OPINION

on a dissertation for obtaining the educational and scientific degree "Doctor" in field of higher education 6 Agricultural sciences and veterinary medicine, professional field 6.1 Crop production, scientific specialty Crop Production

Author of the dissertation: Todor Kostadinov Gubatov, a Ph.D. student in self-study at the Department of Crop Production at the Agricultural University, Plovdiv

The topic of the dissertation: Interaction between environmental conditions and grain yield in common wheat (*Triticum aestivum L.)* varieties

Reviewer: Prof. Dr. Hristina Georgieva Yancheva, Agricultural University-Plovdiv, a field of higher education 6 Agricultural sciences and veterinary medicine, professional field 6.1 Crop production, scientific specialty, "Grasslands and fodder production," appointed as a member of the scientific jury by order № RD – 16-650/ 27.07.2020.

1. The relevance of the problem

Adapting to climate change is essential for the future of agriculture in Europe and the world, that is why a lot of research connected with finding science-based solutions. In this regard, the studies on the influence of environmental factors on the manifestation of varietal characteristics in different crops aim at their proper distribution and overcoming the effects of climate change. The subject of a large part of the research is the field crops, which are exposed to long-term and unpredictable influences by the natural factors of the environment, especially those with a more extended vegetation period (barley, rapeseed, wheat).

Winter bread wheat is one of the leading food crops, which is the subject of numerous interdisciplinary studies related to the effect of the environment on the plant phenotype. In our country, research on the topic of genotype * environment conducted periodically to establish the interaction between factors and evaluate individual variety for about 30 years. Up to date, no important crop has undergone a comprehensive study of the effects of genotype * environment interactions on productivity and a thorough assessment of the variety through the wide range of methods and approaches available.

In the present study, the main emphasis is placed on the efficiency of assessing the interaction between variety and environment and comparing the methods and approaches to evaluate its adaptability and plasticity. A current topic

with increased interest from scientists is the critical evaluation of different statistical techniques to assess the interaction of the variety with the environment by often comparing mutually contradictory parametric methods. In response to this question, a study was conducted to compare the different approaches, techniques, or models for estimating the variation of grain yield and the manifestation of the individual variety in multifactorial experiments.

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

The dissertation's primary goal is related to a detailed study of the laws related to environmental conditions' influence on the variation and level of the grain yield in winter wheat.

The tasks follow the set goal, skillfully using the possibilities of various statistical methods and approaches to extracting correct information about the genotype * environment interaction in wheat grain production. An analysis of the suitability assesses different systems of a particular variety in terms of a compromise combination between the manifestation of the trait grain yield, plasticity, and stability.

The study was conducted in the period 2009 - 2018 in the experimental fields of AGRONOM I HOLDING, Dobrich. Field experiments were conducted to achieve the goal and tasks. They cover two periods of four and two years, during which signs and indicators related to the yield and quality of grain of 24 different wheat varieties were studied. The first 4-year experiment covered 5 study points, the varieties Enola and Pryaspa used as standards. In the second Polish experiment, the varieties Pryaspa, LG Avenue, and LG Anapurna used in 3 test points for standards, and the number of tested varieties increased to forty. Some of the studied varieties from the first experiment repeated (12 pieces), and the selection includes an additional 26 selection lines, varieties under test, and newly recognized varieties.

A large number of statistical analyzes are used for development purposes.

3. Visualization and presentation of the obtained results.

The dissertation is developed on 185 typewritten pages, incl. forty-six tables and 23 figures and is structured in 8 sequential sections (incl.literature), which are written in a high scientific style and reflect the author's ability to analyze and summarize results independently.

4. Discussion of the results and used literature.

The obtained results are reviewed and analyzed in the section "Results and discussion," in which the interaction genotype * medium at the trait grain yield skillfully interpreted; the various methods for estimating the variation in grain yield as well as the methods for compromising the variety for the size and stability of the grain yield. The author also pays special attention to the suitability of conventional techniques for assessing the level and stability of grain yield by comparing several

different models. Wheat varieties were evaluated through the stability of grain yield to properly zoning the studied varieties.

The results' analysis is performed in-depth, in a logical sequence and a high scientific style. Most of the known indices (parameters) for assessing the effects of the environment are analyzed.

The results from each section are compared with previous publications by Bulgarian and foreign authors.

The established regularities in some aspects are original because they do not confirm the already accumulated knowledge about wheat. The excellent efficiency of some of the analyses results from the application of parametric and non-parametric approaches /e.g., sections 7.4. 7.5. and 7.6, in which the ranking assessments are used for the most objective evaluation of each of the studied varieties /.

The conclusions correspond to the experimental results.

The dissertation cites 215 literary sources, 25 in Cyrillic and 190 in Latin, which confirms the author's good awareness of the studied problem.

5. Contributions to the dissertation.

As a result of the research, scientific and applied scientific contributions have been formulated essential for plant science and practice.

Scientific contributions

1. It has been established that the grain yield of wheat is a significant trait that depends in no small extent on the environmental conditions and the interaction between them and has a complex and multicomponent character.

4. The information on the behavior of the grain yield of the individual variety is relative to the group's background in which it is tested. It can be characterized in any of the four groups according to the size of the yield and its stability.

5. Each of the analyzed methods for evaluation of the genotype * environment interaction in itself gives part of the information about each variety's behavior in the conditions of multifactor field experiments, which, however, is not sufficient for its correct comparison with the other studied varieties.

6. Ranking various evaluation approaches can be successfully used to identify varieties with high yields and strong adaptability to different environmental conditions.

Scientific and applied contributions:

1. It has been found that the non-parametric approach of Huhn (1979) and the parametric method of Francis and Kannenberg (1978) are relatively informative for grouping varieties by yield and stability, and the relationship between grain yield and its stability is most pronounced.

2. It was found that the indices "ASV" and "GA" do not give correct

information about the degree of variation of a particular variety in the group.

3. The combination of the classical method (averaging the data from the different conditions) with the correction of the genotype's stability is a correct approach for grouping the varieties to zoning them in specific environmental conditions.

4. The new wheat varieties created in the last few years exceed the yield and stability standards, despite the strong interaction of the grain yield with the environmental factors.

6. Critical remarks and questions.

I have no critical remarks on the presented dissertation. The doctoral student has sufficient theoretical knowledge and practical experience, so I would recommend studying the interaction between environmental factors and grain quality in wheat.

7.**The published articles and citations.**

The doctoral student has presented three co-authored publications in indexed journals, which cover the necessary 30 points for the acquisition of ONS "Doctor," according to the new Law of development of academic staff in Bulgaria.

There is no reference to the cited documents in the submitted papers.

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

CONCLUSION:

Based on the learned and applied by the doctoral student, different research methods, correctly performed experiments, summaries, and conclusions, I believe that the presented dissertation meets the requirements of the Law of development of academic staff in Bulgaria and the Agricultural University Regulations. It gives me a reason to rate it POSITIVE.

I allow myself to suggest to the esteemed Scientific Jury also to vote positively and to award Todor Kostadinov Gubatov the educational and scientific degree "Doctor" in the scientific specialty "Crop Production."

Date: 3.09.2020
Plovdiv

Prof. H. Yancheva, PhD

(.....)