS

To successful finishing the article creation, all of the authors equally contributed to the scientific process. T. S. Rzabayev's main goal was to conduct the practical part of the study and gain desirable results. T. Sh. Assanbayev worked on the systematization of the factual data that was gathered. Detailed analysis of the research results was entrusted to S. Rzabayev. A. Bazargaliyev contributed to the study as a describer of a new horse breed selection method, and K. S. Rzabayev searched for the theoretical basis and designed the article text.

CONFLICT OF INTEREST

None of the authors have any conflict of interest to declare.

DATA AVAILABILITY

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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