

Original Article

## Breeding and productive qualities of ducks of the local population in northern Kazakhstan

As qualidades reprodutivas e produtivas dos patos da população local no norte do Cazaquistão

M. Saginbayeva<sup>a</sup> , G. Temirbekova<sup>b</sup> , A. Nametov<sup>c</sup> , R. Sharipov<sup>d</sup>  and B. Aryn<sup>a</sup> 

<sup>a</sup>S. Seifullin Kazakh Agrotechnical University, Department of Technologies of Production and Processing of Livestock Products, Astana, Kazakhstan

<sup>b</sup>North Kazakhstan Scientific Research Institute of Agriculture, Petropavlovsk, Kazakhstan

<sup>c</sup>West Kazakhstan Agrarian and Technical University named after Zhangir Khan, Uralsk, Kazakhstan

<sup>d</sup>Union of Poultry Farmers of Kazakhstan, Astana, Kazakhstan

### Abstract

The production of duck meat in the republic was previously based on the use of 4-5 lines and populations of the Beijing breed, where the Medeo cross lines (M-1 paternal and M2-maternal) were the most widespread. At the same time, many domestic lines and populations, such as the cross "Bishkulskaia Tsvetnaya", "Kyzylzharsky", whose livestock is concentrated in the Northern region, represent rich genetic material and can be used to create new crosses. This article describes the productive and breeding qualities of ducks of the local population in the Northern region of Kazakhstan, the data obtained make it possible for further purposeful breeding work to create, preserve highly productive poultry, providing highly efficient production of eggs and meat, adapted to both industrial conditions and conditions of keeping in small-scale and farms. On the basis of "Bishkul Poultry Farm" LLP, we obtained results on the assessment of productive and breeding indicators of ducks of the local population.

**Keywords:** line, cross, ducks, productivity, breeding, reproductive qualities, fertilization.

### Resumo

A produção de carne de pato na república era anteriormente baseada no uso de 4 a 5 linhas e populações da raça de Pequim, onde as linhas de cruz Medeo (m-1 paterna e M2-materna) eram mais difundidas. No entanto, muitas linhas e populações domésticas, como cruz "Bishkul Color" e "Kyzylzharsky", cuja população está concentrada na região Norte, representam um rico material genético e podem ser utilizados em novos cruzamentos. Este artigo descreve as qualidades produtivas e reprodutivas dos patos da população local na região norte do Cazaquistão. Os dados obtidos permitem um trabalho de criação mais focado na criação e preservação de aves altamente produtivas, garantindo a produção altamente eficiente de ovos e carne, adaptada tanto às condições industriais quanto às condições de detenção em pequenas fazendas. Com base na "Bishkul avicultura LLP", obtivemos resultados relacionados à avaliação dos indicadores produtivos e reprodutivos dos patos da população local.

**Palavras-chave:** linha, cruz, patos, produtividade, seleção, qualidades reprodutivas, fecundação.

## 1. Introduction

Breeding work with poultry proceeds from the tasks of increasing the production of products, raw materials for industry and improving their quality in order to fully meet the growing material needs of the population.

The average annual production, trade and consumption of poultry meat in the world is growing rapidly. Currently, in the global poultry meat production, the bulk is accounted for by broiler meat – 62.5%, turkey – 7.5%, duck – 4.2%, goose – 2.8%, other poultry meat (chickens, quails, guinea fowl, pheasants) accounts for 23% (Kociš et al., 2003).

The increase in the production of eggs and meat is achieved both by the growth of livestock and by increasing the productivity of poultry. Moreover, the growth of livestock is advisable only if it is accompanied by an increase in egg production and an improvement in meat qualities. A steady increase in productivity is observed when using poultry with high inherited qualities.

Since duck meat production has become more intensive in recent decades, it is necessary to develop appropriate production systems to ensure proper conditions for

\*e-mail: makhabat.saginbayeva@bk.ru

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keeping ducks for the production of good quality meat (Chen et al., 2015).

Meat breeds of ducks are growing rapidly due to genetic selection, effective maintenance systems and rational feeding (Adeola, 2003).

Ducks are represented by an extensive gene pool of breeds, lines and populations, but their numbers are constantly decreasing, especially in our republic, where many populations and breed groups are on the verge of extinction.

Scientists have been solving the problem of preserving the gene pool of poultry for many years. It became especially acute with the transfer of poultry farming to an industrial basis, which led to the creation of highly productive specialized lines and crosses for the production of eggs and meat from limited genetic material (Alpeisov and Moldazhanov, 2002).

Industrial poultry farming is based on the use of poultry obtained as a result of crossing specialized combined lines. In order to have such lines from which parental forms can be obtained, a clear organization of the production of breeding products is necessary, and the methods and techniques of breeding work must correspond to the creation of forms of highly productive poultry for intensive conditions of its maintenance (Alpeisov et al., 2001).

In the process of continuous creation of new, more productive and cost-effective lines and crosses, the replacement of previously separated ones continues, which, like breeds and breed groups, need to be preserved. However, in recent years, the number of livestock has sharply decreased not only of small breeds and breed groups, but also of poultry that recently had industrial significance. In this regard, it is necessary to continue the reproduction of the flock of ducks of local populations.

Ducks are one of the fastest growing and most efficient producers of animal protein and can weigh more than 3 kg in 49 days of the fattening period.

Duck meat is becoming increasingly important in human nutrition around the world because of its high nutritional value. Compared to broiler meat, duck meat contains a higher percentage of protein and a lower percentage of fat and water, as well as a higher content of red muscle fibers in breast meat (Ali et al., 2007).

Duck meat has a high nutritional value. The chemical composition of the pectoral muscle is characterized by a high protein content (20.9–22.2%) and water (74.7–76.5%) and a low fat content (2.3–3.9%). The leg muscles of ducks contain slightly less water (72.5–75.1%) and protein (18.0–18.9%), but more fat (4.6–7.2%) than the chest muscles (Bernacki et al., 2006; Kokoszynski, 2011; Lukaszewicz et al., 2011).

In addition, duck meat is a good source of polyunsaturated fatty acids and has a favorable amino acid composition compared to meat of other animal species (Wolozyn et al., 2006). Duck meat is also useful for the prevention of diseases such as atherosclerosis or hypertension by inhibiting the formation of cholesterol and stimulating blood circulation in the body (Kang et al., 2006).

The full realization of the genetic potential of a bird is possible when environmental conditions are most favorable for its manifestation. In this regard, when creating and using

highly productive poultry, it is important to improve the technology of its cultivation and maintenance in parallel with improving feeding conditions.

The gene pool is a crucial basis for the formation of poultry breeds and a source of genetic resources for their improvement. It is proposed to create heterogeneous populations with the broad involvement of domestic breeds of breed groups, which would contribute to the formation of new lines based on valuable, sometimes rare useful qualities characteristic of populations, lines or even individuals, as well as the development of new methods of genetics and breeding, revealing the possibility of a significant increase in the desirable qualities of poultry (Moldazhanov, 1991).

For modern poultry farming, which is entirely based on the production of hybrid poultry based on the use of the effect of heterosis (overdomination), it is extremely important to create genetically distinct parental lines. This is quite difficult, especially in cases where the breeding material differs phenotypically little. The intensification of poultry farming has led to a wide spread of poultry belonging to a relatively limited number of breeds and crosses.

An important problem of genetics and breeding is the study of the interaction of genotype and environment, as well as some biochemical indicators with poultry productivity. The study of this issue will solve the problem of using poultry in different environmental conditions and predict its productivity (Murtazayeva and Skokov, 2003).

In meat poultry breeding, breeding work is aimed at increasing the yield of hatching eggs, their hatchability, and obtaining young animals with a high growth rate. To obtain highly productive industrial poultry of meat and egg directions, crossing of combined lines (interlinear hybridization) is more effective.

The signs characterizing the reproductive qualities of a bird relate to quantitative indicators and have a polygenic nature of inheritance. Due to their low heritability (0.01–0.20), direct selection for their improvement is ineffective even when using family or combined selection. Therefore, additional tests are used to select birds with the best reproductive qualities (for example, sexual behavior and activity of males, development of secondary sexual characteristics, physiological and biological indicators, etc.).

The main attention in the breeding of meat poultry is paid to the early growth rate, feed payment, the output of daily young to the laying hen of the parent herd, slaughter yield, the quality and composition of the carcass (reducing the proportion of abdominal fat). Selection only by growth rate is becoming less effective, therefore it should be carried out taking into account other productivity indicators, i.e. there is a need for multifactorial selection: by meat yield, carcass shape, egg laying hens of the parent herd, etc.

The continuous process of creating new, more productive, cost-effective lines and crosses continues to replace previously separated ones, which, like breeds and breed groups, need to be preserved. However, in recent years, not only has the number of small breeds and breed groups sharply decreased, but also birds that recently had industrial significance. Along with the reduction of their livestock, breeding work with them has stopped, although

many of them retain a certain breeding value for one or another characteristic of the economically useful qualities of the bird, and in the future can be used in breeding to create new crosses adapted to the conditions of industrial technology and for household farms of the population. The use of such uncompetitive crosses in crosses with newly created or commercially important lines will allow the creation of new parental forms and crosses, as well as heterogeneous populations, which, in turn, are the genetic source of the creation of new forms of poultry (Fisinin, 2000).

In Kazakhstan, there is insufficient data on the use of specific breeds, lines and crosses of waterfowl in production, their conditions of maintenance, feeding, breeding, etc. Almost all breeds, crosses and lines used in poultry farms are used arbitrarily without comparing economic efficiency and adaptability to local conditions.

Thus, scientists have long faced the task of not only preserving the numerous diversity of lines, breeds, populations, but also their rational use both for the production of eggs and meat, and in order to create new more highly productive forms and crosses.

In this regard, the results of this study are relevant and will be used to meet consumer demand for domestic breeding waterfowl adapted to the natural and climatic conditions of the region with a high growth rate and a lower fat content in the carcass at low feed costs per 1 kg of growth.

## 2. Material and Methods

The development of a methodological approach to the procedure and conditions for assessing the breeding value of ducks was carried out by conducting experiments and analyzing data on the productivity of ducks of the “Kyzylzharsky” and “Bishkul Tsvetnaya” crosses in the “Bishkul Poultry Farm” LLP of the Republic of Kazakhstan. The data on the evaluation of the breeding bird population of 4 thousand heads were analyzed. The objects of the study were the duck populations of the collection herd of this poultry farm.

The work with the bird of the breeding core was carried out by methods of family and combined breeding (family with an individual assessment of each individual). Males before landing in nests were evaluated by external indicators of the development of reproductive organs, while individuals with inflammatory processes, underdeveloped, with technical damage, etc. were culled.

In the selection and selection of producers, related mating is excluded, since the technology of cyclic selection is used. Evaluation of ducklings by live weight, meat forms of physique and exterior is carried out at 7 weeks of age. The selection of individuals by live weight is carried out according to the standard deviation of body weight from the average along the line in a particular batch. Drakes of paternal lines are selected with a live weight  $2\sigma$  or more above the average, females –  $0.5\sigma$  or higher. Drakes and ducks of maternal lines are selected with an average live weight and above. When selecting ducklings for further breeding purposes, the development of the pectoral and

leg muscles, the muscularity of the chest, the development of the keel and legs, the feathering of the back are also taken into account. A bird with exterior defects is culled.

Prior to the breeding season, a preliminary assessment and selection of drakes was carried out according to the quality of sperm production.

To assess the producers by the quality of offspring, at least 50 ducklings were taken from each drake, and at least 10 day-old ducklings from a duck. The assessment was carried out at 7 weeks of age according to the growth rate, meat forms of physique and viability during the growing period, feed costs per 1 kg of growth, yield and quality of feather and down (Davtyan et al., 2003).

The ducks of the baseline lines are evaluated up to 40 weeks of age - according to the indicators of maternal productivity (egg production and the percentage of output for the first cycle of egg production) and according to their own indicators (live weight and safety up to 7 weeks of age and from 7 to 24 weeks of age). At 40 weeks of age and older - according to egg production and the percentage of withdrawal for the first 6 months of the egg production cycle, live weight and safety at 7 weeks of age.

Incubation eggs for laying were selected and incubated in the incubator “IF-4000-U-MEL”. All technological parameters of incubation corresponded to the generally accepted methods developed by VNITIP. Heating, ventilation, cooling, alarm systems worked steadily (Dyadichkina et al., 2014).

After the eggs were delivered to the incubation shop, they were sorted and selected in the sorting hall. Calibration was performed manually using laboratory scales. The purity and condition of the eggshells were determined visually. The size and location of the air chamber, the condition of the yolk, the integrity of the hailstones, the presence of various inclusions and the integrity of the shell, its condition (marbling) were checked by X-ray on an ovoscope (Amantai et al., 2018; Tsarenko, 2016). The ratio of the components of the eggs was determined by opening with further calculation of the index of protein, yolk, units of How from each batch (Figure 1).

The main control method was ovoscopy of eggs with their subsequent opening, which was carried out once before laying in the incubator and three times throughout the incubation period on days 8, 13 and 25 (Krivopishin, 1997; Sergeeva, 2001). At the same time, the intensity of growth and development of embryos and extra-embryonic membranes, the degree of use of nutrients by embryos (mainly protein), their readiness for hatching and hatchability of eggs were taken into account, with the explanation of the causes of embryo mortality according to generally accepted methods of VNITIP (Lukashenko et al., 2015).

## 3. Results and Discussion

In the course of the study, the selection of repair young ducks of the “Kyzylzharsky” (KJ) and “Bishkul color” (BC) cross was carried out, manning in breeding nests, with a sex ratio of 1:4 (Figure 2).

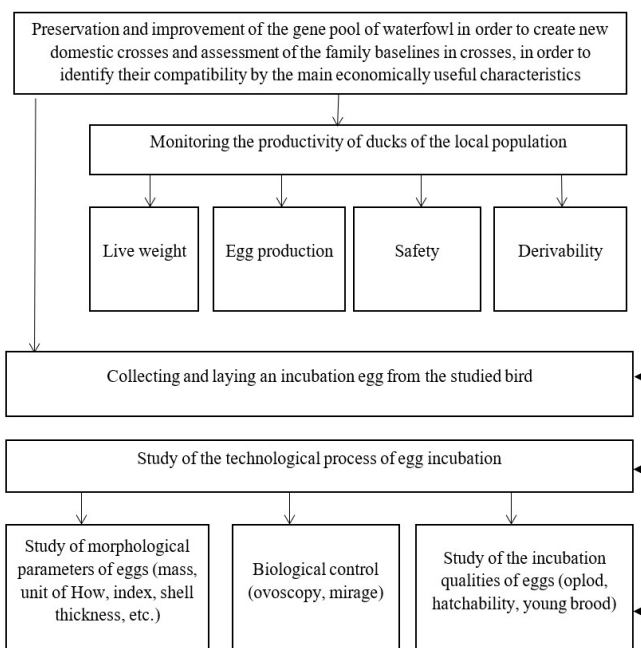


Figure 1. Research scheme.



Figure 2. Ducks of the “Kyzylzharsky” (KJ) and “Bishkul color” (BC) crosses.

The cross of the Kyzylzharsky ducks (K12) is represented by the paternal (K1) and maternal (K2) lines of the Peking duck breed: the paternal line “K1”, created on the basis of the gene pool of the ducks of the M-1 line of the Medeo cross, is a pronounced meat type in appearance and constitution. The maternal line K2, bred using the gene pool of ducks of the M-2 line of the Medeo cross, has good meat forms, but less pronounced in comparison with the K1 line. Ducks of the K2 line are well combined with the paternal K1 line according to the main economically useful signs (Table 1).

As a result of the individual weighing of ducks and drakes before the breeding season, it was shown that the average weight of adult ducks of the BC cross averaged 3386 g, the average weight of adult ducks of the KJ cross averaged 3251 g, significant differences between the live weight of ducks were insignificant and amounted to 3.99%.

In general, the zootechnical indicators of ducks of both crosses before the breeding season corresponded to the declared standards.

The breeding program for ducks of the “Kyzylzharsky” and “Bishkul color” crosses included an individual assessment of the breeding and productive qualities of the bird. Increasing the fecundity of poultry by directly including additional traits in the breeding program that determine the reproductive qualities of ducks, while individuals from the best families and families that combine high fecundity and the growth rate of young animals at an early age were selected.

The selection of the bird according to the selected characteristics was carried out without the use of related mating. Such an approach to breeding lines can significantly increase the fecundity of poultry, reduce feed costs for products, improve or maintain the achieved level of live

**Table 1.** Indicators of productivity of ducks of parental forms of crosses “Kyzylzharsky” (KJ) and “Bishkul color” (BC).

Indicator	Crosses	
	«KJ»	«BC»
Egg production for the initial laying hen for 40 weeks, pcs.	185±12.01	190±10.9
Average egg weight, g	69.7±0.80	65.3±0.63
Safety of adult ducks,%	96	95
Hatching eggs yield,%	93	95
Fertilization of eggs, %	86	87
Withdrawal of ducklings,%	70	66
Live weight of ducks in 7 weeks, kg	3251±407.7	3386±311.2
Safety of ducklings per day, %	85	70
Exit ducklings from the parent pair, head	140	130

weight of ducklings at 7 weeks of age, which ultimately increases the yield per laying hen of the parent herd and reduces its cost.

Young animals for the reproduction of the herd were taken away from ducks not younger than 9 months of age.

In order to carry out targeted rearing of young animals, control over the growth and development of young animals was carried out (Table 2). An important indicator characterizing the growth and development of birds is the change in their live weight. Broiler ducklings are characterized by a low obesity of carcasses and a higher muscle yield, as well as a higher meat yield per laying duck.

The live weight and growth dynamics of young animals aged 1-7 weeks were determined by weekly, individual weighing of the entire livestock.

Weighing of young animals at 7 weeks of age showed that the average weight of ducklings of the “Bishkul color” cross was 3231.8 g, and the average weight of the “Kyzylzharsky” cross was 3291.3 g, with a difference of 1.8%.

In the course of the conducted studies, the productive indicators of ducks of the “Bishkul color” cross and the “Kyzylzharsky” cross for an incomplete productive period (40 weeks of life), presented in Table 3, were studied.

Comparing the productive qualities of both crosses, it should be noted that the parent forms of the “Bishkul color” cross significantly exceeded similar indicators of the “Kyzylzharsky” cross. The cross of ducks “Bishkul tsvetnaya” surpassed the bird of the cross “Kyzylzharsky” in the productivity of broiler ducklings. However, the qualitative indicators of the ducks of the Kyzylzharsky cross, such as muscle output, were approximately at the same level, but the obesity of the carcass was 2.9% higher (Figure 3).

An objective indicator of the quality of eggs is the height of a dense layer of protein and yolk. Protein, yolk and shell perform a number of important functions in the development of the embryo and are characterized by different chemical composition and nutrient content (Table 4).

The results of morphological analysis of an incubation egg collected from a breeding herd indicate that the quality

**Table 2.** Dynamics of live weight of ducklings, g.

Age, days	Crosses	
	«KJ»	«BC»
daily ducklings	51±2.7	49.9±2.88
7	298.6±58.5	280.7±47.8
14	601.2±85.7	598.7±77.1
21	1312.2±163.2	1229.6±184.3
28	1720.4±261.3	1724.9±312.1
35	2340.7±485.6	2201.8±469.3
42	2783.1±596.4	2699.1±610.4
49	3291.3±742.8	3231.8±649.5

**Table 3.** Indicators of laying ducks for the first period of productivity.

Indicators	Crosses	
	«KJ»	«BC»
Egg laying per laying hen for 40 weeks, pcs.	191.2	201.5
Hatching eggs yield,%	94.6	97.2
The safety of an adult bird,%	97.3	96.8
The withdrawal of young animals, %	69.7	80.3
Exit ducklings on a laying hen, goal.	108.3	157.2
Safety of ducklings for a period of 0-7 weeks,%	96.7	97.4
Live weight of ducklings at 7 weeks, kg	3.3	3.35
Obesity of the carcass,%	35.2	31.8
Total muscle output, %	46.7	46.9
The output of the chest muscles,%	14.7	14.6
The output of the leg muscles,%	14.1	14.4
Feather-down output,%	4.3	4.5

indicators of duck eggs were in the norm, but there were some differences between the crosses. Thus, the average weight of eggs from the Kyzylzharsky cross in comparison with the Bishkek Tsvetnaya cross was 6.3% larger, in terms of protein index by 14.6%, yolk index by 22.5%, in terms of protein height by 6.5% and Hau units by 6.1%, respectively; only in terms of shell thickness a difference of 11.1% higher was observed., than in eggs from the “Bishkul color” cross, respectively.

The laying of eggs was carried out in a pre-prepared, tested and put into operation incubator, so that the selection of young animals and work with them fell in the morning hours.

During incubation, biological quality control of eggs was carried out (Figure 4). The main method of control was ovoscopy of eggs with their subsequent opening of embryos (Bondarev, 2001; Dyadichkina and Antonova, 2007).

When the eggs were screened on the ovoscope, an egg with hidden defects was rejected, such as notches, marbling or mottling of the shell; blood inclusions; "krasyuk" (when the yolk is mixed with protein); incorrect location and large size of the air chamber. Eggs with a displaced air chamber to the side or to the sharp end of the egg were also culled (Table 5).

The results of ovoscopy and culling of eggs of the Kyzylzharsky cross at the first screening on day 8, the developing embryo was poorly distinguishable because it was immersed in the yolk, but the vascular system of the yolk sac was well developed and filled with blood (the dead embryos amounted to 1.1%).

At the second viewing on the 13th day of the eggs, the embryo is distinguishable as a dark spot in the center of the egg, and under the shell is allantois (the number of dead embryos is 2.1%). The egg mesh of vessels that were not visible and with too large an air chamber were rejected.



Figure 3. Breeding flock of ducks of the "Bishkul color" cross.

At the third screening on day 25, the contents of the egg are dark, the border of the air chamber is tortuous and the moving shadow of the head and neck of the duckling located near the shell is visible in it (the percentage of embryo death was 3.2%).

Table 4. Morphological analysis of eggs (n=10).

Indicators	Crosses	
	«KJ»	«KJ»
Average egg weight	69.7±0.80	65.3±0.63
Protein Index	0.089±0.04	0.076±0.07
Yolk index	0.403±1.0	0.312±1.12
Protein height, mm	7.64±0.05	7.14±0.08
How Units	82±1.91	77±1.24
Shell thickness, mm	0.36±0.01	0.4±0.06
The ratio of protein mass to yolk mass	1.374	1.228

Table 5. Results of ovoscopy and culling of eggs of "Kyzylzharsky" and "Bishkul color" crosses.

Indicators	Crosses	
	«KJ»	«BC»
Marriage, %	21.8	23.7
including:	13.6	12.9
unfertilized	1.1	1.2
blood ring	2.1	3.9
frozen	3.2	4.5
suffocating	1.5	0.8
tumans	0.3	0.4
cripples	85	70

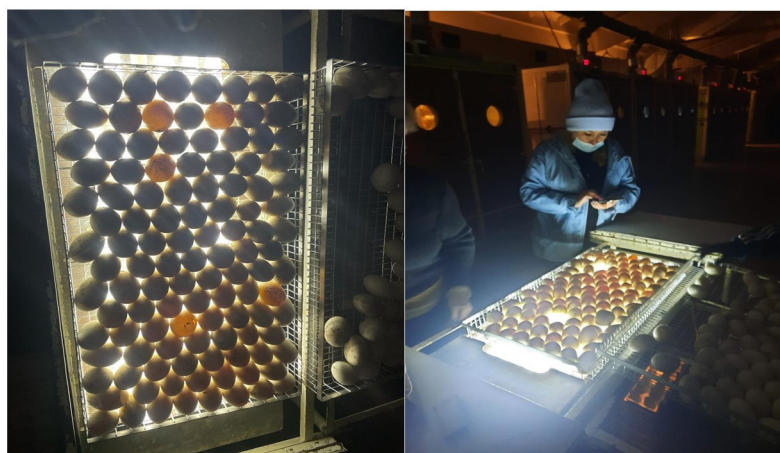


Figure 4. Ovoscopy of duck eggs.



Figure 5. Blood ring.



Figure 6. Frozen embryo.

At the first translucence on the 8th day of the eggs of the “Bishkul colored” cross, the allantois grows intensively and reaches the head of the embryo. The amnion cavity is enlarged and filled with fluid. During this period, the number of dead embryos was 1.15% (Figures 5 and 6).

At the second viewing on the 13th day of the eggs, distinguishable outlines of the embryo were observed. Eggs whose vascular mesh was not visible and with too large an air chamber were rejected (the number of dead embryos was 3.9%).

At the third X-ray on day 25, it was noted that the contents of the egg are dark, the border of the air chamber is winding and a moving shadow of the head and neck of the duckling located near the shell is visible in it. The yolk sac with its contents is drawn into the abdominal cavity. During rejection, the percentage of embryo death was 4.5%.

According to the results of incubation (Table 6), the average weight of laid eggs of the “Kyzylzharsky” cross lines ranged from 69.7 g, and the average weight of eggs of the “Bishkul color” cross was 65.3 g.

Table 6. Results of incubation of eggs of “Kyzylzharsky” and “Bishkul color” crosses.

Indicators	Crosses	
	«KJ»	«KJ»
Laid eggs for incubation, pcs.	300	300
Average weight of eggs, g	69.7	65.3
Fertilization of eggs, %	86.4	87.1
pcs.	259	261
Hatchability of eggs, %	88.9	87.9
Withdrawal of young animals, %	86.9	80.2
heads	261	240
The withdrawal of young animals, %	85	70

It should be noted that the fertilization of eggs of both crosses is quite high. The minimum index of 86.4% was obtained in the cross “Kyzylzharsky” with a sex ratio of 1:4.5, the maximum 87.1% in the “Bishkul color” - at 1:4. A good hatchling of 86.9% was observed in ducklings of the Kyzylzharsky cross, which further contributed to a higher safety of the young.

As a result of a control check of the fertilizing ability of drakes and the identification of promising drakes and the laying of ancestral lines, the first selection of drakes was carried out at the age of 7 weeks; the second - during puberty; the third - before use. When testing producers on the quality of offspring, the sex ratio was 1:20. The results of the analysis of the evaluation of the quality of sperm production and the control laying of incubation eggs for fertilization showed that the bird is well prepared for breeding nests.

The fertilizing ability of drakes and the replacement of the worst in terms of reserve indicators were studied (the percentage of replacement of drakes was – 4%).

For the acquisition and laying of ancestral lines, the best live weight in 7 weeks were selected, young animals received from parents tested for productivity during the first biological period of egg production.

Such an approach to breeding lines can significantly increase the fecundity of poultry, reduce feed costs for products, improve and maintain the achieved level of live weight of ducklings at 7 weeks of age, which ultimately increases the yield of products per laying hen of the parent herd and reduces its cost.

#### 4. Conclusions

The use of the gene pool of domestic bird breeds in breeding work, the preservation of rare and endangered populations is of particular importance, due to their high adaptive properties in terms of quality and quantity of products, and their adaptability to local forage and ecological and climatic conditions.

Analysis of data on breeding, productive and reproductive qualities of the “Kyzylzharsky” and “Bishkul

color” crosses, determined by such indicators as live weight, egg laying of laying ducks, hatching eggs yield, their quality (fertilization and hatchability of ducklings), the safety of young animals and the results of biological control are necessary for further research and determination of the effectiveness of breeding works with crosses of the collection herd of “Bishkul poultry Farm” LLP.

In this regard, it is necessary to evaluate the compatibility lines annually at the poultry farm, and the resulting young animals should be evaluated by the conclusion, live weight, meat qualities of carcasses, safety, feed costs per 1 kg of gain, meat yield per one laying duck of the maternal parent form for further targeted breeding work.

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