13th International Conference of Ecosystems

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APPLICATION OF ECONOMIC-MATHEMATICAL METHODS IN FIELD RESEARCH OF CEREAL CROPS IN THE CONDITIONS OF CLIMATE CHANGES IN UKRAINE IN THE SECOND HALF OF THE 19th – AT THE BEGINNING OF THE 21st CENTURIES

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- guarantees a deeper assessment and understanding of the essence of scientific-practical problems;

- ensures accuracy and unambiguity, the degree of probability and reliability of conclusions;

- contributes to the identification of previously unknown patterns and the formulation of new, relevant tasks for solving in the future.

Thus, in the modern conditions of climate change and other stress factors, the application of economic-mathematical methods in field studies of cereal crops in different soil and climatic conditions of Ukraine: Polissia, Forest-Steppe and Steppe is of great importance. They ensure the systematic use of science-based measures affecting the solution of global social problems of humanity, especially in the conditions of ecological, economic, energy and food crises, which were caused by climate change and military actions of the rf.

FOUNDERS OF KNOWLEDGE ABOUT CORRELATION AND STATISTICAL METHODS

Aristotle

Al-Khalil

Al-Kindi

For the first time, information about the principles of correlation, as the correspondence and interrelationship of various factors, was given in the works of the outstanding Ancient Greece scientist-encyclopedist Aristotle (384–322 BC).

During the 8th – 9th centuries, statistical methods based on the theory of probabilities were first cited in the works of Arab mathematicians:

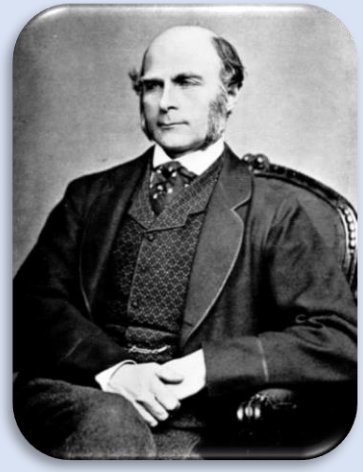
- **Al-Khalil applied the method of data permutation and combination;**
- **Al-Kindi used the method of deciphering cryptographic messages using statistics and frequency analysis.**

SYSTEMATIC APPLICATION OF CORRELATIONAL AND STATISTICAL METHODS IN THE COUNTRIES OF WESTERN EUROPE DURING THE 18th–19th CENTURIES

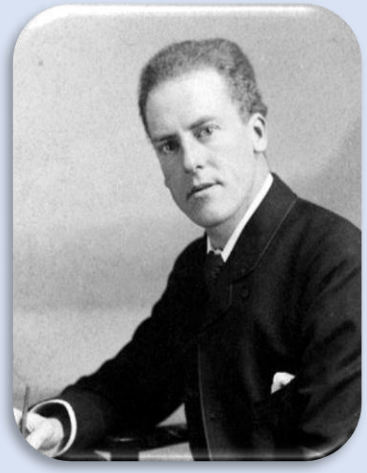
P. Laplace

C. Gauss

A. Legendre



F. Galton



C. Pearson

SYSTEMATIC APPLICATION OF CORRELATIONAL AND STATISTICAL METHODS IN THE COUNTRIES OF WESTERN EUROPE DURING THE 18th–19th CENTURIES

- in 1783 – the French mathematician and astronomer P. Laplace discovered the distribution curve of random variables;

- in 1783 – the German mathematician, astronomer and surveyor C. Gauss exposed the method of least squares;

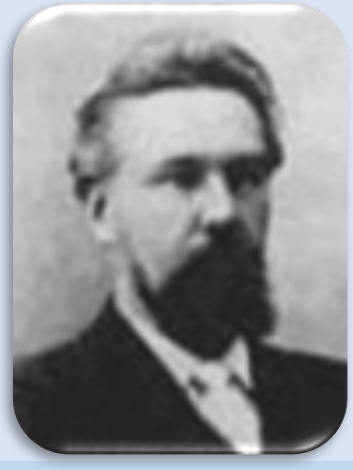
- in 1805 – the French mathematician A. Legendre carried out a detailed description of number theory and the method of least squares;

- in 1889 – English statisticians F. Galton and C. Pearson developed methods for analyzing the relationship between two variables, the theory of partial and pure correlation coefficients, as well as the theory of multivariate correlation.

IN THE FIRST HALF OF THE 20th CENTURY, THE ENGLISH MATHEMATICIAN, STATISTICIAN, BIOLOGIST AND GENETICIST R.A.FISHER MADE A SPECIAL CONTRIBUTION TO THE DEVELOPMENT OF MODERN APPLIED MATHEMATICAL STATISTICS, IN PARTICULAR STATISTICAL METHODS OF EXPERIMENT PLANNING

- in 1922 – introduced the terms «dispersion», «statistical parameters» and the rules for their evaluation;
- in 1925 – developed the theory of statistical testing of hypotheses, namely dispersion analysis;
- in 1930 – first used the diffusion equation in population genetics;
- in 1935 – worked out a detailed method of mathematical planning of the experiment;
- in 1938 – developed statistical tables for biological, agricultural and medical research.

UKRAINIAN SCIENTISTS WHO DEVELOPED METHODS OF MATHEMATICAL STATISTICS FOR PROCESSING THE RESULTS OF AGRARIAN RESEARCH IN THE 20th CENTURY

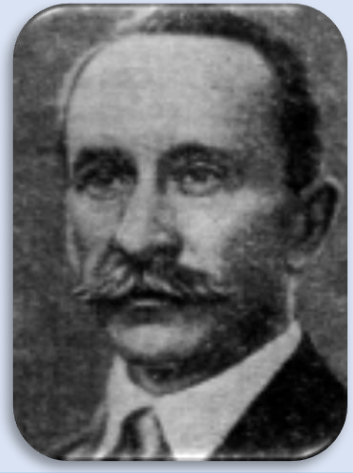


O. H. Doiarenko

M. A. Yehorov

M. M. Wolff

Ye. Ye. Slutskyi



A. O. Sapiehin

B. O. Dospiekhov

UKRAINIAN SCIENTISTS WHO DEVELOPED METHODS OF MATHEMATICAL STATISTICS FOR PROCESSING THE RESULTS OF AGRARIAN RESEARCH IN THE 20th CENTURY

- in 1908–1909 – A. H. Doiarenko, M. A. Yehorov developed a methodology for the analysis of research data with the mandatory use of mathematical statistics methods;

- in 1911 – M. M. Wolff was one of the first to introduce economic-mathematical methods: the theory of probabilities and mathematical statistics for the analysis of observations in agricultural experiments;

- in 1912 – Ye. Ye. Slutskyi developed a methodology of obtaining rational research results under various combinations of conditions;

- in the 1930s – A. O. Sapiehin, in the 1960s – B. O. Dospiekhov developed a methodology for analyzing the results and assessing the accuracy of field multifactorial experiments for the effective cultivation of agricultural crops.

AT THE BEGINNING OF THE 21st CENTURY, THE DEPENDENCE OF GENERAL SIGN ON SEVERAL GROUPS OF FACTORS WAS DETERMINED IN FIELD RESEARCH OF AGRICULTURAL CROPS

GENERAL SIGN:

- yield of agricultural crops;
- productivity of crop rotation;
- quality of agricultural products.

TECHNOLOGICAL FACTORS:

- genetic purity of varieties and hybrids;
- predecessors, saturation of crop rotations with different groups of crops;
- sowing depth and rate, sowing periods;
- tillage;
- application of fertilizers;
- use of plant protection products;
- seed preparation;
- crop care.

CLIMATE FACTORS:

- rainfall;
- air temperature and humidity;
- number of sunny and cloudy days;
- wind force.

APPLICATION OF ECONOMIC-MATHEMATICAL METHODS FOR DETERMININING THE DEPENDENCE OF CEREAL CROPS GROWING EFFICIENCY ON TECHNOLOGICAL AND CLIMATE FACTORS

The dependence of a general sign is revealed using:

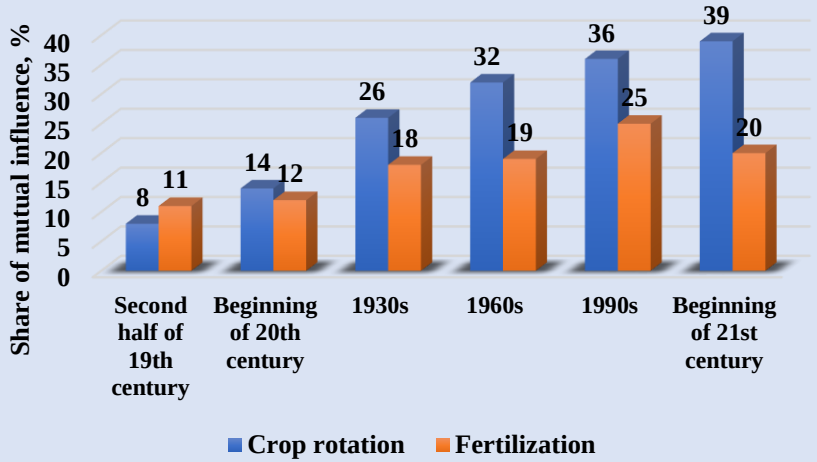
- **correlation analysis,**
- **regression analysis,**
- **dispersion analysis,**
- **factor analysis,**
- **cluster analysis.**

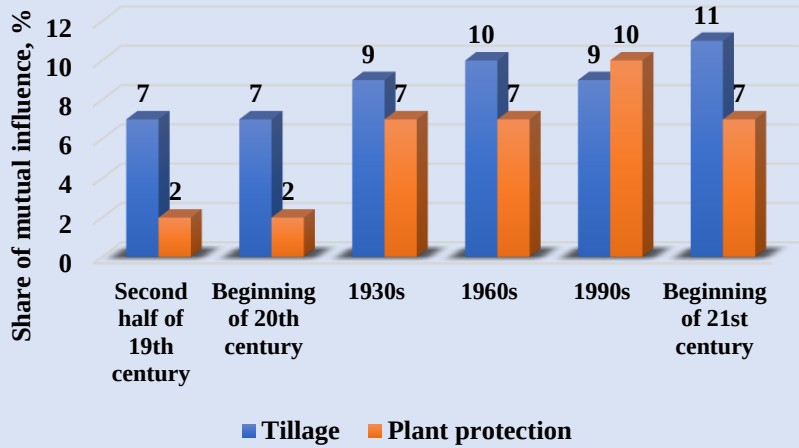
To determine the share of mutual influence, dispersion analysis was used – a method of statistical data analysis in multivariate experiments.

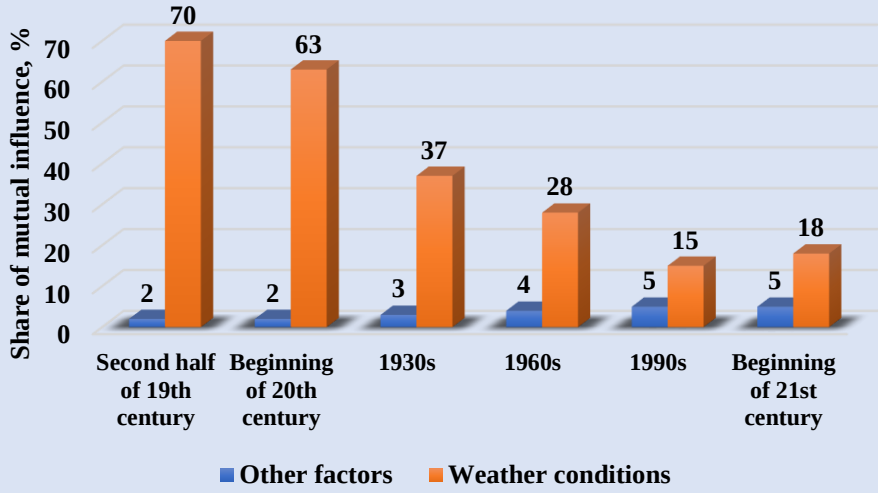
Dispersion analysis is based on determining the effect of both systematic (controlled) and random (uncontrolled) factors, as well as their interaction on the variation of the performance of a general sign.

DYNAMICS OF THE SHARE OF MUTUAL INFLUENCE OF THE MAIN TECHNOLOGICAL FACTORS AND WEATHER CONDITIONS ON THE PRODUCTIVITY OF CEREAL CROPS IN THE CONDITIONS OF CLIMATIC CHANGES IN UKRAINE IN THE SECOND HALF OF THE 19th – AT THE BEGINNING OF THE 21st CENTURIES, %

Source: compiled based on the results of the author's long-term scientific research and studies by scientists: Ye. O. Yurkevych, N. P. Kovalenko & A. V. Bakuma, 2011; N. P. Kovalenko, 2014; O. V. Demydenko et al., 2019; Ye. O. Yurkevych et al., 2021.

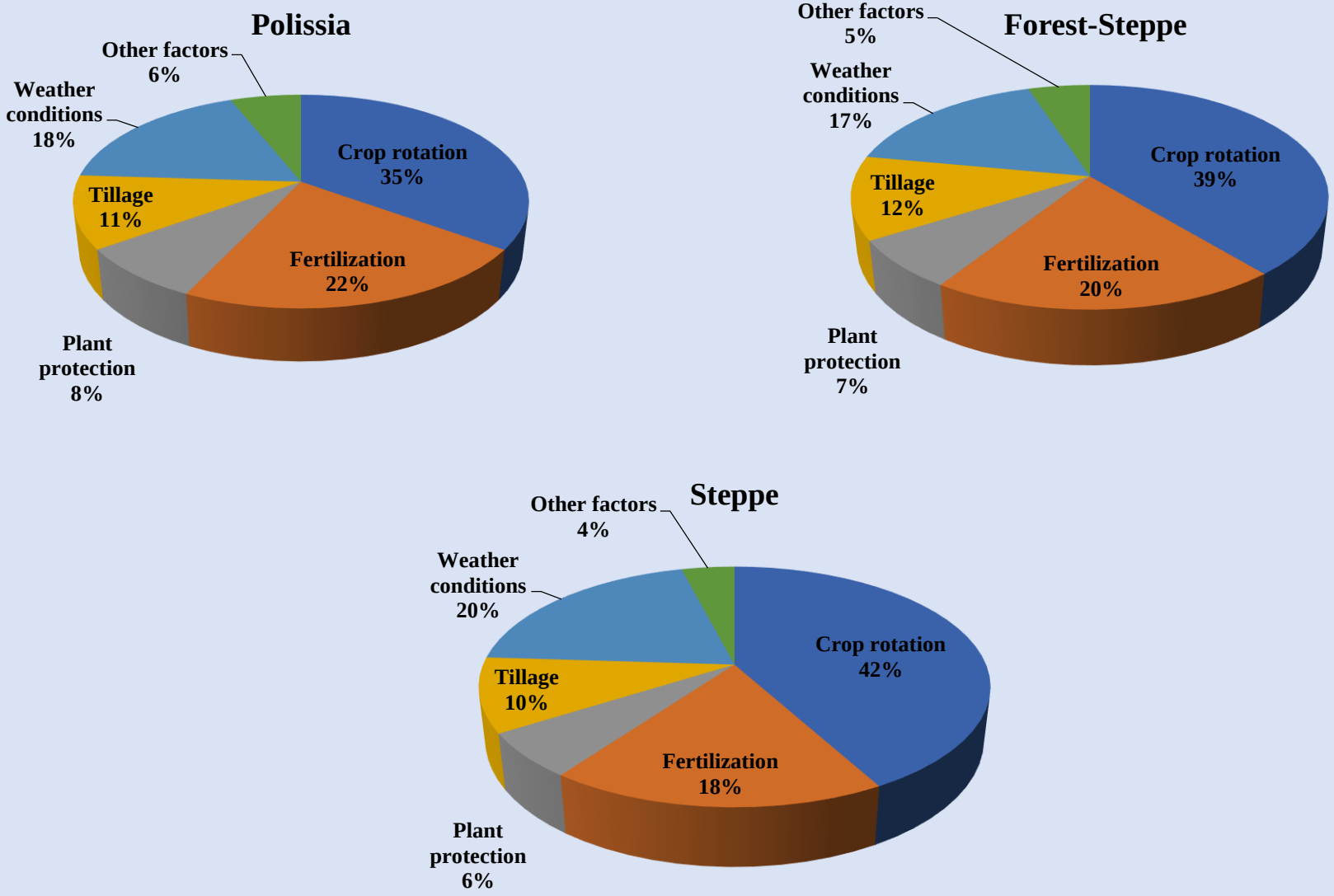






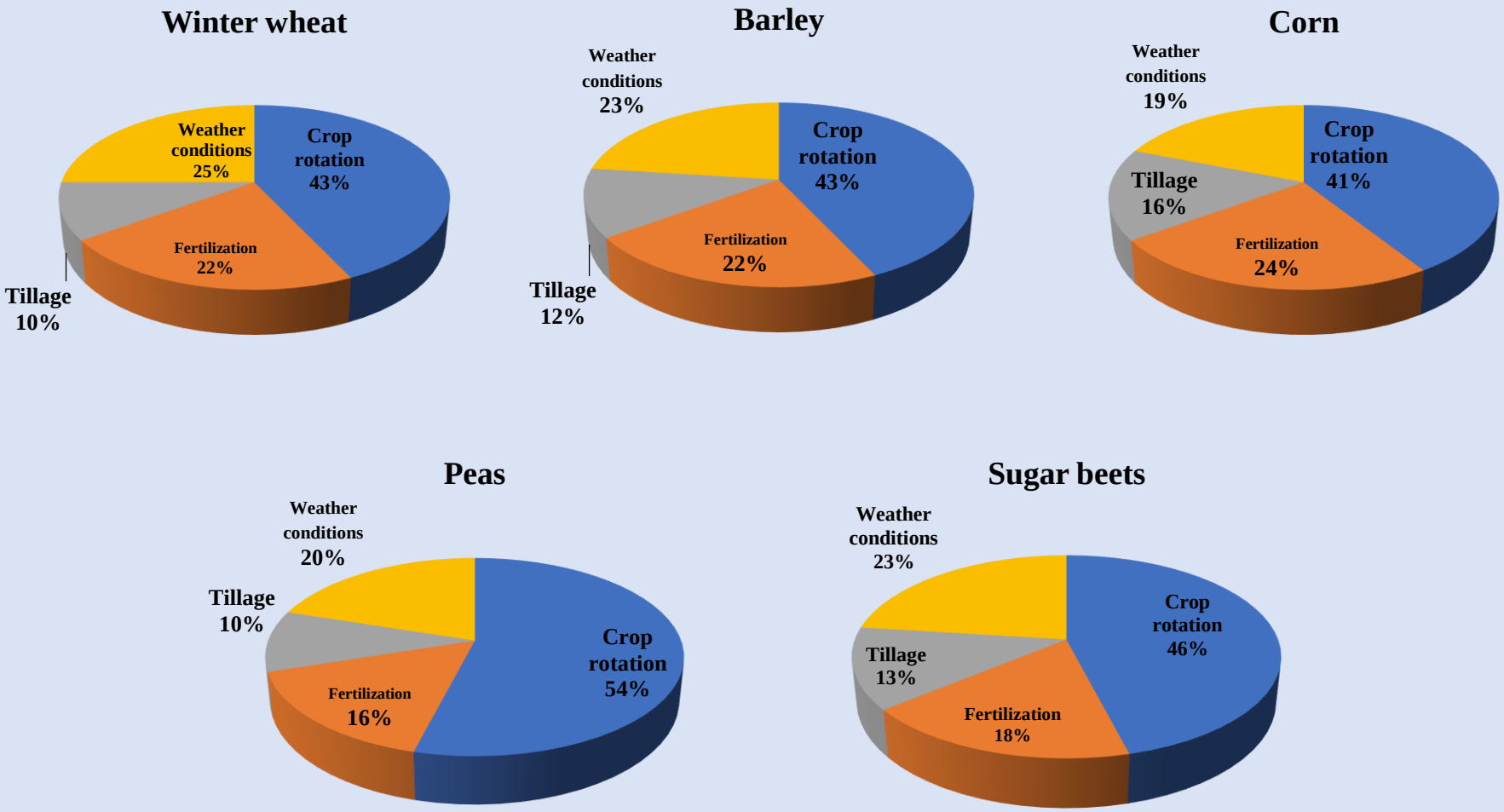
SHARE OF THE MUTUAL INFLUENCE OF THE MAIN TECHNOLOGICAL FACTORS AND WEATHER CONDITIONS ON RATIONAL LAND USE IN THE CONDITIONS OF CLIMATIC CHANGES IN UKRAINE AT THE BEGINNING OF THE 21st CENTURY, %

Source: compiled based on the results of the author's long-term scientific research



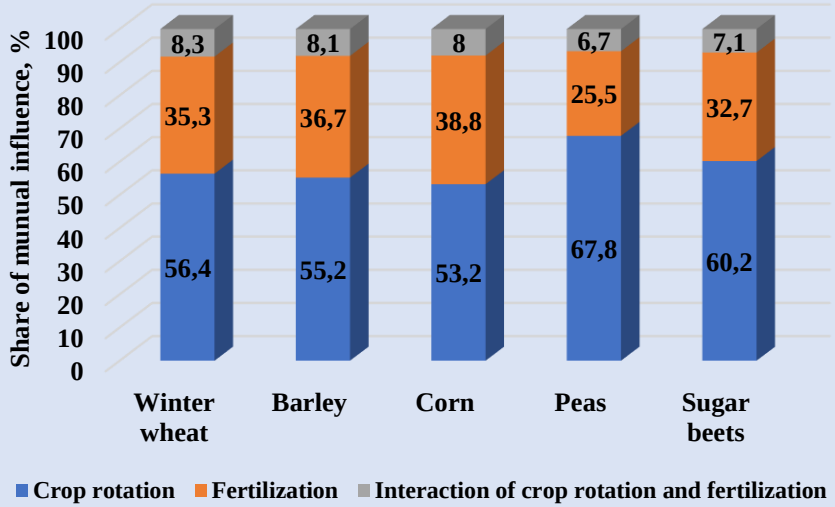
SHARE OF THE MUTUAL INFLUENCE OF THE MAINE TECHNOLOGICAL FACTORS AND WEATHER CONDITIONS ON THE PRODUCTIVITY OF THE LEADING CEREAL, LEGUMES AND TECHNICAL CROPS IN THE FOREST-STEPPE OF UKRAINE AT THE BEGINNING OF THE 21st CENTURY, %

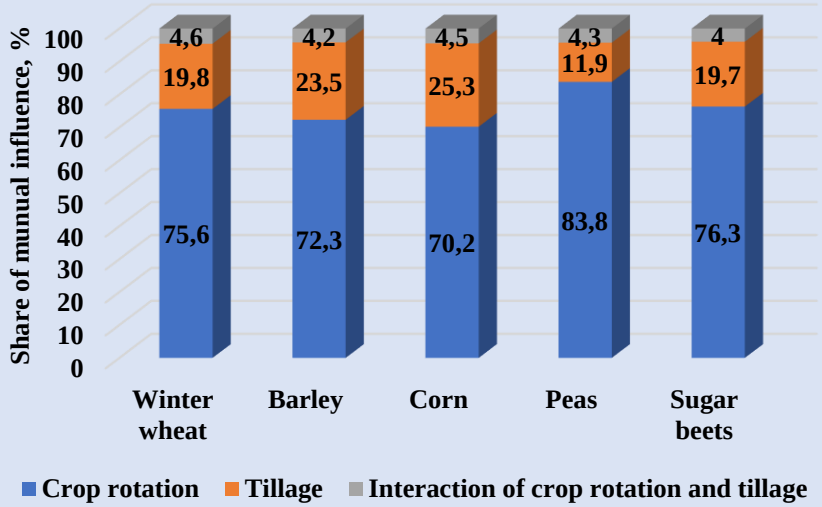
Source: compiled based on the results of the author's long-term scientific research

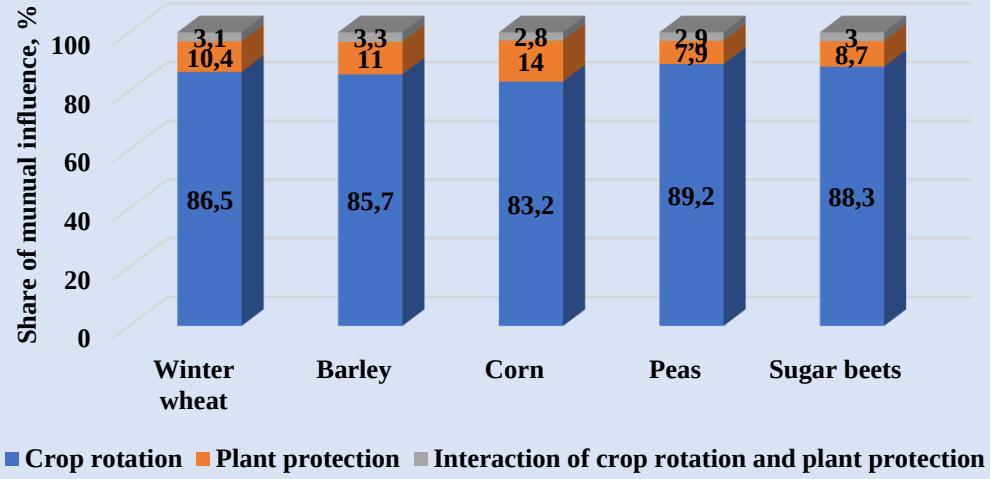


SHARE OF THE MUTUAL INFLUENCE OF CROP ROTATION AND OTHER TECHNOLOGICAL FACTORS ON THE PRODUCTIVITY OF LEADING CEREAL, LEGUMES AND TECHNICAL CROPS IN THE FOREST-STEPPE OF UKRAINE AT THE BEGINNING OF THE 21st CENTURY, %

Source: compiled based on the results of the author's long-term scientific research







CONCLUSIONS

It can be concluded that the emergence of economic-mathematical methods took place in Ancient Greece with the first mention of the principles of correlation in the works of the outstanding scientist-encyclopedist Aristotle. At the beginning of the 20th century, statistical methods for processing the results of agrarian research were developed in the works of Ukrainian scientists: O. H. Doiarenko, M. A. Yehorov, M. M. Wolff, Ye. Ye. Slutskyi, A. O. Sapiehin and others. The application of mathematical statistics methods for processing the results of field studies of cereal crops ensured the accuracy and reliability of the obtained results, the identification of previously unknown regularities for their effective growth and development.

As a result of the processing of long-term data on the yield of agricultural crops by the method of dispersion analysis, it was established that during the second half of the 19th – the beginning of the 21st centuries, the share of the mutual influence on the productivity of cereal crops of the main technological factors increased, which restrained the negative impact of adverse weather conditions up to 52%. The effectiveness of the predecessors in crop rotations largely depended on the amount of applied fertilizers and weather conditions. Differentiation of methods of tillage for main crops in crop rotation depending on the predecessor provided increased efficiency of fertilizer application and obtaining high and stable yield of cereal crops. The use of effective varieties and hybrids, plant protection products, seed preparation, depth and rate of sowing, as well as optimal sowing periods of cereal crops were of great importance. The specified technological factors were closely interrelated and determined the yield of all agricultural crops.

Thank you for your attention!