

## 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», specialty: 201 «Agronomy»

**Relevance of the topic and the obtained results.** Wheat belongs to *Triticum* of the gramineae family. According to the number of chromosomes, the *Triticum* can be divided into diploid, tetraploid, hexaploid and octaploid *Triticum*. The common wheat is hexaploid wheat. 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. According to FAO data, from 2014 to 2016, the global average wheat planting area was 220 million  $\text{hm}^2$ , the yield per unit area was 3,323  $\text{kg}/\text{hm}^2$ , and the total output was 738 million tons. 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  $\text{hm}^2$ , 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. The development of wheat varieties with the ability to resistance to powdery mildew can effectively increase resistance to powdery mildew, fundamentally solving the problem of its resistant variety by plants. A promising approach in modern breeding in the combination of molecular genetic developments with traditional breeding methods.

**The most significant scientific results obtained by the applicant personally.**

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.

An analysis of the plagiarism check report for the presence of textual borrowings (Strike Plagiarisma Program) was done and it was proved that the dissertation work of Tao Ye "Plant-breeding Value of Wheat is Depending on the Functional Features of Powdery Mildew Phytopathogens" is the result of the applicant independent research and does not contain elements of plagiarism and borrowing in accordance with the resolution of the Cabinet of Ministers of Ukraine dated 12.01.2022 No. 44, paragraph 9. The used ideas, results and texts of other authors have a link to the corresponding source.

**The scientific novelty of the obtained.** 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 resistance 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 validity and reliability of the obtained scientific results.** The reliability of the results of laboratory and field experiments obtained and presented in the dissertation is based on the use of modern general scientific and special methods of research, analysis and synthesis. Evaluating the completed research that formed the basis of the dissertation, it should be noted the successful combination of different methodological approaches (classical selection and molecular biotechnology) to achieve the assigned tasks, which ensured the integrity of the work.

**The main provisions of the dissertation** covered in nine publications, of which nine are articles (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 INTRODUCTION** presents the relevance of the chosen topic, its novelty, the list of tasks, objects and methods of research.

**In CHAPTER 1**, the scientific literature in the topic of the dissertation research are analyzed, it was highlighted the current situation with the hazards of

powdery mildew, the risk of wheat plants being affected by powdery mildew, and the possible ways to solve wheat powdery mildew by traditional breeding methods and molecular genetics methods.

**In CHAPTER 2**, the soil and weather conditions during field research are described. The methodology of field and laboratory research is covered in detail.

**In CHAPTER 3**, the results of the evaluation of the variety collection of winter wheat and the resistance to powdery mildew. Based on the results of the evaluation, the resistance of 86 new wheat strains to powdery mildew was tested. 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.

**In CHAPTER 4**, the study results of the *TaGDSL* gene are obtained using Y2H system cDNA library. The functional properties of the *TaGDSL* gene were studied, and a high degree of conservatism and homology with other plant species was established. The silencing (RNAi) *TaGDSL* plants had enhanced powdery mildew resistance. Functional identification of the *TaGDSL* gene from wheat by the long -growth period assay proved that silencing of *TaGDSL* gene could resist to powdery mildew in wheat plants. After inoculation with powdery mildew, the straw biomass, grain, number of spikelets, and 1000-grain weight of the RNAi lines were significantly more than WT lines at the maturation. These results support that *TaGDSL* is a negative regulator of powdery mildew resistance. our findings demonstrate that *TaGDSL* silencing is potentially useful since it can help generate genetically modified genotype materials with powdery mildew resistance in wheat grains.

**CONCLUSIONS AND PROPOSALS FOR BREEDING** summarize the results of the conducted research, and present proposals for breeding programs to create varieties with resistance to powdery mildew and a complex of valuable traits.

**Evaluation of the language and style of the dissertation.** The structure of the dissertation is logical and it corresponds to assigned aims and tasks defined for

its implementation. The conclusions are based on statistically confirmed research results and correspond to the tasks set. The work contains a sufficient amount of tabular and illustrative material. The author's correct use of indirect indicators and indices is a positive aspect of the work.

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

**Remarks and wishes for the dissertation content.** Evaluating the dissertation positively, the following wishes and shortcomings should be noted.

1. In Chapter 1, there is no analysis of the actual state of indicators of resistance to powdery mildew in the winter wheat in Ukraine and the China.

2. In Chapter 2, subsection 2.1.1 «2.1.1. Test materials»: The 86 winter wheat samples were used to identify powdery mildew. We need to specify the variety characteristics of each sample and how many plants were inoculated with powdery mildew per sample? How is powdery mildew inoculated?

3. In Chapter 4, subsection 4.4.2. "Construction of *TaGDSL* gene RNA interference (RNAi) vector and genetic transformation in wheat" have the title «The *TaGDSL* positively regulated physiological responses to powdery mildew», Although a summary of grain physical properties can be seen in the conclusions of Chapter 4, it is not analyzed in the CONCLUSIONS and ANNOTATION.

4. CATALOGUE, «2.2 Experiment 2. The discovery and functional analysis of the *TaSFT2L* gene». And CHAPTER 2 2.2. «Experiment 2. The discovery and functional analysis of the *TaSFT2L* gene». Please explain the following why *TaSFT2L* gene and not *TaGDSL* gene?

5. CONCLUSION, Fourth point «Silencing of this gene increased wheat susceptibility, indicating that *TaRBL* plays an important role in wheat defense against powdery mildew, providing a reference for elucidating the mechanism of wheat resistance to powdery mildew». How did you get *TaRBL*?

6. In Chapter 4, *TaGDSL* is obtained by yeast hybridization, but it is not

mentioned in the CONCLUSION?

**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. and applicant Tao Ye, deserves to be awarded the scientific degree of Doctor of Philosophy in the specialty 201 «Agronomy» of the field of knowledge 20 «Agricultural sciences and food».

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