STATEMENT

on the dissertation submitted for the award of the educational and scientific degree Doctor in: Field of Higher Education: 6. Agricultural Sciences and Veterinary Medicine, Professional Field: 6.1. Crop Science, Scientific Specialty: Forage Production, Grassland Management

Author of the dissertation: **GEORGI STOYANOV STOYANOV**
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Title of the dissertation: Study of the possibilities of using mathematical models for yield management of maize (*Zea mays* L.) grown in different directions.

Reviewer: Assoc. Prof. Dr. Katya Spasova Uzundzhalieva, Institute of Plant Genetic Resources – Sadovo. Field of Higher Education: 6. Agricultural Sciences and Veterinary Medicine. Professional Field: 6.1. Crop Science. Scientific Specialty: Breeding and Seed Production of Cultivated Plants

Appointed as a member of the scientific jury by Order № RD-16-823/04.07.2025 of the Rector of AU.

1. Relevance of the problem

The dissertation examines the possibilities for improving maize productivity through an integrated approach, including the selection of appropriate hybrids and the application of balanced fertilization. The aim of the present study is to contribute to the sustainable development of maize production under conditions of climate change and increasing demand for food and raw materials, by applying mathematical models that can significantly reduce the negative effects of climate change on yields, and consequently on farmers' incomes. In this sense, the relevance of the topic is undeniable. The study applies modern analytical methods that are becoming increasingly important in agricultural decision-making.

2. Aim, tasks, hypotheses and research methods

The aim of the dissertation is to develop mathematical (analytical) models with five maize hybrids of different FAO groups and different origin (generation), in two production directions – silage and grain. The study includes hybrids DKC 4416, LG 31.390, PREMEO, PIONEER P9889, and KNEZHA-461, tested with foliar fertilizers. The field trial was conducted under irrigated conditions.

To achieve this aim, the following tasks were set:

1. To investigate the productive potential of the crop in its two main production directions – silage and grain.
2. To construct and study models for the influence of foliar products on yield.
3. To model yield depending on structural elements.
4. Based on models describing the influence of meteorological conditions and foliar products, to evaluate optimal ranges of their variation and possible decreases in quality indicators.
5. To compare the results of the applied methods and the developed models and their predictive accuracy relative to real data.
6. To apply statistical analysis using the CART method for selecting adequate models.
7. To conduct error diagnostics, analysis, and evaluation of the developed models.

The study was carried out with 5 maize hybrids × 3 foliar fertilization variants = 15 treatments. The experiment was performed according to the split-plot method (Shanin, 1977), with 4 replications and an experimental plot size of 15 m².

3. Illustration and presentation of the results

The dissertation consists of 175 pages, including 29 figures and 36 tables, which indicates sufficient volume and appropriate illustration of the obtained results.

4. Discussion of results and literature used

The phenological development of maize was monitored, biometric indicators were recorded, and yield structural elements, productivity and chemical indicators, as well as energy and protein nutritional value of the forages were evaluated. The data were processed using statistical methods – correlation analysis, regression models for the influence of foliar fertilizers on maize hybrid productivity, cluster analysis, CART method for processing and analyzing empirical data. Based on the results and the applied mathematical models and statistical analyses, 15 conclusions were formulated regarding the response of maize hybrids to foliar fertilization. The influence of foliar fertilizers on green biomass and grain yield was established. Regression models were developed to determine the degree of influence of foliar fertilizers.

The reference list includes 191 sources, of which 24 in Cyrillic and 167 in Latin script, which demonstrates the doctoral candidate's good awareness of research on the topic.

5. Contributions of the dissertation

Scientific contributions

1. For the first time, under the agroecological conditions of the Stara Zagora region, specific patterns of growth, development, and vegetation duration were established in five maize hybrids from the early and mid-early FAO groups.
2. The quantitative influence of the factors *foliar fertilization* and *hybrid* on grain and biomass yield was determined. Two-factor variance analysis showed that foliar fertilization had the greatest effect (72.3% for grain yield and 81.3% for biomass), exceeding the effect of the genotype factor.
3. Strong positive correlations were proven between key yield components and productivity indicators – e.g., between number of leaves and plant height ($r = 0.866$), as well as between cob length, 1000-kernel weight, and grain yield.
4. Regression models were developed ($R^2 = 0.8553$ for biomass and $R^2 = 0.9283$ for grain yield), and with a data-mining model using CART machine learning, the possibility of predicting the influence of foliar fertilizers was confirmed.
5. Using hierarchical cluster analysis, the studied hybrids were grouped based on productivity and chemical composition, providing opportunities for targeted use in production.

Applied contributions

1. The positive effect of foliar fertilizers on biomass yields (up to +49.6%) and grain yields (up to +31.8%) was demonstrated. The best combination was identified – *Aminosol* + *Lebosol B* + *Lebosol Zn* and *Nutriplant 36*.
2. Hybrids with the highest responsiveness to foliar fertilization (Premeo, Pioneer P9889, DKC 4416) were identified, making them suitable for intensive production.
3. Based on the results, specific combinations of foliar fertilizers were proposed for optimizing technological parameters in maize cultivation, with the goal of increasing crude protein content in biomass and grain.
4. A scientifically based technology for foliar fertilization of maize was developed, applicable under the conditions of Southeastern Bulgaria, supported by statistically proven results.

5. A practical basis for precision maize fertilization management was established, including possibilities for adapting the model to different hybrids and production directions (biomass, grain, etc.).

6. Critical remarks and questions

I have no critical remarks or recommendations.

7. Published articles and citations

A significant part of the results has been published in three scientific publications. Three reports were presented – one at an international forum and two at national forums. The submitted abstract objectively reflects the structure and content of the dissertation.

CONCLUSION

Based on the research methods applied by the doctoral applivant, the properly conducted experiments, the generalizations and conclusions made, I consider that the submitted dissertation meets the requirements of the Higher Education Act and the Regulations of the Agricultural University for its application, which gives me grounds to evaluate it **positively**.

I therefore propose to the esteemed Scientific Jury to also vote positively and award Georgi Stoyanov Stoyanov the educational and scientific degree **Doctor** in the scientific specialty Forage Production, Grassland Management.

Date:01.09.2025г.
Plovdiv

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