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Impact of scheme selection for parental pairs onto weight growth formation and Hereford calves' body type.

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ABSTRACT

Into Russian population of Hereford can distinguish three large exterior-constitutional groups: a compact, medium (intermediate), and tall type. The research aim was studying the impact of selection scheme for parental pairs, taking into account the body type onto weight' growth formation of Hereford' calves. The experimental groups were completed from descendants depending on scheme selection for parental pairs: group I was made up of the sons of compact bulls and tall cows (II), group II - from the sons of tall bulls and compact cows, III group was obtained with homogeneous selection of tall parents (IV), IV group - with homogeneous selection of compact parents. Assessment of the type of build-up of bulls-producers, cows, and young animals was carried out according to the size of the measurement of height in the sacrum. A significant advantage of bull calves from the homogeneous selection of tall parents in 18 months of age is established over all groups of peers. In order to achieve maximum progress in the productive qualities of the Hereford breed, the selection for the intensity of weight growth must be supplemented with an assessment of the type of constitution of the animals.

Keywords: Hereford breed, selection scheme, body type, living mass.

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INTRODUCTION

Meat cattle breeding in Russia is based, mainly, on the breeding of 4 breeds of cattle: Aberdeen-Angus, Kalmyk, Hereford and Kazakh white-headed. Thus Hereford breed occupies 15% of the total livestock of purebred beef cattle [1, 2]. Selection and breeding work is supervised by the National Association of breeders of Hereford cattle (National association of Hereford cattle breeders).

Recently, the Hereford breed in Russia is strongly influenced by a tribal material of imported origin, mainly from Canada. Intensive use in the reproduction of a herd of deep-frozen sperm with artificial insemination, transplantation of embryos from animal leaders of the world gene pool contributed to the enlargement of the exteriors and increase the massiveness of the domestic population of Hereford cattle [3, 4]. These intraparticle transformations became possible due to the multidirectional selection process in the domestic and foreign practice of beef cattle breeding. For a long time in Russia, the priority in breeding programs was the creation of early-ripening types of beef cattle, which subsequently led to the formation of compact small animals, with a barrel-shaped body. Young growth of a compact type of Hereford cattle shows a high growth rate for a short period of time. It is characterized by an early period of intense fat loss, which leads to inefficient consumption of feed. Hereford high-growth type is characterized by long growth, i.e. the ability to maintain the high growth of live weight for a long time, mainly due to muscle tissue [5].

Thus, at the present stage of selection-breeding work with the Hereford breed of cattle in Russia, a reorientation towards increasing the tallness and long stature of animals are observed. As a result of a purposeful in-breed selection, 2 enlarged types were created: The Ural Hereford and Dmitrievsky [6, 7].

MATERIALS AND METHODS

The research was carried out in Ltd «Kalininskaya Agrofirma», Chelyabinsk Region, Russia. The subject of the study were purebred Hereford bullheads. The experimental groups were recruited from descendants depending on the scheme of selection of parental pairs: group I (n = 30 heads) was made up of the sons of compact bulls and tall cows (II), group II (n = 30 animals) from sons of tall bulls and compact cows VK), III group (n = 32 heads) was obtained with a homogeneous selection of taller parents (IV), IV group (n = 31) with homogeneous selection of compact parents.

In the distribution of bulls-producers, cows, and bull-calves according to the type of physique, the height in the sacrum (Table 1) was guided by the size "according to the instruction" Procedure and conditions for carrying out bonitizing of breeding cattle meat direction of productivity "(M., 2012) [8].

Table 1: Scale of estimation of Hereford cattle by body type

Group	Body type		
	Compact	Medium	Tall
Bulls-producers	135≤ *h*	135<*h*<140	*h*≥140
Cows	130≤ *h*	130<*h*<135	*h*≥135
Bulls	119≤ *h*	119<*h*<125	*h*≥125

Note: *h* - height in the sacrum, cm

The young animals were withdrawn from their mothers at the age of 205 days. After weaning, the bull-calves were transferred to a testing station, where they were kept in small groups in separate sections. Feeding was carried out on the foraging-fodder yards. The level of feeding was the same for all groups of animals.

Growth and development of experimental bull-calves were studied according to the monthly weighings, on the basis of which the average daily gain was determined. An assessment of the type of the young body was carried out at the age of 15 months with the removal of animals from the test of their own productivity.

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The influence of the scheme of selection of parents of different types of physique on the development of weight growth and the type of the structure of offspring was studied by dispersion analysis using the ANOVA procedure of Statistica 10.0 program according to the following model:

$$Y_{ij} = \mu + A_i + B_j + (AB)_{ij} + e_{ij}$$

Y_{ij} – value of the analyzed indicator,
μ - population value,
A_i – effect of i father body type (1, 2),
B_j – effect of j mother body type (1, 2),
$(AB)_{ij}$ – interaction father×mother
e_{ij} – random error.

The reliability of the intergroup differences was assessed by the Tukey test.

RESULTS

Studies have shown that the weight growth of bull-calves is largely due to the results of the selection of parental pairs. Thus, at the time of birth, young growth from tall parents with homogeneous selection exceeded the live weight of peers from other groups (Table 2).

Table 2: Live weight dynamics of calves Hereford by different variants of selection, kg (X±Sx)

Age of months	Selection option			
	I	II	III	IV
At birth	28,6±0,64^{bc}	29,7±0,59^{ab}	31,2±0,61^{a}	27,1±0,41^{c}
8 months	223,2±4,67^{b}	231,4±4,52^{ab}	242,6±4,98^{a}	219,1±4,04^{b}
12 months	342,3±8,98^{b}	359,4±6,05^{ab}	371,2±7,61^{a}	339,6±4,89^{b}
15 months	412,5±10,28^{b}	431,0±5,71^{b}	468,4±9,18^{a}	404,6±6,50^{b}
18 months	469,3±10,66^{c}	504,2±7,03^{b}	551,6±9,41^{a}	468,3±7,75^{c}

Note: $^{a, b, c}$ the values in a row with different indices differ with reliability (P <0.05).

The maximum advantage was established over descendants of compact parents - 4.1 kg (15.13%, P <0.001). The descendants obtained with a heterogeneous selection of pairs were inferior to calves from Group III by 1.5-2.6 kg (4.81-8.33%, P> 0.05, P <0.01). And among the heterogeneous groups, the sons of tall fathers were larger than the peers from compact bulls by 1.1 kg (3.85%, P> 0.05).

By the time of weaning (8 months) the descendants of tall bulls (II and III group), obtained both with a homogeneous and heterogeneous selection, increased their advantage over peers from compact fathers. A parent pair of tall body type is capable of producing heavier calves by 19.5-23.5 kg (8.74-10.73%, P <0.01-0.05) by the age of 8 months, in contrast to compact animals and when pairing compact fathers with tall mothers. The combined genotype using tall bulls by the age of 8 also exceeded the genotypes of Groups I and IV by 8.3-12.1 kg (3.72-5.61%, P> 0.05). At the same time, a minimal weaning live mass characterized offspring from compact ancestors.

Differences in the body weight of bull-calves became even more significant by the age of 1 year. The difference between the extreme variants of homogeneous selection reached 31.2 kg (9.19%, P <0.05) in favor of descendants of the tall parent couple. Among the heterogeneous groups of experimental young, leadership was established for sons from compact mothers and tall fathers with an advantage of 17.1 kg (5.00%; P> 0.05).

As a result of the custom pairing of parents of a compact body type, the lightest animals were obtained by the end of the test period for their own productivity (15 months). They were inferior to all groups of youngsters of different variants of selection by 7.9-63.8 kg (1.92-13.62%, P> 0.05, P <0.001). The maximum weight gain was recorded in the group of offspring from the homogeneous selection of tall animals - 468.4 kg.

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By the end of the period of control growing (18 months), the rank of the distribution of live weight of bull-calves from different variants of selection has been preserved. The significant advantage of bulls from a homogeneous selection of tall parents was established over all groups of peers - 47.4-83.3 kg (9.40-17.79%, P <0.01-0.001). It should be noted that the live weight of sons from compact fathers only at this stage reached the level of weight growth, shown by the offspring of tall parents at the previous stage of control (15 months), after 3 months of cultivation.

Sons of tall fathers at all periods of weight growth control were significantly (P <0.01-0.001) superior to the descendants of compact bulls-producers (Table 3). At the same time, the advantage increased both in absolute indicators and in relative indicators. The maximum superiority of the sons of tall fathers reached at the age of 18 months - 55.0 kg (11.73%, P <0.001).

Table 3: Live weight dynamics of calves Hereford from parents of different body types, kg (X±Sx)

Age of months	Progeny	
	FatherC(*n*=61)	Father V(*n*=62)
At birth	27,8±0,39	30,4±0,43***
8 months	221,1±3,06	237,1±3,43**
12 months	340,9±5,03	365,3±4,91**
15 months	408,5±6,01	452,0±6,26***
18 months	468,8±6,50	523,8±7,74***
	MotherC(*n*=61)	MotherV(*n*=62)
At birth	28,3±0,39	29,9±0,47*
8 months	225,1±3,10	233,2±3,61
12 months	349,3±4,05	357,0±6,09
15 months	419,3±5,22	441,4±7,69*
18 months	484,3±6,11	508,6±9,20*

Note: the reliability of the difference: * - P<0,05, ** - P<0,01, *** - P<0,001

A tall cow phenotype also contributed to better offspring development. However, the maternal effect on the live weight of the sons was less pronounced (P> 0.05, P <0.05). The greatest advantage of bull calves from tall mothers was shown at 18 months of age - 24.3 kg (5.02%, P <0.05).

Influence of the type of the physique of the father on the variability of the live weight of the offspring is significant (P <0.001) at all stages of the measurement (Table 4). At the same time, the ex-terrier of the bull exerts a minimal impact (8.90-8.91%) on the weight growth of the sons in the period of 8-12 months. The maximum variability of the live weight of the bull-calves was determined by the father type at the end of the control culture (19.10%, P <0.001).

Table 4: Impact of factors of father, mother and their interaction onto variability of the live weight of sons,%

Age of months	n (head)	Factor		
		Father	Mother	Interaction Father×Mother
Atbirth	123	14,24***	4,73**	0,00
8 months	123	8,91***	2,07	0,45
12 months	123	8,90***	0,76	0,29
15 months	123	16,68***	3,99*	1,54
18 months	123	19,10***	3,35*	3,05*

Note: the reliability of the difference: * - P<0,05, ** - P<0,01, *** - P<0,001

The effect of the mother phenotype on the variability of the weight gain of the sons is less, determining 0,76-4,73% of the total variability of the trait. The minimum effect of cows on the live weight of the offspring was fixed at one-year-old age (0.76%, P> 0.05), which was further intensified to 3.35-3.99% (P <0.05). However, the maximum maternal effect is established on the live weight of newborns (P <0.01).

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The type of the physique of the parents affected the expression of this parameter in the offspring (Figures 1, 2). At the same time, tall fathers differed in high prepotency regardless of the phenotype of mothers participating in the selection. So, from tall bulls-producers, 86.7% of descendants were obtained, in height in the sacrum corresponding to the requirements of a high type of physique. At the same time, only 18.0% of sons were met from compact fathers whose measurements corresponded to the specified standard. The main mass (57.4%) of bull calves from bulls-producers of compact body type belonged to an intermediate phenotype.

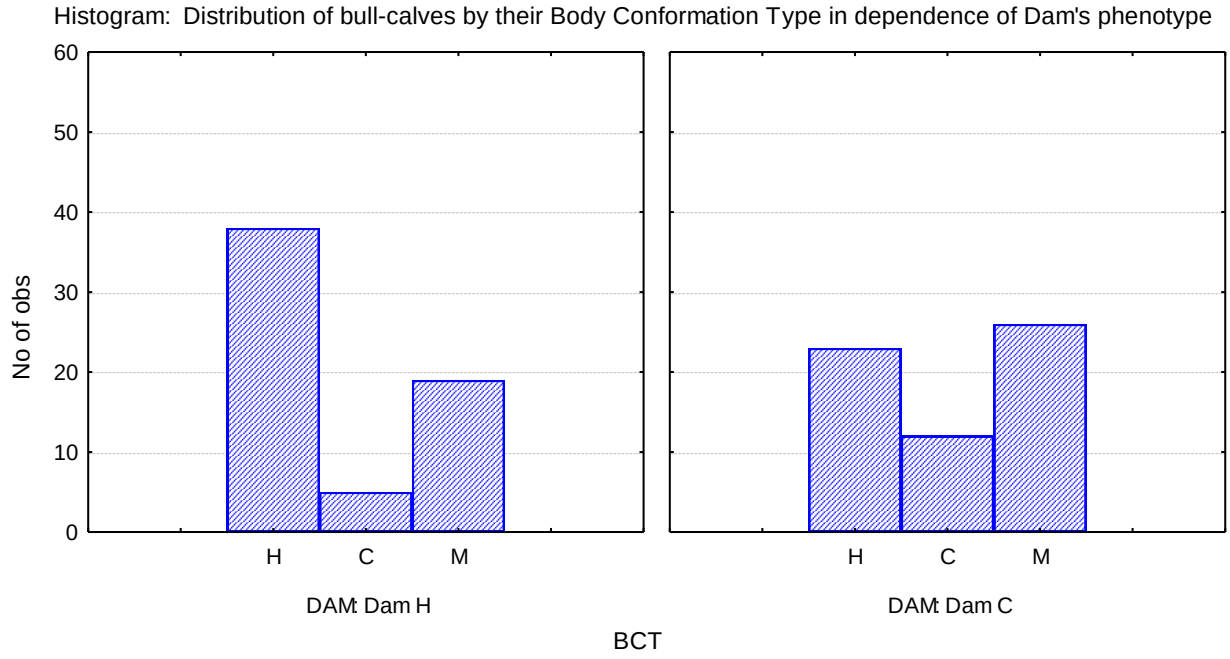

Figure 1: Distribution of gobies by body type, depending on the phenotype of mothers
Note: Dam H and Dam C are mothers of tall and compact body types, respectively; H, C, M - offspring of tall, compact and average body types; No of obs - number of observations

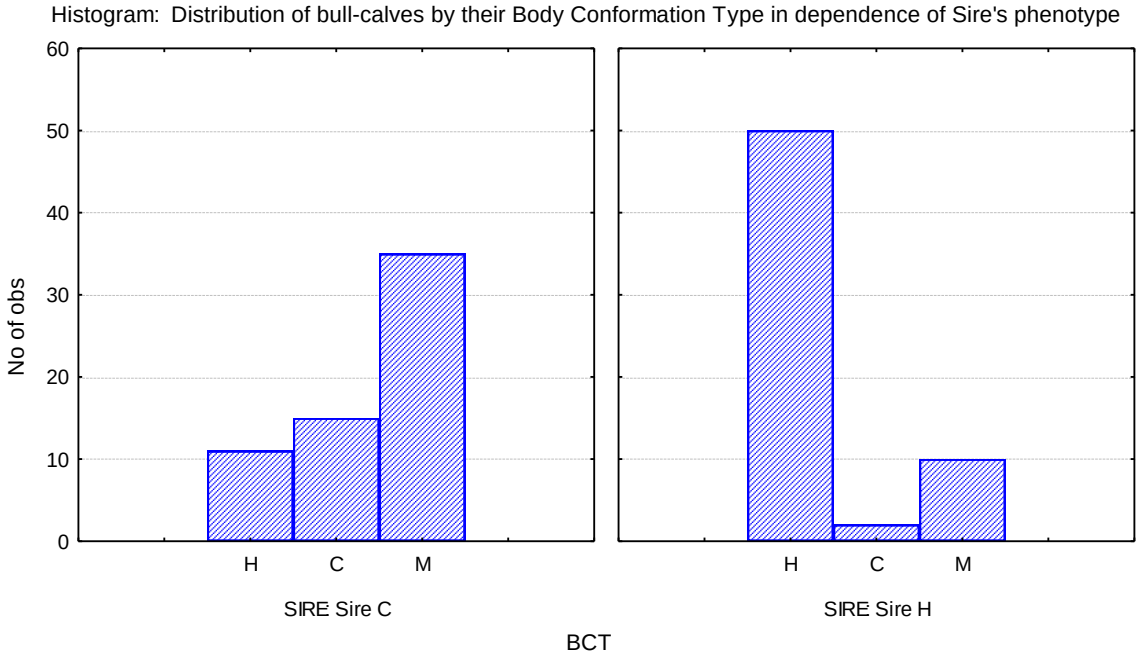

Figure2: Distribution of gobies by body type, depending on the phenotype of fathers
Note: Sire H and Sire C are fathers of tall and compact body types, respectively; H, C, M - offspring of tall, compact and average body types; No of obs - number of observations

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When analyzing the distribution of experimental bulls on the exterior, it is established that the type of physique of mothers to a lesser extent determines the severity of the trait in descendants. So, only 61.3% of the sons of tall cows echoed their external assessment. And among the bulls obtained from compact mothers, the distribution by body type was observed in the following proportion: tall type - 37.7%, middle type - 42.6%, compact type - 19.7%.

The scheme of selection of parental pairs significantly determined the severity of the type of physique of the offspring (Figure 3). As a result of homogeneous selection of tall parents, 87.5% of sons inherited their body type.

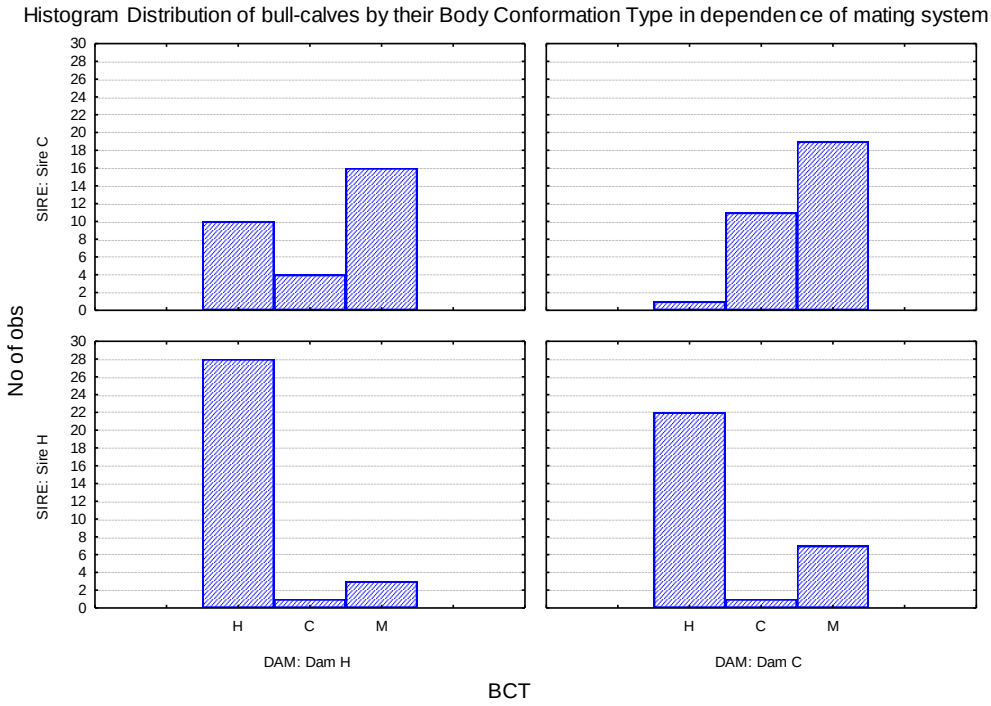

Figure 3: Distribution of calves by body type depending on the scheme selection for parental pairs
Note: Dam H and Dam C are mothers of tall and compact body types, respectively; Sire H and Sire C are fathers of tall and compact body types, respectively; H, C, M - offspring of tall, compact and average body types; No of obs - number of observations

On the contrary, only 3.3% of tall sons were obtained from a homogeneous selection of compact parents, and 63.3% of descendants met the requirements for an average body type. The heterogeneous scheme of selecting tall bulls to compact cows contributed to the reduction of the number of tall sons (up to 73.3%) in favor of developing an average phenotype (23.3%).

DISCUSSION

Intra-breed variability of Hereford cattle as a body type is an important tool in improving the breed [9]. In the population of Hereford Russia, there are 3 large exterior-constitutional groups of animals: compact, medium (intermediate) and tall types. In this case, the differentiation of beef cattle according to the types of physique is carried out on the basis of a scoring score, depending on the height measurement in the sacrum [10]. In accordance with the current instruction in Russia, a 5-point system for evaluating the type of physique of all sex and age groups of animals has been adopted [8]. In our research on the selection of parental pairs, we used cows and bulls-producers of two contrasting exterior-constitutional phenotypes: compact and tall. Height in the sacrum of tall cows was higher than 135 cm, bulls - 140 cm. The linear measurement of compact animals did not exceed 130 cm for cows and 135 cm for bulls-producers. As a result of different schemes for selecting parental pairs, bull-calves were obtained, differing in their physique-type expression, which was evaluated at 15 months of age when animals were removed from the test of their own productivity. Thus, the average height in the rump of bull-calves from the homogeneous selection of tall parents was 128.8 ± 0.67 cm,

which exceeded the indicator of the sons of compact parents by 8.7 cm (7.24%, P <0.001). Among the offspring of the heterogeneous selection of parental pairs, the maximum height in the sacrum was distinguished by the sons of tall fathers (126.5 ± 0.58 cm), which exceeded the peers by 3.6 cm (2.93%, P <0.001).

The scheme of selection of parental pairs in meat cattle breeding has a strong influence on the weight and linear growth of offspring, which significantly determines the economic efficiency of the industry [16]. At the same time, Kolstad [17] found that heterogeneous selection has a significant potential for increasing the productivity of beef cattle. According to our data, the combination of different schemes for selecting parental pairs, taking into account the severity of their body type, is a real tool for modifying meat herds in the desired direction. Use in reproduction of a herd of bulls-producers of tall body type can increase the size of the live weight of sons in the 18-month-old age by 55.0 kg (11.73%, P <0.001). While the selection of cows with a large format of the exterior for the reproduction of the herd makes it possible to obtain offspring at 24.3 kg (5.02%, P <0.05) more massive than compact mothers. Experiments carried out in the Hereford teens under various content systems also show that the daughters of tall fathers, regardless of the cultivation technology, surpassed offspring from compact and medium-sized bulls-producers in terms of live weight, growth intensity and height in the sacrum [18].

CONCLUSION

The scheme of selection of parental pairs, taking into account the type of physique of animals, has a significant influence on the weight growth of Hereford bulls. Homogeneous selection of tall parents allows you to get the most massive sons. Progeny from a parent couple of compact body type with minimal live weight and height in the sacrum. The variability of the live weight of the bull-calves was determined to a greater extent by the type of the physique of the father, which reached 19.10% (P <0.001) of the sum of all the active factors. Thus, in order to achieve the maximum progress in the productive qualities in the Hereford breeds, selection by growth intensity must be supplemented by an assessment of the type of constitution of the animals.

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