

REVIEW

of the official opponent for PhD thesis of

He Songtao

«Complex ecological, physiological and genetic analysis of the response of

***Cucurbita* genus representatives to salt stress»,**

submitted for a Doctor Philosophy Degree (PhD)

Field of study: 10 – Natural Sciences

Specialty: 101 – Ecology

Relevance of the topic and the obtained results. The problem of increasing the area of saline soils on the Earth is complex in its causes and consequences. At the same time, the state of natural and artificial ecosystems will be primarily determined by the ability of living organisms to adapt to salinity conditions. Taking into account the peculiarities of the way of life and role in ecosystems, the processes of response and adaptation to soil salinity, which are realized by plants, are crucial. For cultivated plants, this is also directly related to the issues of ensuring the efficiency of agriculture and the provision of food for humanity. In this regard, the *Cucurbitaceae* family and the genus *Cucurbita* are no exception, whose representatives have long been widely cultivated around the world due to the presence of a number of economically valuable traits. In turn, the successful existence of representatives of the genus *Cucurbita* in saline soil conditions is possible only if they implement a set of adaptation mechanisms that cover different levels of organization, starting with the molecular one.

All of the above confirms the relevance of the topic of He Songtao's dissertation research and the logical definition of the research objective: to establish mechanisms of response to salt stress and adaptation to it, which are implemented by representatives of the genus *Cucurbita* at different levels of organization, as well as eco-physiological aspects of the formation of salt resistance, quantitative and qualitative characteristics of plants when using grafting technology.

The most significant scientific results obtained by the postgraduate personally. The work is distinguished by the fact that it presents the results of a comprehensive ecological, physiological and genetic analysis of the response of *Cucurbita* genus representatives to salt stress. He Songtao has implemented research covering different levels of living organization and logically summarized the results. He Songtao has studied and characterized in detail the effect of salt stress on the size and

vitality of pumpkin plants, on their leading physiological processes, the metabolism of essential organic substances, and on ion absorption and accumulation. The results of the analysis of the expression of the WRKY gene family revealed a number of important regularities in the formation of salt tolerance based on the processes occurring at the genetic and molecular level. The results of studying the use of inoculation technology and arbuscular mycorrhizal fungi to increase the level of salt tolerance of melons and the quality of the products obtained are valuable from both theoretical and practical points of view.

The scientific novelty of the obtained results. He Songtao's dissertation has a number of indicators of scientific novelty that relate to both the methodological aspects of the study and the results obtained. It is worth noting that for the first time, He Songtao logically combined genetic and physiological studies with scientific approaches to plant population ecology, namely the methodology for assessing plant vitality by Y.A. Zlobin. This allowed for a deeper analysis of the peculiarities of the response of representatives of the genus *Cucurbita* to salt stress.

In addition, for the first time there have been screened 12 WRKY family transcription factors in pumpkin in response to salt stress, and analysed their phylogenetic relationships, spatiotemporal 21 expression patterns, tissuespecific expression characteristics, and transcriptional activities under salt stress in detail.

For the first time, the eco-physiological interactions and transformations that occur during the cultivation of *Cucurbitaceae* using grafting technology and the use of arbuscular mycorrhizal fungi were investigated and clarified. The further development of the theoretical and practical principles of the use of salt tolerant pumpkin rootstock for cultivation of watermelon have been gained.

The practical significance of the obtained results. The materials of the dissertation were covered in scientific publications and included in the curricula of the specialties of 101 Ecology at the Sumy National Agrarian University.

The rationale and reliability of the obtained scientific result. The materials presented in this dissertation are based on research conducted at a high scientific and methodological 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.

The main provisions of the dissertation published. Research results of He Songtao are presented in 12 scientific works: 3 articles were published in a scientific journals, included in the database of Scopus/Web of Science, 3 articles were published in professionals scientific journals of Ukraine, 6 - abstracts of reports at scientific conferences.

The work structure meets the established requirements. It consists of Abstracts, List of published works on the theme of the dissertation, List of conventional abbreviations, Introduction, three Chapters, Conclusions, the List of sources and Appendices.

The INTRODUCTION, in accordance with the established requirements, presents there levance 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. The chapter contains four subsections.

CHAPTER 2: The methodology of research is covered in detail. The chapter contains four subsections.

CHAPTER 3: The results of the research are presented. The section contains 5 subsections. The ecological, physiological, genetic aspects of adaptation and response of genus *Cucurbita* to salt stress are described in detail. The data on the use of grafting and interspecies interactions to ensure adaptation and increase salt tolerance of plants are presented.

CONCLUSIONS summarize the results of the conducted research.

The content of the dissertation fully reflects the main results given in the research.

The list of references includes 352 sources. The dissertation contains five appendices.

The degree of validity of research results, reliability of data and their novelty. The reliability of the research results presented in the dissertation is based on logical, scientifically based the use of the complex theoretical (analysis, synthesis, explanation, generalization, a mathematical and statistical) and empirical (experiment, measurement, comparison) research methods. Experimental field and laboratory ecological-physiological and laboratory genetic studies were carried out, chemical, spectrometric, fluorescent, morphometric, and vitality analyses were applied, and among mathematical and statistical calculations, point estimation of statistical series and dispersion analysis were used. The data of mathematical and statistical calculations

objectively confirm the reliability of research results. The dissertation has a high level of scientific novelty.

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. 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.

Correspondence of the dissertation to the specialty and the profile of the council. The dissertation is a completed scientific study totally corresponds to the field of knowledge 10 «Natural Sciences» specialty 101 "Ecology".

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

1. In CHAPTER 1, subsection 1.3 is significantly larger than the others. To optimize the proportionality between the subsections, the literature review on genetic aspects of providing salt tolerance plants should have been presented in a more concise format.

2. The paper does not characterize in sufficient detail the properties of the pumpkin varieties (cultivars) covered by the study. For example, cultivar 'Baimi112', which was used in the study of pumpkin rootstock on the growth of grafted watermelon.

3. The information in Figure 2.1 should have been presented in the appendices

4. Despite the fact that the work is well illustrated, in it would be worthwhile to present three-dimensional graphs and models that would demonstrate the response of representatives of the genus *Cucurbita* to different levels of salt stress.

Wishes for the dissertation: Taking into account that the state of agroecosystems and their productivity is largely determined by the state of the rhizosphere, He Songtao should continue and expand research aimed at studying the effect of arbuscular mycorrhizal fungi on the state of plants genus *Cucurbita* and their agropopulations

General conclusion. The dissertation work of He Songtao «Complex ecological, physiological and genetic analysis of the response of *Cucurbita* genus representatives to salt stress», which was submitted for defense to the specialized academic council for obtaining the degree of Doctor of Philosophy in the field of knowledge 10 – «Natural Sciences», specialty 101 «Ecology», in terms of relevance, scientific and theoretical level, main results of validity, provisions and results published in professional publications, novelty of the formulation and practical significance meets the

requirements of the order Ministry of Education and Science of Ukraine No. 40, January 12, 2017 «On approval of requirements for registration dissertation» and Resolution of the Cabinet of Ministers of Ukraine of 12-th January, 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 institution of higher education, scientific institution on awarding the degree of Doctor of Philosophy» with changes introduced in accordance with 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, He Songtao, deserves to be awarded the scientific degree of Doctor of Philosophy in the specialty of 101 – «Ecology» of the field of knowledge 10 «Natural Sciences».

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