

Conference Paper

Relative Variability in Signs of Reproductive Fitness of Pigs

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Studies of relative variability make it possible to forecast the future. The equations of rectilinear and multiple regression make it possible to determine a productive indicator by indirectly evaluating correlatively related features. We developed mathematical model on the relative variability in the signs of reproductive fitness of pigs in the breeding factories of the North Caucasus: “Ventsy-Zarya”, “Gulkevichsky”, “Kavkaz” and “Zarya” of the Krasnodar Territory, “Rossiya” of the Stavropol Territory, and “Rossiya” of the Rostov region. We analyzed the correlations of reproductive fitness in these breeding farms to determine a reliable and objective assessment of cause-and-effect dependencies, and the values, nature and direction of their action. Significant differences were established between the nature of relations in various breeding farms; however, their action vectors coincided. The models we developed take into account all of the processes occurring in the population under the influence of tribal selection and can be used in the planning of breeding measures.

Keywords: pig breeding, relative variability, correlation, regression, breeding index.

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1. Introduction

Correlative variability manifests itself in the process of development of the organism, acting in the form of correlation pleiades (signs associated with each other). The influence of external conditions can make significant adjustments to the correlative variability. In some cases, the creation of new lines, types and breeds of animals requires a break, a violation of the correlative antagonistic (according to Anker) connections [1–4]. This can be achieved through systematic breeding. The relevance of the study of correlative variability does not decrease, but remains in demand due to the need to develop

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specialized animal lines suitable for breeding and exploitation in intensive technology [5–9].

Knowledge of correlation relationships within lines and populations allows for the control of the selection process. For instance, N.K. Belyaev in his work “The Problem of Genetics and Breeding of the Silkworm” (Tiflis, 1936) noted that “conducting selection by simple mechanical selection of the phenotypically best individuals in the line, according to the once outlined scheme, without taking into account hidden correlation shifts, is completely unacceptable” (cited according to reports USSR Academy of Sciences [10]).

Hybridization programs emphasize the need for line specialization in breeding for signs of reproductive success [11]. Fitness, in the interpretation of King J., reflects the genetic basis of reactions with three main components: reproduction potential; growth and development potential, and the potential for sustainability or survival [12]. That is, it can be considered as a genetic response to an environmental reaction.

2. Methods and Equipment

In this regard, we conducted studies to study the relative variability between the signs of reproductive fitness in the breeding factories of the North Caucasus: “Ventsy-Zarya”, “Gulkevichsky”, “Kavkaz”, “Zarya” of the Krasnodar Territory, “Rossiya” of the Stavropol Territory; “Rossiya” of the Rostov region

3. Results

The correlation coefficients of reproductive fitness for different farms have their own characteristics. For example, in the breeding plants “Rossiya” of the Stavropol Territory, “Ventsy-Zarya” of the Krasnodar Territory, “Rossiya” of the Rostov Region, the degree of connection is approaching the average (0.41-0.46). A high relationship between the number of piglets at weaning and the litter weight at 2 months was revealed. For the breeding plant “Rossiya” of the Stavropol Territory, it was 0.81; for “Rossiya” of the Rostov region, it was 0.92. The relationship between the litter weight in 2 months and a litter weight of 6 months is close to functional (0.92-0.98). It should be noted that high correlation coefficients between the commodity litter weight at 6 months and multiple fertility, milk yield, the number of piglets by weaning, litter weight of 2 months, act in one direction and indicate a correlated set of characters (correlation pleiades) (Fig. 1).

The properties of breeding models were investigated by constructing three-dimensional spatial surfaces, giving an idea of the nature of the bonds, allowing to

Fig. 1. Correlation dependencies of reproductive fitness

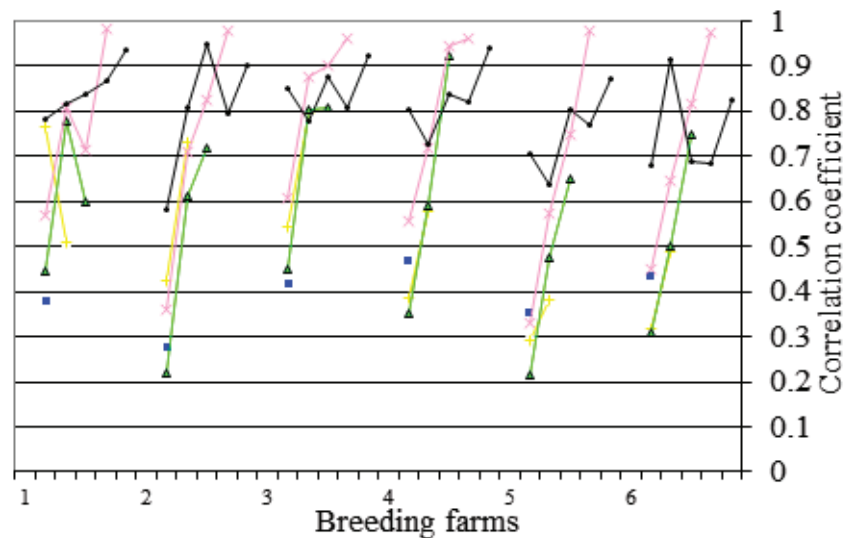


Figure 1: Correlation dependencies of reproductive fitness (Note: 1 - “Kavkaz”, 2 - “Gulkevichsky”, 3 - “Rossiya” of the Stavropol Territory, 4 - “Rossiya” of the Rostov Region, 5 - “Zarya”, 6 - “Ventsy-Zarya”)

identify effects (shifts) that occur in different populations with different combinations of characters. The graphs also serve as a nomogram for predicting the commodity litter weight at 6 months. The value of Y_i can be determined by projecting the abscissa and ordinates (X, Z) on the plane. The angle of inclination of the plane to the axes shows the degree of dependence of the commodity litter weight at 6 months on the studied signs (Fig. 2).

Correlation shifts are reflected on the plane in the form of bends, which is due to the structure of intra-linear variability and environmental factors of each specific population. Bends of the plane are marked in combinations (X_1, X_3) and (X_3, X_4). Analyzing the correlation coefficients between the traits of the reproductive qualities of large white breed pigs in the North Caucasus zone, it should be noted that, in general, they are of the same nature, both in magnitude and direction (Fig. 3).

The graphs were obtained using specific models of the breeding farms. These planes reflect fluctuations caused by changes in various factors, including environmental ones. Under changing environmental conditions, the plane “shifts to a new level” and becomes undulating. In the studied populations of the breeding farms, various tilt angles and surface undulations were noted. The main mechanism of such oscillations is the change in the strength of the dependence in time, which is characteristic of each specific population. The plane of the graph allows identifying existing trends in relationships, indicators of signs of reproductive fitness.

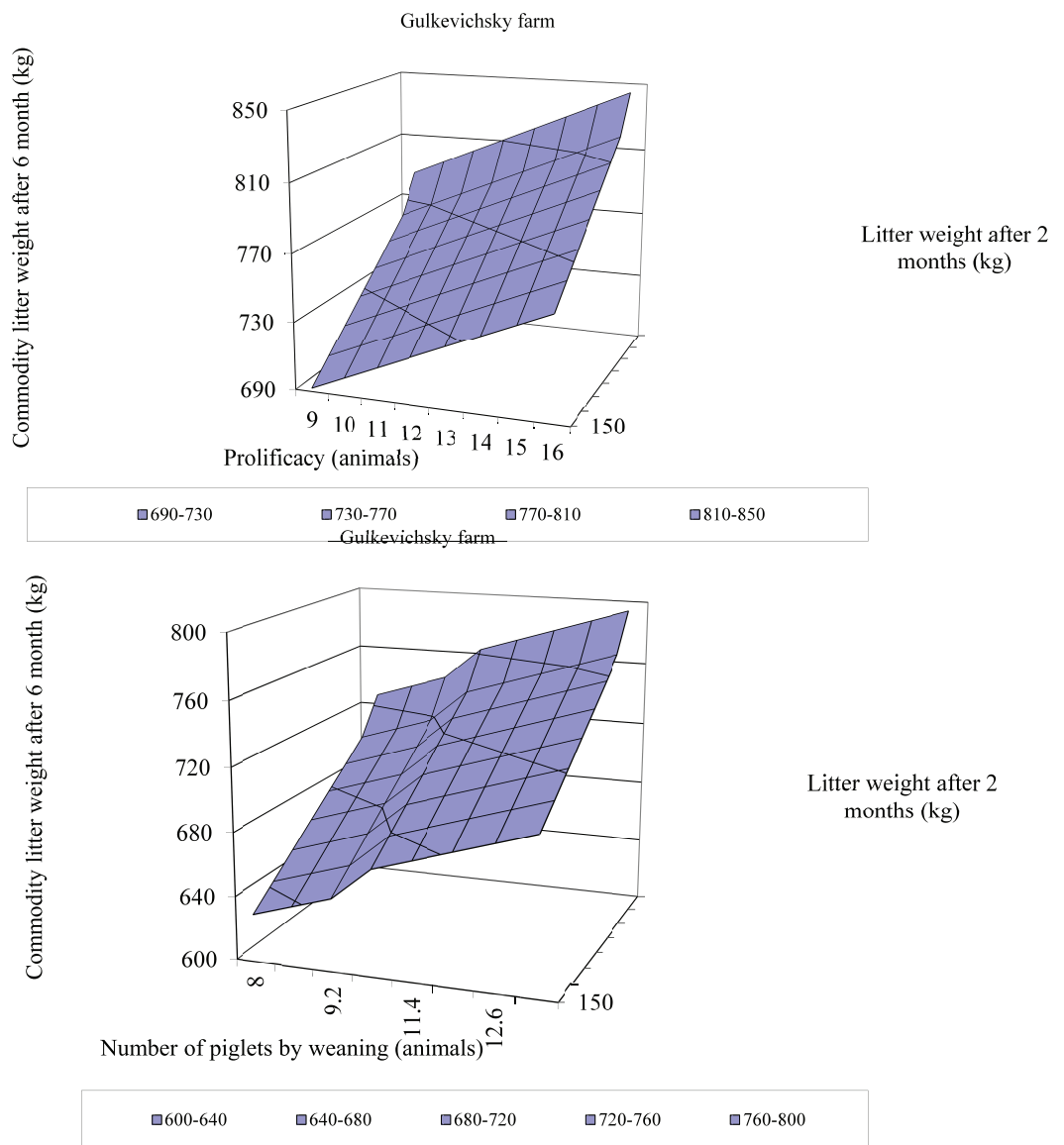


Figure 2: Dependence of the commodity litter weight on combination of signs

When analyzing the correlations of reproductive fitness in the breeding farms of the North Caucasus, a reliable and objective assessment of cause and effect dependencies was obtained; the values, nature and direction of their action were determined. Significant differences were established between the nature of relations in various breeding farms; however, their actionvectors coincided.

As a result of the studies, it was found that the system of the correlated complex of characters is under strict selection control. “The formation of adaptation, in contrast to random hereditary differences, includes the historical process of establishing the necessary ontogenetic correlations, the integration process”,as noted by E. Keshman [13]. The formation of such systems opens up new possibilities for selection, causes the

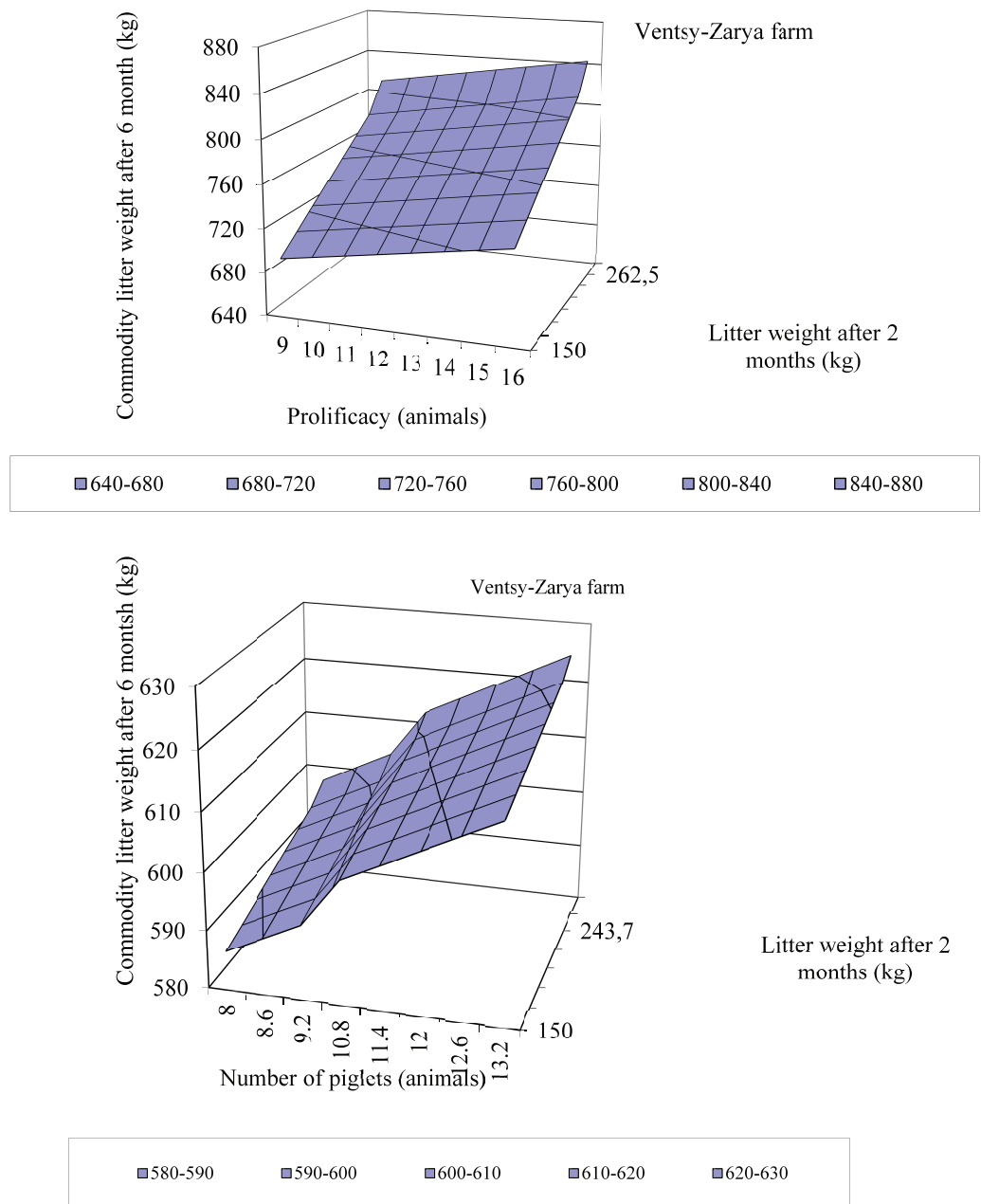


Figure 3: Dependence of the commodity litter weight on combination of signs

emergence of new forms of isolation, which is important when studying the long-term effect of intralinear selection. One of the best farms in the North Caucasus, the Gulkevichsky breeding plant, was taken as a model population. The level of breeding work, the reliability of accounting, technology, allow establishing the biological characteristics of the signs of reproductive fitness. The main productive indicator of the productivity of sows is the commodity litter weight at 6 months. Due to technological features, this indicator is not taken into account in practice, and indirect methods of calculation

were used to characterize it. The design of the breeding index of the commodity litter weight was carried out taking into account the established correlation relationships; the equations of rectilinear regression were compiled for various combinations of breeding characters. Substituting into the formula the values of breeding characteristics of selection, it is possible to determine the litter weight at 6 months. Below are the equations of rectilinear regression for breeding farms of the North Caucasus:

TABLE 1

“Kavkaz” $Y = -485 + 57.8X_1 + 13.9X_2$ $Y = -84.4 + 44.8X_1 + 60.4X_3$ $Y = 57.9 + 26.6X_1 + 3.27X_4$	“Rossiya: of the Rostov region” $Y = 101.0 + 17.9X_1 + 10.3X_2$ $Y = 105.0 + 14.4X_1 + 65.2X_3$ $Y = 58.1 + 15.8X_1 + 3.54X_4$
“Rossiya” of the Stavropol Territory $Y = -17.5 + 21.6X_1 + 12.0X_2$ $Y = 164.0 + 12.2X_1 + 61.7X_3$ $Y = 51.5 + 16.1X_1 + 3.70X_4$	“Ventsy-Zarya” $Y = 56.0 + 25.5X_1 + 11.1X_2$ $Y = 28.6 + 26.1X_1 + 76.5X_3$ $Y = 128.0 + 20.4X_1 + 3.88X_4$
“Zarya” $Y = 142.0 + 23.1X_1 + 9.56X_2$ $Y = -56.6 + 19.3X_1 + 74.5X_3$ $Y = 84.9 + 20.1X_1 + 3.29X_4$	“Gulkevichsky” $Y = 237 + 21.5X_1 + 11.9X_2$ $Y = 216 + 1.47X_1 + 95.5X_3$ $Y = 49.2 + 18.2X_1 + 4.74X_4$

Note: Hereinafter, the following code of signs will be used:

X1 - prolificacy, animals; X2 - milk content, kg; X3 - number of piglets by weaning, animals; X4 –litter weightafter 2 months, kg; X5 - litter weightafter 6 months, kg; X6 - reproduction index, score.

4. Discussion

Using correlation and regression analysis, we evaluated the role of various traits called by Norton, I.O., Sclater, J. G. the vital properties that determine the productivity of the population as a whole [14]. An analysis of the correlation coefficients of the reproductive fitness of pigs in the North Caucasus zone from an evolutionary point of view indicates the presence of correlation pleiades. The theory of correlation pleiades of Terentyev [15] helps not only explain the phenomenon, but also allows developing ways to control the population to achieve the goal.

5. Conclusion

Studies of correlation variability make it possible to make forecasts for the future. The equations of rectilinear and multiple regression make it possible to determine a productive indicator by indirectly evaluating correlatively related features.

The developed models take into account all the processes occurring in the population under the influence of tribal selection, and can be used in the planning of breeding

measures. Models indicate the dynamics of indicators of reproductive fitness in the population.

Conflict of Interest

The authors have no conflict of interest to declare.

References

- [1] Anker, A. (1982). *Importance and Problems of Pig Selection. Actual Issues of Applied Genetics in Animal Husbandry*. Moscow: Kolos, pp. 216-252.
- [2] Tretyakova, O.L. (2017). Differentiated Selection and Hybridization of Pigs Norwegian *Journal of Development of the International Science*, vol. 1, issue 5, pp. 15-21.
- [3] Maximov, A., et al. (2019). Determining Genotypes of 3-Breed Pig Hybrids by Marker Genes and their Interrelation with Meat Productivity. *Bulgarian Journal of Agricultural Science*, vol. 25, issue 4, pp. 782-794.
- [4] Svinarev, I.Y., et al. (2017). Relationship between the Polymorphism of the PRLR and MC4R Genes with the Breeding Index of Pig Reproductive Qualities. *Pig Breeding*, vol. 8, pp. 11-15.
- [5] Fedorenko, V.F., et al. (2018). Best Practices in Domestic Livestock Breeding. In *Scientific Analytical Review*. Moscow: FGBNU "Rosinformagrotech", pp. 61-70.
- [6] Svinarev, I.Y., Kulikova, N.M. and Shevchenko, A.V. (2015). Efficiency of Index Breeding of Landrace Variety. *Pig Breeding*, vol. 8, pp. 25-28.
- [7] Svinarev, I.Y. and Shevchenko, A.V. (2014). Malformations of Sow Nipples, Reliability of Diagnosis. *Pig Breeding*, vol. 8, pp. 43-45.
- [8] Gorlov, I.F., et al. (2019). Evaluation of Combining Ability of Lines in Hybridization of Pigs. *Research Journal of Pharmaceutical, Biological and Chemical Sciences*, vol. 10 pp. 1164-1171.
- [9] Svinaryov, I.Y., et al. (2015). Modeling a Regional Pig Breeding System. *Scientific Journal of Kuban State Agricultural University*, vol. 114, pp. 1001-1017.
- [10] Belyaev, D.K. and Ratner, V.A. (1962). Analysis of Genetic and Phenotypic Correlations in Connection with Some Problems of Selection and Evolution. *Doc. USSR Academy of Sciences*, vol. 142, issue 3, pp. 699-702.
- [11] Lawlor L.R. (1976) Molting, Growth and Reproductive Strategies in the Terrestrial Isopod *Armadillidium Vulgare*. *Ecology*, issue 57. pp. 1179-1194.

- [12] King, J.L. (1967). Continuously Distributed Factors Affecting Fitness. *Genetics*, vol. 55, pp. 483 - 492.
- [13] Keshman, E. A. (2008). On the 100th Anniversary of Vladimir Pavlovich Efroimson. *Genetics*, vol. 44, issue 10, pp. 1301-1308.
- [14] Norton, I.O. and Sclater, J. G. (1979). A Model for the Evolution of the Indian Ocean and the Break-up of Gondwanaland. *Journal of Geophysics Research*, vol. 84, pp. 6803-6830.
- [15] Terentyev, P.V. (1959). Methods of Correlation Pleiades. *Bulletin of Leningrad State University, Biology*, vol. 9, issue 2, pp. 137-141.