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THE ROLE OF GENETICS AND BIOTECHNOLOGY IN THE DEVELOPMENT OF ANIMAL HUSBANDRY

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Abstract
This article reviews the contribution of genetics and biotechnology to the improvement of agricultural plants and animals, with particular emphasis on animal husbandry. It discusses the practical significance of the laws of heredity, experimental polyploidy, induced mutagenesis, heterosis, male sterility, progeny testing, and immunogenetics. These approaches have supported the development of higher-yielding plant varieties and more productive livestock breeds and lines. In cattle, pig, sheep, and poultry production, genetic selection and crossbreeding are associated with improved growth, feed utilization, product output, and resistance to disease. The article also highlights the importance of accounting for both heredity and environmental conditions when organizing breeding programs. The reviewed evidence shows that the integration of conventional selection with genetic and biotechnological methods provides a scientific basis for increasing agricultural productivity and creating resilient biological resources.

Keywords: Genetics, biotechnology, animal husbandry, breeding, heredity, heterosis, polyploidy, mutagenesis, immunogenetics, livestock productivity.

Introduction

The study of the fundamental laws of heredity established the scientific basis for breeding agricultural animals and plants.

By applying these laws, existing livestock breeds and crop varieties can be improved and new ones can be developed. The inheritance patterns of many economically valuable traits in agricultural animals and plants have also been identified.

Experimental polyploidy has facilitated the development of many new crop varieties. A multiple increase in chromosome sets may result in vigorous plant growth and higher yields. Many cultivated plants, including wheat, cotton, potato, fruit trees, and citrus crops, have been identified as natural polyploids.

The development of triploid sugar beet varieties increased leaf biomass used as livestock feed by 20-30% and sugar content by 1.5-2.0%. In subsequent years, tetraploid rye and tetraploid alfalfa varieties were developed and introduced into agricultural production.

The use of induced mutagenesis laid the foundations for radiation and chemical breeding. More than 100 plant varieties worldwide have been developed through experimental mutagenesis. In

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particular, short-stemmed, lodging-resistant varieties of wheat, barley, and rice with improved grain quality have been produced.

In the Commonwealth of Independent States (CIS), mutant varieties of wheat, beans, and millet have been developed. The exploitation of genetically controlled heterosis, or hybrid vigor, is now widely applied in both crop production and animal husbandry.

Hybrid maize is cultivated extensively throughout the world. Compared with pure-line varieties, hybrid varieties may produce 25-30% more grain and demonstrate greater tolerance to cold, drought, and disease. Hybrid wheat varieties with yield increases of 20-30% are also widely cultivated.

Genetic studies identified male-sterile maize lines. When used as female parents, these lines are fertilized by pollen from fertile maize plants. This phenomenon was investigated in the 1930s by M. I. Khadzhinov, G. S. Galeev, and other researchers, who demonstrated its value for producing hybrid varieties. The method is now used in the development of hybrids of maize, sorghum, wheat, rye, sugar beet, and onion.

Heterosis is widely exploited in cattle, pig, sheep, and poultry breeding to produce crossbred animals for meat, wool, egg, and milk production. Crossbred livestock and poultry are distinguished by higher productivity, faster growth and development, greater disease resistance, and more efficient feed utilization.

Genetic analysis has enabled breeding males to be evaluated through progeny testing. In Karakul sheep breeding and fur farming, the inheritance of coat color has been studied, supporting the production of pelts with valuable colors. A heterogeneous mating method has also been developed for blue-gray Karakul sheep.

Methods have been developed to account for the effects of heredity and environmental conditions on livestock productivity. Their application has contributed to the organization and improvement of breeding programs.

Advances in immunogenetics are used to verify livestock parentage, predict selection outcomes, and exploit heterosis. Livestock breeds and lines with inherited resistance to various diseases are being developed across different branches of animal husbandry.

Genetics is also important in medicine for understanding, preventing, and managing hereditary or genetically influenced conditions, including epilepsy, schizophrenia, and hemophilia; for studying chromosomal disorders; and for supporting pharmaceutical biotechnology, including the production of antibiotic preparations.

CONCLUSION

Genetics and biotechnology provide an essential scientific foundation for modern plant and animal breeding. Polyploidy, induced mutagenesis, hybridization, male sterility, progeny testing, and immunogenetics make it possible to manage hereditary variation more purposefully and to increase the reliability of selection. In animal husbandry, these methods contribute to higher productivity, faster growth, improved feed efficiency, stronger disease resistance, accurate parentage verification, and better organization of breeding work.

The greatest practical benefit is achieved when genetic potential is evaluated together with environmental conditions, feeding, management, and performance records. The responsible integration of conventional breeding with genetic and biotechnological approaches can accelerate

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the development of productive and resilient breeds and lines, thereby strengthening the sustainability and competitiveness of agricultural production.

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