

## REVIEW

of the official opponent

for PhD thesis of **Tao Ye** «**Plant-breeding Value of Wheat is Depending on the Functional Features of Powdery Mildew Phytopathogens**»,

submitted for a for a Doctor Philosophy Degree (PhD)

Field of study: 20 «Agricultural sciences and food»

in the Specialty 201 «Agronomy»

**Relevance of the topic and the obtained results.** Common wheat (*Triticum aestivum* L) is one of the most important food crops in the world. Wheat provides about a fifth of our food calories and protein. China's annual wheat output accounts for about 17 percent of the global total, making it the world's largest wheat producer. China's wheat planting area is widely distributed throughout the country. In recent years, the planting area has stabilized at about 24 million hm<sup>2</sup>, ranking first in the world. Wheat powdery mildew caused by *Blumeria graminis* F. sp. *tritici* is one of the increasingly serious fungal diseases in wheat production in China and other countries. Powdery mildew is a kind of living parasitic fungi, which has the characteristics of short life cycle, easy long-distance transmission of spores and strong sexual recombination ability. After powdery mildew infection, the wheat plant is easy to lay down, the leaf is dry, the death rate is fast, seriously affects the normal growth and development of wheat. It should be noted that a great deal of scientific work has been devoted to regulating resistance to powdery mildew through agro-technical approaches, but there is a lack of information on alternative approaches to this problem. Therefore, the research topic chosen is undoubtedly important, relevant and quite ambitious, as creating varieties capable of resistance to powdery mildew is a very difficult task that also needs to be studied at the molecular genetic level.

**The most significant scientific results obtained by the postgraduate personally.** In the dissertation, the theoretical aspects of the selected research topic were deeply revealed, a collection of winter wheat varieties from various originator institutions was studied. The authors identified the adult disease resistance of powdery mildew of 86 new wheat line. The experiment was conducted at the Wheat Test Base in Henan Province in 2020-2022. The test materials were from 45 relevant breeding units in China. There are 86 new wheat line. The test carried out powdery mildew resistance identification. And analyzing the source of disease resistance genes. Using pedigree analysis and parental resistance to disease to derive disease resistance genes for varieties that are resistant to disease. The mechanisms of powdery mildew resistance in winter wheat plants were investigated at the molecular and genetic level.

**The scientific novelty of the obtained results consists in** the scientific novelty lies in solving an important scientific problem of creating and evaluating the source material of winter wheat with a resistance to powdery mildew.

*For the first time.* Discovering new resistance genes and analyzing their molecular mechanism is the key to control powdery mildew. The purpose of this study was to clone the *TaGDSL* gene from wheat, explore its role in powdery mildew resistance by using modern molecular biological methods, and analyze its function, so as to provide theoretical basis for the creation of wheat powdery mildew resistance varieties.

*It was improved.* the scheme of evaluation of selection material of winter wheat on the indicator of resistance to powdery mildew. The issue of improving the quality of the crop by controlling certain breeding traits has been further developed.

**The practical significance of the obtained results.** Based on the results of the research, a working collection of winter wheat samples with resisting to powdery mildew was transferred to the laboratory of selection and seed production of Henan Grain Crop Genome Editing Engineering Technology Research Center of China; Materials of study are included in educational programs on disciplines of educational level of Bachelor of 4 Agronomy at Henan Institute of Science and Technology. We identified a gene, *TaGDSL*, that plays an important role in the resistance to powdery mildew. This gene is induced by powdery mildew and plays an important role in wheat resistance to powdery mildew.

**The rationale and reliability of the obtained scientific result.** The obtained results have a high scientific level. The author used a wide toolkit of scientific knowledge and research, which combined generally accepted methods, the latest approaches to solving a scientific problem, has proper statistical processing of results and their objective interpretation. Statistically reliable differences between the research variants were established, the application of mathematical analysis methods made it possible to establish regularities of the effect of one gene on the formation of wheat resistance to powdery mildew. Methods of selection and molecular biology were successfully combined to solve the specific task. The experimental part of the dissertation is informatively illustrated and has a detailed visualization. The experimental data, computational results, and conclusions appear logical, concrete, and convincing, and have the potential for further implementation in scientific programs with other crops.

The main provisions of the dissertation published in 9 scientific works, 9 articles are in a specialized scientific publication, three in specialized Ukrainian publications of the "B" category, and four in publications included in the international scientometric database Scopus, two in specialized scientific journals of the EU. The results were also published in four abstracts of international scientific

conferences. The materials of the publications reflect the main provisions of the dissertation. The chronology of the publication of articles and reports at conferences corresponds to the stages of work at the dissertation.

**The work consists of** an Introduction, an annotation, 4 chapters, conclusions, proposals for breeding and 4 appendices. The list of literature includes 176 items. The content of the dissertation fully reflects the main results given in the research.

**INTRODUCTION** the relevance of the conducted research is briefly substantiated, the task and objectives are formulated, the scientific novelty and practical value of the results, data on the approbation of the results at international scientific events are given.

**CHAPTER 1** provides a review of the literature, which summarizes the theoretical background and argues for the choice of research topics. It was carried out on the basis of modern literary sources, presented concisely, in a logical sequence and with a rather deep analytical approach. Focusing attention on the relevance of breeding methods of winter wheat resistance to powdery mildew, the chapter consistently reveals the possibilities and prospects of using methods of molecular biology.

**CHAPTER 2** describes the materials, conditions and methods of the experiments. It includes practical breeding studies to evaluate source material for resistance to powdery mildew and genetic studies aimed at finding a suitable gene that will ensure the expression of this resistance. The authors describe in detail the methods, pre-treatment and equipment used in the study.

**CHAPTER 3** was carried out in conditions favorable for winter wheat growing. As initial material, In this study, the resistance to powdery mildew was identified in 86 samples of winter wheat that participated in regional tests from different breeding establishments, in order to provide a basis for further research and utilization of these materials. The origin of resistance genes of new wheat samples with excellent resistance to disease was analyzed by genealogy analysis. The results of disease resistance identification and analysis of possible sources of disease resistance genes provide scientific basis for further research and application of these materials.

**CHAPTER 4** is the most illustrated one compared to other parts of the work. The results of research on transgenic lines, cloning of the *TaGDSL* gene and its expression are presented here. Based on the methods of molecular biology, prediction of this gene, the features of powdery mildew resistance, depending on the functions and state of *TaGDSL*, were established. It was found that *TaGDSL* interactions with *Pm46* were demonstrated by yeast hybridization experiments. Based on the research, Enhanced resistance to powdery mildew in *TaGDSL* plants by silencing (RNAi). Functional characterisation of the *TaGDSL* gene in

wheat by a long-growth assay demonstrated that silencing the *TaGDSL* gene can resist powdery mildew in wheat plants. These results support that *TaGDSL* is a negative regulator of powdery mildew resistance. The results suggest that *TaGDSL* silencing has a potential role as it could help generate transgenic genotypic material with resistance to powdery mildew in wheat seeds.

**CONCLUSIONS and PROPOSALS FOR BREEDING** summarize the results of the conducted research. In the programs for creating initial material of winter wheat with high resistance to powdery mildew use the following varieties. Some resistance genes against powdery mildew were suggested. The gene of wheat can be used to develop new resistant powdery mildew genotypes.

**The degree of validity of research results, reliability of data and their novelty.** In the course of research, a rather broad scientific program was carried out. The research was done at modern level, with using methods of breeding and molecular biology according to generally accepted methods. The results of the research are calculated with statistical analysis and have a correct and convincing interpretation. The conclusions of the dissertation are logically composed on the basis of the research results highlighted in the chapters of the work. The dissertation has a high level of scientific novelty. Thus, the dissertation has a high theoretical level, and its results are of significant scientific value for further research.

**Evaluation of the language and style of the dissertation.** The thesis is written in scientific English with the use of a large amount of illustrative material, which improves the understanding of experimental data. A brief summary of the research results, presented in an understandable logical sequence. The style of the dissertation meets the generally accepted requirements in biological and agronomic research.

**Correspondence of the dissertation to the specialty and the profile of the council.** The dissertation totally corresponds to the field of knowledge 20 «Agrarian sciences and food», specialty 201 «Agronomy».

**Discussion clauses and remarks to the dissertation.** Positively evaluating the dissertation work of Tao Ye, at the same time, it is worth to focus on the following remarks and wishes:

1. Please check the English writing of your dissertation for problems. There are some grammatical errors in the text.

2. The literature review is built on the basis of modern literary sources, however, there are extremely few publications by Ukrainian scientists in this list. However, there are a sufficient number these articles on the information resources.

3. CHAPTER 2. "The experiment was seeded in early October 2020, and white powder was inoculated in mid-March of the following year. The strain was a mixed

strain of powdery fungus". Please give details on the inoculation time, inoculation method and how many plants are inoculated with powdery mildew?

4. It is recommended to add physiological indicators to CHAPTER 3 to demonstrate the effect of each variety on powdery mildew resistance, such as yield, plant height, number of spikes, etc.

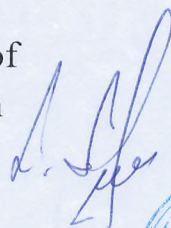
5. In CHAPTER 4 it is described that the *TaGDSL* was obtained by yeast two-hybridization. Therefore please add this section to conclusions to chapter 4.

6. It would be advisable to make the recommendations for practical breeding more detailed, since they reflect the prospect of using the results obtained by the researcher in the further work of author herself and other scientists.

**General conclusion.** The dissertation work of Tao Ye «Plant-breeding Value of Wheat is Depending on the Functional Features of Powdery Mildew Phytopathogens», submitted for defense to the specialized academic council for obtaining the degree of Doctor of Philosophy in the field of knowledge 20 "Agricultural sciences and food» in the specialty 201 «Agronomy» in terms of its relevance, scientific and theoretical level, main results of validity, main provisions and results published in professional publications, and novelty of the setting and practical significance meets the requirements of the order of the Ministry of Education and Science of Ukraine No.40 dated January 12, 2017 «On approval of requirements for registration dissertation» and the Decree of the Cabinet of Ministers of Ukraine dated January 12, 2022 No.44 «On approval of the Procedure for awarding the degree of Doctor of Philosophy! and cancellation of the decision of the one-time specialized academic council of the higher educational institution, scientific institution on awarding the degree of Doctor of Philosophy with amendments made according to the Resolution of the Cabinet of Ministers No.341 dated 03.21.2022. Based on the mentioned above, I believe that the author of the dissertation, Tao Ye, deserves to be awarded the scientific degree of Doctor of Philosophy in the specialty 201 «Agronomy» of the field of knowledge 20 «Agrarian sciences and food».

**OFFICIAL OPPONENT:**

doctor of agricultural sciences,  
professor, professor of the Department of  
Breeding, Genetics and Seed Production  
of the Poltava State Agrarian University



**Mykola MARENYCH**

