



REVIEW

on a dissertation for obtaining the educational and scientific degree "Doctor" in the field of higher education 6. Agricultural Sciences and Veterinary Medicine, professional field 6.1 Crop Production, scientific specialty Forage production and grasslands

Author of the dissertation: Georgi Stoyanov Stoyanov, full-time PhD student at the Department of Crop Production at the Agricultural University, Plovdiv

Topic of the dissertation: Study of the possibilities of using mathematical models for managing the yield of corn (*Zea mays L.*) grown in different directions

Reviewer: Prof. Dr. Hristina Georgieva Yancheva, Agricultural University-Plovdiv, field of higher education 6. Agricultural Sciences and Veterinary Medicine, professional field 6.1 Crop Production, scientific specialty: Forage production and grasslands, livestock farming, appointed as a member of the scientific jury by order No. RD-16-823/04.07.2025 from the Rector of AU.

1. Relevance of the problem.

The topic of the dissertation is related to studies on corn, which is among the leading crops of global economic and agro-ecological importance, providing raw material for the food, feed, and bioenergy industries. Dynamically changing climatic conditions, the growing pressure for optimal use of soil and water resources, and the need for sustainable productivity increase the search for new, scientifically based approaches to yield management in various crops. The presented dissertation uses mathematical models that provide an opportunity for quantitative assessment and prediction of the influence of agrotechnical factors, climatic parameters, and genotype characteristics on the productivity of corn grown in different production areas. These models provide a scientific basis for the implementation of precise technologies that allow the optimizing yields, increasing the quality of production, and reducing the ecological footprint, which makes them extremely relevant in the context of sustainable and competitive agriculture.

2. Purpose, tasks, hypotheses, and research methods.

The purpose of this work is the development of mathematical (analytical) models for five maize hybrids with different FAO and origin (different generations), in two directions – for silage and for grain. To achieve the goal, seven tasks have been set, related to the study of the productivity of maize for silage and grain, modeling of yield depending on foliar fertilizers, structural elements and meteorological conditions, comparison and evaluation of the obtained models and their prognostic accuracy, as well as performing statistical analysis (including using the CART method), diagnostics and error assessment.

Appropriate research methods were used to fulfill the tasks set. Mathematical

analyses – dispersion, regression, and factorial – were performed based on a large number of indicators obtained during the derivation of a three-factor field experiment conducted using the fractional plot method.

3. Visualization and presentation of the results obtained.

The presented dissertation totals 174 pages, is well-structured, and includes all necessary sections according to the requirements for the "Doctor" degree — including the introduction, literature review, study purpose and objectives, materials and methods, results and discussion, statistical analyses and models, conclusions, as well as scientific-theoretical and scientific-applied contributions, and references. The results are analyzed in a clear scientific style and are well-illustrated with 2 diagrams, 39 figures, and 36 tables.

4. Discussion of the results and literature used.

The literature review is well organized and systematically covers existing research on the origin, distribution, and economic importance of maize. It thoroughly examines how nutritional regimes affect the growth, development, and yield of the crop in both silage and grain production. Additionally, it explores how foliar fertilization influences the chemical composition of biomass and grain. The review also presents models for evaluating the impact of structural elements on yield and for forecasting productivity.

The referenced sources include 276 publications, 144 in Cyrillic and 132 in Latin, demonstrating both comprehensive coverage and depth of study. The doctoral student's expertise in the subject enables accurate analysis and synthesis of the findings. Fifteen well-supported conclusions have been formulated, fully consistent with the data obtained from field, chemical, and statistical research and analysis.

5. Contributions of the dissertation work.

Based on the results obtained, the following scientific-theoretical and scientific-applied contributions have been formulated, the most important of which are:

Scientific and theoretical contributions

1. For the first time in the agro-ecological conditions of the Stara Zagora region, specific patterns in growth, development, and vegetation duration have been established in five corn hybrids from the early and medium-early FAO group.

2. The quantitative influence of the factors "foliar fertilization" and "hybrid" on grain and green mass yield was established. The two-factor analysis of variance shows that the greatest influence is exerted by foliar fertilization (72.3% for grain yield and 81.3% for green mass), surpassing the effect of the genotypic factor.

3. Strong positive correlations have been proven between basic structural elements of yield and productivity indicators.

4. Regression models have been developed ($R^2 = 0.8553$ for green mass and $R^2 = 0.9283$ for grain yield), and based on a data mining model with machine learning of the CART type, the possibility of predicting the impact of foliar fertilizers has been proven.

5. Using hierarchical cluster analysis, the studied hybrids are grouped based on their productivity and chemical composition, which allows for targeted use in production.

Scientific and applied contributions

1. Specific combinations of foliar fertilizers are proposed to optimize the technological parameters in corn cultivation to increase the crude protein content in the green mass and grain.

2. A scientifically based technology for foliar fertilization of corn has been developed, applicable in the conditions of Southeastern Bulgaria, and it is supported by statistically proven results.

3. A practical basis for precise fertilization management in corn has been created, which also includes opportunities to adapt the model for different hybrids and production directions (biomass, grain, etc.).

6. Critical notes and questions.

I have no critical comments on the presented materials.

7. Published articles and citations.

In connection with the dissertation, the doctoral student has published 3 publications, one of which is independent and two are co-authored, thus covering the required minimum of 30 points.

The presented abstract objectively reflects the structure and content of the dissertation.

CONCLUSION

Based on the various research methods learned and applied by the doctoral student, the correctly conducted experiments, the analyses and formulated recommendations and conclusions made, I consider that the presented dissertation meets the requirements of the Law for Development of Academic staff in the Republic of Bulgaria and the Regulations of the Agricultural University for its application, which gives me reason to evaluate it POSITIVELY.

I would like to propose to the members of the esteemed Scientific Jury to vote positively and award Georgi Stoyanov Stoyanov the educational and scientific degree of "Doctor" in the scientific specialty of Forage production and grasslands, professional field 6.1 Crop Production.

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Plovdiv

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