

## REVIEW



of doctoral dissertation for awarding the educational and scientific degree of “**Doctor**” in area of higher education: 6. *Agrarian sciences and veterinary medicine*; professional field: 6.1. *Crop production*, scientific specialty *Crop production*

**Author of the doctoral dissertation:** Todor Kostadinov Gubatov – a self-study doctoral student at the Department of Crop production, Agricultural University of Plovdiv

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

**Reviewer:** Prof. Dr. Dragomir Gospodinov Valchev, Institute of Agriculture in Karnobat, area of higher education: 6. *Agrarian sciences and veterinary medicine*; professional field: 6.1. *Crop production*, appointed as a member of the scientific jury with Order No ПД-16-650/27.07.2020 by the Rector of the Agricultural University.

### **1. Short introduction of the candidate**

Todor Gubatov was born on 4.07.1958 in the village of Bozveliysko, Varna region. In 1979 he completed his secondary education at the Polytechnic Secondary School in Provadiya. In 1984 he completed his higher education with specialty Plant Protection at the Agricultural University of Plovdiv. From 1983 to 1986 he worked as an agronomist in plant protection at the Agrarian and Industrial Complex (APK) in Vetrino, Varna region. In the period from 1986 to 1991 he worked as a research scientist in the field of biotechnologies at the Institute for Wheat and Sunflower - General Toshevo in the Wheat Breeding Section. In 1988 he acquired the qualification of biotechnology specialist - stress resistance "Genetic engineering of plants" at Colorado State University - USA. Since 1991 he has managed Agronom I Holding EOOD - Varna. The main scope of business of the Holding are wheat breeding and seed production and trade with field crops and farming goods.

### **2. Relevance of the problem**

The selection of common wheat genotypes of high and stable yield is a key aspect in the breeding programmes, which aim at obtaining new forms of high productivity and suitable for various conditions and growing areas. The interaction of genotype × environment has a strong influence on the manifestation of traits, which makes the selection of a suitable genotype even more difficult and complex. The evaluation of this interaction can be used to identify genotypes of high productive potential and phenotype stability in different environments.

The evaluation of any variety of common wheat in terms of its manifestation in diverse ecological environment is essential for its cultivation and zoning. Studying the specific behavior of a common wheat variety in different environmental conditions, which are too diverse in Bulgaria, is a must.

In this regard, the topic is exceptionally dissertable and is of interest to science and practice.

### **3. Aim, tasks, hypotheses and methods of research**

The aim of the study is well defined - to research in the largest possible details the regularities related to the influence of environmental conditions on variation and level of the grain yield in winter wheat. In order to achieve this aim were set 3 tasks pertaining to researching the effect of environmental conditions on grain yield, studying the possibilities of different statistical methods and approaches for obtaining accurate information about the genotype\*environment interaction in wheat grain production, analyzing the suitability of different approaches for objective assessment of a particular variety in terms of a combination compromise between the manifestation of the grain yield trait and its plasticity and stability. The scientific hypothesis pertains to studying the efficiency and objectivity of the evaluation of variety\*environment interaction. Special attention is paid to the comparison between the methods and approaches for evaluation of the varietal behavior in terms of its adaptability and plasticity.

Todor Gubatov has succeeded in providing the required methodological level of scientific research. The material and methods of work are appropriately selected and ensure that objective scientific information is obtained. The study includes 40 varieties of wheat created in Bulgaria. Nineteen of them were created by Agronom I Holding, and three varieties are distributed with a license agreement. The study includes data from a unified field experiment based on the three main factors characteristic of this type of study: genotype (G), year conditions (season E) and test location (L).

For the purposes of the study were used a large number of statistical analyses which were split into three groups depending on the information they provide. To obtain maximum information for each of these groups were used statistical packages of general and specific use, as follows: Gen Stat 15, GEST 98, GGE biplot, 6.3, IBM SPSS Statistics 23, Plant Breeding Tools 1.3 and others.

All of the above lead to conclude that the conducted studies were performed at a high scientific level.

### **4. Visualization and presentation of the obtained results**

The results from the study are presented on 185 pages, organized into 8 sections and include a total of 46 tables, 23 figures and literature list. In terms of composition the dissertation is well organized and follows the traditional structure: Introduction (3 pages), Literature Review (31 pages), Aim and Tasks (1 page),

Material and Methods (19 pages), Results and Discussion (100 pages), Conclusions (3 pages), Contributions (2 pages), Literature (26 pages). The tables are well structured and competently show the statistical and mathematical processed results from the study by all included traits.

### **5. Discussion of results and used literature**

A detailed literature review was done, including 215 literary sources, of which 25 in Cyrillic and 190 in Latin letters. Thematically, it corresponds with the problems the dissertation works on. The literature review shows that Todor Gubatov is well informed about the achievements in this field in Bulgaria and abroad. This allows him accurately and objectively to interpret the results obtained over the years of the study.

The dissertation includes complete characterization of the wheat varieties included in the study.

Soil and climatic characterization was conducted regarding the cultivation conditions at the five locations in the regions of Dobrich, Ruse, Veliko Tarnovo, Yambol and Plovdiv, where the experimental work was carried out.

In the main section - "Results and Discussion" is presented extensive experimental material obtained from conducted field research and maximum data was extracted with suitable statistical analyses by means of modern statistical programmes. Todor Gubatov's approach logically end the main sections with summaries, which bring better completion.

Based on the obtained results the doctoral student establishes that:

The variation of the attribute GY is very strong as a result of the influence of the conditions of the year, the test locations and the genotype, as a factor. The interaction of the trait with the environmental conditions is about 32% of its total variation and is mainly due to the combined effect of the year \* location interaction (88%). 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.

In general, the Kang model (1993) cannot be accepted as a criterion for assessing the suitability of other models for the analysis of variation in MET experiments. The other studied models, which are also well known, are effective to identify the varieties in terms of the value of their variance in the group. This is a serious reason for these models to be used as possible tool to evaluate the stability of a variety individually or in a group, as here. Therefore, it is not possible to make a simultaneous assessment of the level of the trait and its degree of variation by the values of any of the old popular methods studied, especially in a large group of varieties.

The studied indices of the AMMI model which determine the stability of the genotype provide correct evaluation of it. The rank evaluations provide an excellent opportunity to successfully divide the varieties from one group by their variance

value. With regard to grain yield, none of the used indices can differentiate the varieties in terms of their grouping by stability.

The studied indices for assessment of the behaviour of the trait in various environmental conditions provide correct information about the stability of each specific variety. The "ASV" index (AMMI Stability Value) does not provide objective information on the variation of varieties when it is necessary to compare them with each other. The most effective for differentiation of the varieties according to their variability in the conditions of MET are the models of AMMI and GGE especially through their graphic module.

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 information on the grain yield behaviour of the individual variety is relative to the background of the group in which it is tested and for that reason can be placed in any of the four groups. The grouping of varieties by compromise between grain yield and stability can be done by old simple statistical approaches (indices), which have been well known for a long time.

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 for assessment of the level and stability of the yield gives similar information when arranging the varieties from the studied group, as there is no fundamental difference between them. All applied modern methods for analysis of the genotype\*environment interaction are sufficiently informative, therefore they are operative for differentiating the behaviour of varieties in a wide range of growing conditions.

The measurement of the variation of the grain yield of the variety grown in different conditions is an action, which is obligatory for its objective assessment, against the background of the rest of the group. The assessment of the stability of individual grain yield varieties is most objective when using the adjusted average index. 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 zone them in specific environmental conditions. The arrangement of the studied varieties by spatial representation of the yield ranks and its stability is an effective way for complex assessment of the genotype. The assessment of the stability of grain yield of each variety can be done quickly, accurately and correctly, using modern statistical packages created for this purpose.

## **6. Contributions of the doctoral dissertation**

On the basis of the conducted experimental work and obtained results Todor Gubatov draws the conclusions as follows:

### **Scientific contributions**

1. Grain yield in wheat is a productive trait that is highly dependent on environmental conditions due to the complex change in traits from which it is formed.

2. The interaction of the grain yield trait with the environmental conditions has a complex and multi component character, which is difficult to predict and analyze without experiments against the background of the unpredictable conditions of the seasons.

3. The analysis of the change (variation) of the grain yield of the variety, grown in different conditions, is obligatory for its objective assessment, against the background of the other varieties of the group.

4. The information about the grain yield behavior of the individual variety is relative to the background of the group in which it is tested and thanks to it 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 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.

6. Ranking approaches for the evaluation of varieties can be successfully used to identify those varieties of the experiment with high yield and strong adaptability (adaptation) to different environmental conditions.

### **Applied science contributions**

1. Relatively informative for grouping varieties by yield and stability are the non-parametric 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.

2. When applying the indices "ASV" and "GA" it is not possible to obtain correct information about the degree of variation of a particular variety in the group, therefore they should not be used for this purpose.

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

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

### **7. Critical notes and questions**

I have no critical notes or questions.

### **8. Published articles and citations**

Todor Gubatov announces three scientific publications related to the dissertation. Two of them are in English in the Bulgarian Journal of Agricultural Science magazine, and the third is in the Bulgarian Journal of Crop Science (Rastenievadni nauki). He is the first author in two of the articles. No document was submitted on citation of the articles.

The submitted abstract objectively represents the structure and content of the doctoral dissertation.

### **CONCLUSION:**

On the basis of the various methods of research learned and applied by the doctoral student, the correctly performed experiments, the summaries and conclusions made, I consider that the presented dissertation meets the requirements of the Development of Academic Staff in the Republic of Bulgaria Act and the regulations of the Agricultural University for its application, which gives me reason to evaluate it **FAVOURABLY**.

I allow myself to offer the honourable Scientific Jury also to vote favourably and to award Todor Kostadinov Gubatov the educational and scientific degree of "Doctor" in scientific specialty Crop production.

**Date:** 3.09.2020  
Karnobat

**REVIEWER:**

  
(Prof. Dr. D. Valchev)