OPINION

on a dissertation for obtaining the educational and scientific degree **"PhD"** by: field of higher education 6. Agricultural Sciences and Veterinary Medicine, professional field 6.1. ***Crop science***, the scientific specialty ***Field crops***.

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Topic of the dissertation: An effective methodology for identification of highly productive and stable winter wheat genotypes by combining traditional and innovative statistical approaches

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1. Relevance of the problem a .

The relevance of the dissertation work is also present with the choice of crop, namely wheat, which is the main food component worldwide. In addition to classical research related to the creation and zoning of new more productive and sustainable varieties, as well as the optimization and improvement of agricultural technology, the possibility of combining traditional breeding methods with modern statistical and biotechnological tools is of interest. The successful implementation of this innovative approach would contribute to accelerating the genetic progress in wheat, and not only at the regional level.

2. Purpose, tasks, hypotheses and research methods.

The aim of the dissertation is based on an in-depth literature review, which includes a total of 195 sources and covers over 27% of the total volume of the dissertation. It is related to establishing the possibility of combined application of traditional and innovative statistical approaches for complex assessment of winter wheat varieties while simultaneously determining productivity, stability and adaptability under contrasting growing conditions. Achieving the set goal is linked to the implementation of five main tasks, which I believe are correctly selected, follow a logical sequence and are fully sufficient for its successful achievement. The methodological part of the dissertation is consistent with the tasks that must be completed. 118 winter wheat genotypes were used as source material, representing a wide variety of local Bulgarian varieties and foreign samples, provided by leading scientific and private breeding centers in Europe, Asia and North America. Their selection is subject to four main criteria that guarantee representativeness and applicability of the results. The same are described briefly, accurately and clearly by the author. The field experiment is described in detail and correctly, including its main characteristics (schemes, acrotechnics, RD, etc.), the yield and its components. The doctoral student very skillfully links the specificity of the

individual phenophases with the specific meteorological conditions. The choice of statistical methods is consistent with the main goal, to provide a reliable, multidimensional and prognostically justified assessment of the genotypes included in the experiment, tested in the conditions of three fundamentally different meteorological years. The methods are described in detail, their choice is justified, and is supported by modern literary sources. The soil and meteorological characteristics are presented correctly.

3. Visualization and presentation of the results obtained.

The results represent a significant part of the dissertation (28% of its total volume). The section begins with descriptive statistics, illustrated by Boxplot diagrams, showing the variation of the observed agronomic traits. This is followed by an assessment of the influence of the environment, genotype and the interaction between them on the yield and its elements. The author uses principal component analysis. The next step in the study is to analyze the relationships between the traits and their effect on productivity. Linear (LMM) and nonlinear (RF) models, structural equation models (SEM) were used. The most economical option – Model 5, which includes only the two main components NGM (number of grains per square meter) and TGW (Weight per 1000 grains), demonstrates high efficiency, as with a minimum number of paths it explains 98.2% of the variation in yield. The results are illustrated graphically and in tables. Based on these results, the doctoral student applies cluster analysis to establish the optimal number of clusters, as this directly affects the quality of the classification and interpretation of the results. Next, the stability and productivity of the genotypes are assessed, using BLUP analysis, WAASB index, WAASBY index, and YSI index. The superiority index (Pi) shows the deviation of each genotype from the highest yields achieved in each environment, with lower index values reflecting closer performance to the optimum regardless of the conditions. The genotypes used in the dissertation are classified according to this indicator, and the results are presented in a table. In addition, a classification was made in terms of the Kang stability index (KSI), which integrates both the yield and stability of the genotypes. The results are presented in a table. The comparative analysis between the three indices makes an extremely good impression, and the results presented by means of a network diagram demonstrate not only the skillful handling of statistical methods in agriculture, but also the high computer literacy of the doctoral student. Despite the obtained results useful for science, the single indices used analyze productivity and stability separately. This has provoked the author to look for an opportunity to apply the so-called *multi-trait selection indices*, which allow for a combined consideration of stability and average productivity. The doctoral student also ranks the genotypes used in relation to two more indices – MTSI and MGIDI, and then makes a comparative arrangement of the genotypes by the rank of the indices. The results are illustrated by means of a Venn *diagram of the overlap* between the leading 20 genotypes according to MGIDI, MTSI and WAASBY.

All results are systematized in 15 conclusions, which are formulated very precisely and present the development of the dissertation work in chronological order.

4. Contributions of the dissertation work.

The purpose of the dissertation has been fulfilled, and as a consequence of this, the doctoral student's contributions to agricultural science are noted. A total of 11 contributions have been noted, 6 of which are scientific and 5 are scientific-applied. They are formulated briefly, accurately and clearly, and I do not believe that they need

to be corrected.

5. Critical notes and questions.

Despite its theoretical appearance, the dissertation is very interesting and enjoyable to read, while at the same time making significant contributions to science. It is extremely well constructed, using a high scientific style without terminological inaccuracies. For each task and subtask, there is a complete and clearly presented analysis with specific results. Therefore, I have no questions or comments about the dissertation and the doctoral student.

6. Published articles and citations.

In terms of scientometric indicators, the doctoral student reaches the required number of points based on two articles in the journal of the Thracian University *Agricultural Science & Technology*, one of which is the first author and the second is an independent one. 5 citations are also presented.

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 generalizations and conclusions made, I believe that the presented dissertation meets the requirements of the Law on the Protection of Agricultural Research and Development 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 esteemed ***Scientific Jury*** to also vote positively and award Georgi Stoyanov Raykov the educational and scientific degree of ***"PhD"*** in the scientific specialty *of* ***Field crops***.

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city of Plovdiv