УНИВЕРСИТЕТ
по Архитектура, Строителство и Геодезия
1046 София, бул. "Хр. Смирненски" №1
Регистрационен индекс и дата
1354/01.09.2025г.

REFERENCE

on the dissertation ***"Soil-climatic assessment when creating vineyards for white wines"***

for obtaining the educational and scientific degree "Doctor" in the field of Higher Education, professional field 5.7. Architecture, Civil Engineering and Geodesy, scientific specialty "Land Management and Agricultural Land Protection (incl. Property Management)" at the Department of "Sustainable Land Use and Property Management" at the Faculty of Geodesy of the University of Architecture, Civil Engineeringand Geodesy - Sofia

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Scientific consultant: Prof. Dr. Eng. Margarita Mondeshka-Nedyalkova, UACEG

Reviewer: Prof. Dr. Metodi Teoharov Kostadinov, retired, Sofia-1229, Nadezhda 3, bl. 307, entrance G, ap. 98, e-mail: **mteoharov@abv.bg**; mobile phone: 0884 123 823, Professional field 6.1. "Plant breeding", scientific specialty "Soil science", appointed as a member of the Scientific Juri by order N 404/09.06.2025.

1. Brief biographical data

Assistant professor Eng. Lyubomir Stoyanov was born on 01.04.1991 in Sofia. In 2017, he graduated with a bachelor's degree from the Faculty of Geodesy of the University of Agricultural Sciences and received the qualification "Engineer in Land and Property Management", and in 2019, a master's degree and qualification "Engineer in Management of European Infrastructure Projects". From 2017 to 2020, he worked as a junior expert at the Road Infrastructure Agency and the Geodesy, Cartography and Cadastre Agency - Sofia. He holds certificates for an appraiser of real estate, agricultural land and perennial crops. Since February 2020, he has been an assistant professor at the Department of Sustainable Land Use and Property Management at the Faculty of Geodesy, where he leads classes in the disciplines of Soil Science, Ecology, Land Use and Protection, Agricultural Territory Planning, Territory Planning and Real Estate Valuation. From the very beginning, he began research work on developing a multi-level model for assessing the agro-ecological conditions of "soil-climate-vine" system for vineyards establishment and white wines production. He was enrolled as a freelance PhD student on 30.01.2024 and finally completed his dissertation on the topic "Soil-climatic assessment when creating vineyards for white wines" on 18.02.2025, when he obtained the right for dissertation defense. Assistant Professor Stoyanov speaks English very well and this gives him the opportunity to follow the innovations and achievements in his scientific specialty. He has serious professional training in the specialty and the potential to develop significant topics and tasks and to solve current problems in science and practice. He has proven himself as an organized and proactive researcher and a precise and talented young scientist in the field of soil and land resources management and their rational use. He is a member of the Bulgarian Soil Science Society.

2. Relevance of the problem and benefits for practice

The cultivation and widespread distribution of varieties for white wines in the world as well as in our country has been of century's importance. Currently, the great interest of humanity in these varieties and wines continues to stem from their high technological, taste and, last but not least, healthy qualities for humans. The grapevine cultivation is carried out directly in open natural conditions and their influence plays an important role in its development and fruiting. Scientific knowledge of the soil environment, climate and geomorphological conditions through their indicators is essential for the cultivation of grapevine varieties for white wines. In this regard, science requires the implementation of sustainable management of soil and land resources in the individual wine-growing regions of Bulgaria, using original and proven results for soil and climatic conditions. The study of climatic elements, properties and qualities of each individual soil are the basis for the accurate determination of agro-ecological requirements and zoning of grapevines. Climatic changes and impacts, the constant decrease in soil fertility due to anthropogenic and technogenic impacts require the development and application of modern methods and models for growing modern grape varieties and producing white wines. This can only be achieved through scientific parameterization of soil and climatic conditions, indicators and elements for real proof of the agro-biological, agro-industrial and technological potential of grape varieties for such production in each region.

In this regard, the development and application of modern interdisciplinary models are the basis for obtaining good results. In this sense, I highly appreciate the chosen scientific topic and the developed dissertation work by the PhD student and I believe that they are particularly relevant, timely and useful for soil and viticulture. I am convinced of the possibility of their widespread application in practice. Evidence of this is the data and results obtained on geomorphological and soil-climatic conditions and the developed five-stage model. The relevance and benefits also stem from their emphasized agro-ecological, business, economic and social significance. Given the above, I accept that the developed topic is relevant, proven in a regional aspect and extremely important for practice.

3. Literary competence and study of the problem

The literature review is presented on 55 pages and occupies 38% of the dissertation. 118 sources were used, of which 37 in Bulgarian and 81 in English. It includes 5 important sections and 13 subsections, which fully cover and defend the goals and objectives of the dissertation and its subject matter. The general part consistently examines indicators that form the assessments of soil, climatic and geomorphological conditions and their influence on grapevine, the main grape varieties for creating modern and effective grapevines in Bulgaria. Finally, an analysis of the current methodology is made. Both modern and old classics by Bulgarian and foreign authors, but mostly from the last two decades, were used to reveal the main diagnostic and agro-ecological indicators for assessing the terroir environment, the factors and conditions that prove suitable for growing varieties for white wines. Particular attention is paid to sources that determine the characteristics and qualities of white and red wines. In this regard, many authors and studies are cited, providing new information about the influence of climatic conditions, topography, slope and exposure on their cultivation. Attention is also paid to slopes with different components, relief and altitude and, last but not least, important diagnostic indicators, such as soil profile depth, texture, humus content, total carbonate content, soil moisture, groundwater table, soil reaction and total soil porosity. Specific authors and results are cited for agro-climatic indicators that determine the temperature, air and precipitation regimes of soils and the terroir environment, related to the vine ontogenesis. On this basis, specific sources of recommended wine grape varieties with the best suitability in viticulture regions and zones of Bulgaria and the European Union have been studied. It is striking that after each important diagnostic and evaluation indicator in the subsections, it ends with certain and specific conclusions. The most

important points related to the diagnostic indicators in the literature review, summarized as conclusions at the end of each subsection, I find very relevant and correct. Considered in a broader aspect, the conclusions made have the character of significant innovations that can be used for transfer into practice. This is further evidence of the correct choice of literary sources, their accurate interpretation for the purposes of the tasks set and their connection with practice. The very good language knowledge, modestly indicated as good by the author, allows him to cite a series of suitable and ready-to-implement grape varieties for white wines. Assistant professor Stoyanov, as a young soil scientist and agroecologist, is well acquainted with and uses the methodology for working on the cadastre of agricultural lands in Bulgaria, which allows him to assess its advantages and disadvantages and to take advantage of this to establish a new methodological framework in his research.

Overall, the literature review, the general and methodological parts of the dissertation are scientifically sound, purposeful and precisely presented in terms of content. I perceive their presentation and knowledge as an important stage of the PhD student education, with which he convincingly defends his educational degree.

4. General characteristics and evaluation of the dissertation work

The dissertation work has been developed in accordance with the Law on the Development of the Academic Staff in the Republic of Bulgaria and the Regulations on the Conditions and Procedure for Acquiring Scientific Degrees and Titles of Academic Positions at the University of Architecture, Civil Engineering and Geodesy. The total volume is 146 pages, including 46 tables and 22 figures. The content gives a broad view of the large-scale scientific research work carried out. All this is proven with rich research material, data and information. The topic is scientifically formulated, up-to-date, methodically sustained and strictly agro-ecological. The rich textual, evidentiary and illustrated materials are very stylishly and clearly presented. The main chapters, sections and subsections of the dissertation include parameters and characteristics that clearly and convincingly defend the dissertation topic. Overall, it is well-formed and represents an interdisciplinary and multi-layered scientific work, proving interrelationships and regularities in the "soil-climate-vine" system.

The goal is precisely justified and achieved through four scientific tasks, namely:

1. Review of literature related to the impact of environmental factors on the vineyards development and viticulture.

2. Parameterization of indicators (climatic, soil, geomorphological) that have an impact on the development of vines.

3. Development of an adapted and supplemented model for soil-climatic assessment of geographical territories, showing the degree of their suitability for growing highly productive vineyards for white wines.

4. Assessment of the soil-climatic conditions in the Karlovo, Rousse, Varna and Kavarna municipalities for creation of highly productive vineyards for white wines, based on the biological characteristics and requirements of the relevant grape varieties.

Agricultural territories from four municipalities were selected as objects of research and application of the model, where the possibilities for agro-ecological and model cultivation of vineyards for white wines have not been sufficiently studied. For this purpose, modern methodological research approaches were applied, which include the use of a five-stage model for assessing impact and processes, developed for environmental conditions by Mondeshka (2012), adapted and further

developed by Mondeshka-Nedyalkova (2025) for fruit crops and improved and applied by the author of the dissertation on grape cultivation.

The general part of the dissertation is purposeful and consistent with the researched indicators, is interpreted correctly and is arranged in a meaningful and scientifically sound manner with appropriate sources. The special part occupies 62% and is entirely aimed at proving the five-stage model with a lot of data, information and illustrated materials. I believe that the development and implementation of such models for assessing the given environment, conditions, processes and phenomena is an extremely important and responsible scientific research of great importance for the sustainable management of the studied resources. The author of the dissertation applies an interdisciplinary approach and carries out complex research to create a five-level model for assessing the soils, climate and topography of the regions selected by him. Using national and foreign experience in science, he carries out in-depth complex research to create a five-level model for scientific assessment of the soil environment, climatic and topographic conditions and the introduction of varieties for white wines in the regions selected by him. Having become acquainted with international experience and in particular with the nine-level model of Saaty (2012), which is quite complicated and difficult to implement, Assistant Professor Stoyanov adheres to the five-level model of Mondeshka-Nedyalkova (2025) and has the opportunity to improve it for the grapevine culture. The parametric nature of the model is clearly protected by a formula that takes into account the vulnerability, probability and significance of risk and limiting factors. All this allows the author to develop a risk assessment matrix that visually, with color scales, shows its categories. Additionally, a matrix has been developed to determine the significance of risk impacts, in order to prevent and limit their occurrences. The model has been developed in stages, with the first four stages being basic and leading, in this: selection of appropriate indicators, definition of assessment intervals, determination of weighting coefficients (according to the significance concerning the vine) and summarization of the assessments through a three-dimensional matrix (x, y, z) and suitability classification. Terroir impacts and interactions of the main factors and conditions are a continuation of the model's proof and are systematized in three stages:

1. Set determination of soil and climatic indicators necessary for the purpose.

2. Evaluation scales and correction coefficients.

3. Assessment of environmental conditions, which includes: a) soil and climatic conditions; b) a comprehensive assessment of the same.

On this basis, assessment scales have been developed for the thickness of the soil profile, total porosity, humus and carbonate content, soil reaction and groundwater table. Based on the proven assessment scales, the optimal values for the white wines production have been given. Precise research and assessment work has been carried out on the climatic elements, which allows four assessment scales to be proven: for air temperature, annual temperature sum, annual precipitation sum and amount of precipitation in the months of September and October. The developed parametric assessments of soil and climatic conditions in connection with the vineyards creating in Karlovo, Rousse, Kavarna and Varna municipalities determine the scientific and applied nature of the thesis. For this purpose, when assessing soil and climatic conditions, the author correctly first develops additional characteristics of the soil, climatic and topographic conditions, and then makes an assessment of the same. These characteristics specify the assessments and give a broader idea in many cases of the individual limiting factor. In the general assessment of the conditions and factors, the soil characteristics are reduced to a subtype level and the indicators are filled with verified results for soil diagnostics, which makes the parametric assessments very accurate. For each agricultural territory, conclusions have been made for the cultivation of the relevant varieties, according to their terroir

environment. A conclusion has been made for the Karlovo municipality, which shows that the complex assessment after correction of the risk factors is 3.21 for soil conditions and 3.72 for climatic conditions and according to the integral matrix, the land of the municipality falls into the category with very good conditions. Suitable for cultivation are the medium-ripening varieties Misquet Cherven, Sauvignon Blanc, Chardonnay, etc. The same assessment approach has been used for the other municipalities. The land of the Rousse municipality falls into the category of terrains with very good conditions and suitable for growing white wine varieties Misket Vrachanski, Viognier and Dimyat and is characterized by favorable climatic conditions. For Kavarna, mid- and late-ripening white wine varieties such as Sauvignon Blanc, Chardonnay and Riesling Italian are recommended. The land of Varna has almost the same conditions, but here mid-ripening white wine varieties such as Rkatsiteli, Chardonnay and Sauvignon Blanc are recommended.

5. Contributions of a scientific, confirmatory and scientific-applied nature

5.1. Contributions of a methodological and fundamental nature

5.1.1. Scientifically based modern approaches and methods for parameterization of soil, climatic and geomorphological indicators and conditions related to the cultivation of grapevines and the production of white wines have been studied and applied.

5.1.2. A modern and established paradigm has been used to assess the risk effect of external impacts, the probability of their occurrence and the significance of the risk of their influence according to established criteria.

5.1.3. A new five-level model with 12 scales for complex agro-ecological assessment with quantitative values for interpreting the characteristics of soils, climate, topography and grapevines has been created. The model proves its visible advantage over those created based on the use of relative values for assessment.

5.1.4. I appreciate as a fundamental contribution the transfer of assessment indicators proven by foreign scientists, with the aim of improving the multi-level model for assessing the suitability of the vine under certain local growing conditions.

5.1.5. I highly appreciate the created five-level model and consider it a successful scientific experiment to prove the significance of the previously developed model of Mondeshka-Nedyalkova (2025) and its improvement through the current development by Assistant Professor Stoyanov with new methodological approaches, tailored to the requirements and suitability of the grapevine culture.

5.1.6. In terms of its importance, the created model is comparable to the Land Evaluation of FAO-UNEP (1979), which allows to determine, eliminate or limit the limiting factors in the introduction of new varieties for the white wines production.

5.2. Contributions of a confirmatory nature.

5.2.1. The created five-stage model confirms its use by other agricultural crops, which is of great importance in creating permanent plantations, in particular in growing vineyards for the production of white table wines.

5.2.2. I appreciate as a contribution of a confirmatory nature the quantitative parametric assessment of external conditions and factors, with the aim of the appropriate and effective use of soil and land resources and increasing soil fertility.

5.2.3. The terroir environment and the studies carried out on the vine confirm the importance of the genetic principle in studying soils and the possibility of diagnosing them accurately at the relevant taxonomic levels, which allows for a quantitative parametric assessment of the biological potential of the grapevine crop, with the aim of its environmentally friendly cultivation.

5.2.4. New confirmatory data and information have been obtained for the management of risk factors and impacts when growing grapevine varieties for white wines.

5.3. Contributions of a scientific- applied nature.

5.3.1. I highly appreciate the scientific model for a virtually implemented project through the parametric assessment of soil-climatic and geomorphological conditions and factors in connection with the establishment of vineyards for white wines in the Karlovo, Rousse, Kavarna and Varna municipalities.

5.3.2. The developed scientific work responds to the call made in the National Strategy for the Development of Viticulture and Winemaking in Bulgaria (2000-2025) for the implementation of modern methods and technologies for growing vineyards and producing white wines.

5.3.3. The main scientific-applied contribution of the developed dissertation topic is the new scientific and practical approach to reflecting the different information levels in the development and implementation of projects for the organization, creation and cultivation of vineyards for white wines and their agro-ecological zoning.

6. Evaluation of the abstract

The abstract is written in accordance with the legal requirements and the Regulations for their application. The results are presented in 46 tables and 23 figures with appended literature of 118 sources. It is a very good guide to action. The total volume is 72 pages. The results of the thesis, presented in this way, accurately and truthfully reflect the content of the dissertation work. I do not find any significant errors and omissions in the presentation of the text and the appended materials.

7. Evaluation of scientific publications on the dissertation work

In accordance with the requirements, the abstract lists three articles in Bulgarian. They were published consecutively in 2024 and 2025 in the Annual of the University of Architecture, Civil Engineering and Geodesy. Since they were not presented to me, it is not possible to evaluate them scientifically. From the title, I understand that they have developed topics and ideas of the scientific profile of the dissertation and the department in which the PhD student works. One of the articles is independent, in the second he is the first author, and in the third he is the second author, which shows that he can work and interpret the results independently.

8. Assessment of the personal contribution of the PhD student

Judging by the professional field and scientific profile in which the dissertation work was developed and the scientific articles were published, the literature used, the professional back ground and qualities of the PhD student, it is clearly seen that his share is more than significant and definitely stands out. The applied interdisciplinary and integrated approach to results interpreting to the greatest extent expands his scientific horizons for independent work and complements the educational and scientific disciplines with new ideas and knowledge. The author's share in the publications, the scientific style and his own handwriting by the dissertation development are visible evidence of the emphasized personal contribution of the PhD student to his overall scientific research work, which

exceeds the required minimum of points according to the relevant scientometric indicators and defends his scientific degree "Doctor".

9. Critical remarks

1. In all international and national soil classifications it is accepted that their nomenclature at the type level is necessarily to be marked with a capital letter.

2. According to the accepted versions of the national classifications from 1983, 1992 and 2019, it is not correct for Pseudopodzolic soils to have a double name/nomenclature.

3. Dark Gray and Light Gray soils have a changed nomenclature in accordance with the World and National Soil Classification and are marked as Phaeozems and Luvisols, respectively.

4. In the title of the topic, it is more correct to use the word "creation", which includes the preliminary creative scientific activity of the PhD student, carried out with the aim of "building vineyards for white table wines".

5. The table number is missing on page 38.

6. The literature does not mention WRBSR (2006, 2022), used in the text.

7. There are a few technical errors (pp. 17, 22, 31, 47, 74, 78, 79, 87, 90, 97, 98, 101, 1021 103, 107, 121).

8. On the title page, it is correct and legal to write that the developed work and the Abstract are for the award of the educational and scientific degree "doctor", and not for a scientific-educational one, which in its essence and content is a lower level, if at all it can be conditionally assumed that there is one.

The remarks made do not in the least diminish the scientific and innovative significance of the dissertation work and the achieved scientific results and contributions.

Conclusion:

The developed scientific work is a completed scientific study with actually proven results and contributions to science and practice. The overall scientific research activity fully meets the scientometric indicators and criteria of the Law on the Development of Academic Staff in the Republic of Bulgaria and the Regulations on the conditions and procedure for acquiring scientific degrees and occupying academic positions at the University of Architecture, Civil Engineering and Geodesy. With full conviction, I recommend to the members of the esteemed Scientific Jury to vote positively and to award Assistant Professor Eng. Lyubomir Lyudmilov Stoyanov the educational and scientific degree "doctor" in the professional field 5.7 Architecture, Civil Engineering and Geodesy, scientific specialty "Land Management and Agricultural Land Protection (incl. Property Management)".

08/27/2025 Reviewer:

/Prof. Dr. Metodi Teoharov/