SCIENTIFIC OPINION

on Ph.D. thesis about awarding the educational and scientific degree „**Doctor**“ in: doctoral program "Plant Growing", Field of higher education: 6. Agricultural Sciences and Veterinary Medicine, Professional field 6.1. "Crop science"

Autor of the thesis: Todor Kostadinov Gubatov, Ph.D. student of self – study at the Department of Crop Science, Agrarian University – Plovdiv.

Thesis title: „Interaction between environmental conditions and grain yield in common wheat (*Triticum aestivum* L.) varieties“.

Referee: Prof. Dr. Nelly Kirilova Valkova - Institute of Field Crops, Chirpan, professional field 6.1 Crop Production, scientific specialty "Breeding and Seed Production of Crops", appointed as a member of Scientific jury according to Order No. РД-16-650 of 27.07.2020 of the Rector of the Agrarian University – Plovdiv.

1. Relevance of the problem.

In the context of the established climate change trends, the study of the impact of environmental factors on the quality and quantity characteristics of crops has become an increasingly relevant and important topic. This dissertation studies the genotype * environment interaction and its impact on grain yield of common wheat, it also offers an assessment of a number of varieties by using a wide range of scientific methods and approaches . The author examines a number of methods and models for assessing the effect environment has on the behavior of the variety in terms of its adaptability and plasticity. The relevance of the problem is discussed in the introduction as well as throughout the main section of the dissertation. The derived conclusions are not only theoretical, but also can be applied in practice.

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

The aim of the study is to research in details the traits related to the influence of environmental conditions on the variation and the level of the grain yield trait in common wheat. In order to fulfil the set target, the study explores three clearly-defined problems related to assessing the degree of impact of environmental factors on grain yield as well as the efficiency of different statistical methods aimed at assessing a common weed variety in terms of its adaptability and plasticity.

The author has chosen suitable methods and approaches that are relevant for the field of study. The data presented in the study examines a total of 24 Bulgarian standard varieties of common wheat, tested in 5 locations of study for comparison. In a second field experiment, set in 3 locations, the number of tested varieties was increased to 40, 13 of which Bulgarian, 9 – foreign, 11 – candidate varieties and 7- breeding lines. In order to produce objective results, each of the selected test locations had a unique combination of soil and climatic conditions. The data from the experiments was analyzed by applying a set of statistical methods and tools - . Gen Stat 15, GEST 98, GGE biplot , 6.3, IBM SPSS Statistics 23, Plant Breeding Tools 1.3, Statgraphics Centurion XVI , Statistica 10, STAR, 2.0.1, XlStat 2014.2.03, Unistat Statistical package 6 , StabilitySof.

3. Visualization and presentation of the results and cited literature

The study contains 185 typewritten pages. The content is well structured and contains all necessary sections. The results of the study are supported by 46 tables and 23 figures, which present the information in a concise and clear manner. Each section ends with a clear summary of the results discussed in the respective section. The list of cited literature includes a total of 215 literary sources, of which 25 in Cyrillic and 190 in Latin letters. 104 of the cited literature sources were written in the past 10 years. The used external sources are relevant for the topic and the main hypothesis of the dissertation. The author demonstrates good knowledge of the subject matter and familiarity with both local and international studies of the problem addressed in the dissertation. The author shows good skills in using existing scientific work and building upon it to make his own conclusions and observations.

4. Discussion of the results presented in the study

The results are analyzed, summarized and interpreted correctly. The PhD candidate demonstrates good knowledge of the subject and the latest analysis methods used in this field. The contribution of the author is evident when comparing his dissertation's results to those presented in the works of other local and international authors. The study contains a complete bibliography and all used sources are cited correctly.

The analysis of the collected data shows that the factors with the highest impact on variation in yield are season (year) and test location. The combination of season × location accounts for 88% of the observed variation. Interaction between the genotype and the environment has a non-linear character with a share of about (20%), which generally makes it difficult to correctly assess the reaction of each variety to others in the group. Applying and comparing the results of different methods, the PhD candidate concludes that the method of Kang (1993) cannot be accepted as a criterion for assessing the suitability of other models for the analysis of variation in MET experiments. The study explores models which can be used to assess the stability of a specific variety in terms of its degree of variance in the group. The study demonstrates that there is no single method which can offer a simultaneous assessment of both the level of the trait and its degree of variation. The studied indices for assessment of the behavior of the trait provide correct information about the stability of each specific variety. The study presents the models which are demonstrated to be most effective for differentiation of the varieties according to their variability in the conditions of MET.

On the basis of the obtained results and conducted analysis, it is concluded the approach for evaluation by ranking by means of statistical indices is correct and fully applicable for differentiation of valuable varieties from each studied group. The grouping of varieties by compromise between grain yield and stability can be done by old simple statistical approaches, the results of which can be reconfirmed by using the latest statistical software programs, which are designed specifically for these purposes (GenStat, GGEBiplot, GEST, Genes, Stable.) After comparing a number of different models for assessment of the level and stability of the yield, the author concludes that the ranking of varieties can be successfully used to identify those in the group with the desired high yield and high adaptation to different environmental conditions. The application of different approaches gives similar information when arranging the varieties from the studied group.

The author makes an assessment of the stability of grain yield of each variety in field experiments by applying various statistical parameters and scientific approaches; he outlines the ones which demonstrate to be most suitable and efficient for the purpose. On the basis of the conducted study, the PhD candidate offers 20 conclusions.

5. Contributions

The dissertation contains scientific-theoretical and scientific-applied contributions, which in terms of content, significance and usefulness for science and practice in the researched field, are sufficient for obtaining an educational and scientific degree "Doctor".The contributions of the PhD candidate's work are summarized at the end of his dissertation paper. The most important ones are as follows:

- The grain yield is impacted and dependent on the environmental conditions. The interaction between genotype and environmental factors is multi-component and complex.

- Each of the analyzed methods for assessment of the genotype × environment interaction in itself gives part of the information about the behavior of each variety in the conditions of multifactor field experiments, which, however, is not sufficient for its correct comparison with the other studied varieties. The ranking of varieties can be successfully used to identify those in the group with the desired high yield and high adaptation to different environmental conditions.

- Relatively informative for grouping varieties by yield and stability are the nonparametric approach of Huhn (1979) and the parametric method of Francis and Kannenberg (1978) in which the relationship between grain yield and its stability is most pronounced. The combination of the classical method (averaging of the data from the different conditions) with the correction by the stability of the genotype is a proper approach for grouping the varieties in order to zoning them in specific environmental conditions.

I accept and recognize all the contribution of the PhD candidate. They are his personal work and proof that he can conduct experimental work on his own and correctly interpret the results obtained.

6. Critical notes and questions

I have no critical notes or recommendations to the dissertation submitted for opinion. Some technical errors in the text were made in the disigh of the thesis and the abstract. These errors are insignificant and do not reduce the value of the thesis.

7. **Published scientific papers and cites**

The abstract presented objectively reflects the structure and content of the dissertation. Three scientific publications in Bulgarian Journal of Agricultural Sciences have been presented in connection with the dissertation. In two of them the Ph D student is being first author. No citations are given.

CONCLUSION

On the basis of the various methods of research, the correctly performed experiments, the sumaries and the conclusions made, the dissertation submitted meets the requirements of the a law for the development of the academic staff in the Republic of Bulgaria and the Agrarian University Regulations for its application, which gives me a reason to rate it **POSITIVE**.

I allow myself to offer the honourable Scientific Jury also to vote positively and to award Todor Kostadinov Gubatov the educational and scientific degree of „Doctor„ in the scientific specialty "Plant Growing".

Date: 25.08.2020
Chirpan

PREPARE THE OPINION:.....
(Prof. Dr. Nelly Valkova)