# STATEMENT

on a dissertation thesis for the award of the educational and scientific degree "Doctor" in: field of higher education Agricultural Sciences and Veterinary Medicine, professional field 6.1 "Crop Production," scientific specialty "Forage Production and Grassland Management"

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Title of the dissertation thesis: **Study on the Potential of Natural and Artificial Grasslands for $CO_2$ Sequestration.**

Reviewer: Assoc. Prof. Katya Uzundzhalieva, PhD, Institute of Plant Genetic Resources – Sadovo, field of higher education Agricultural Sciences and Veterinary Medicine, professional field 6.1 "Crop Production," scientific specialty "Breeding and Seed Production of Cultivated Plants,"
appointed as a member of the scientific jury by Order No. RD-16-475/02.04.2026 of the Rector of the Agricultural University.

**1. Relevance of the problem.**

The dissertation represents an in-depth study of the potential of grasslands to absorb $CO_2$, which can serve as a powerful tool in combating climate change. This determines the relevance and significance of the issue under consideration in the context of changing climatic conditions.

The identification of components that stimulate carbon uptake, as well as the development of innovative management practices, are of key importance for increasing the capacity of these ecosystems to absorb $CO_2$. In the context of a changing climate, efforts to promote the sustainable management of grasslands will be essential for reducing emissions and mitigating the negative effects of global warming.

This study aims to investigate the potential of natural and artificial grasslands for carbon sequestration, which may contribute to long-term ecological balance. The functionality of grasslands goes far beyond their role as a source of forage. They play an important role in protecting soil from erosion, regulating the water regime, and contributing to biodiversity within grassland communities.

Over the past decade, grassland ecosystems have also been considered as an opportunity for capturing and storing $CO_2$. In our country, grassland communities occupy approximately one-third of the utilized land. However, studies on the potential of these grasslands for $CO_2$ uptake and accumulation are almost entirely lacking. This is precisely what motivates the present research and makes the topic highly relevant.

**2. Aim, objectives, hypotheses, and research methods.**

The aim of the present dissertation is clearly and precisely formulated, namely to investigate the capacity of natural and artificial grasslands for carbon

sequestration. To achieve this aim, three specific tasks have been defined.

The object of the study includes four different experimental sites, each characterized by specific features. The methods employed fully correspond to the set objectives, the expected results have been obtained, and the relevant conclusions have been drawn.

Data on agroclimatic conditions for the period 1991–2020 are provided. A statistical analysis of all collected data has been performed using the Multiple Regression method.

**3. Visualization and presentation of the obtained results.**

The dissertation comprises 175 pages and includes all mandatory components. It is very well illustrated, with the obtained results presented in 61 figures, 37 tables, and 3 photographs.

**4. Discussion of the results and references used.**

The results of the conducted research are presented clearly, precisely, and comprehensively. An agrometeorological characterization of the meteorological conditions in the studied regions during the experimental period has been made. The species composition and basal cover of grass stands in four polygons have been studied, and the general patterns and specific characteristics determining the relative contribution of each pasture area to carbon sequestration processes have been identified, with corresponding conclusions drawn.

For each polygon, the soil carbon content has been determined, which is a key indicator of soil fertility, ecological status, and its potential participation in the carbon balance and climate processes. Another important indicator that has been assessed is $CO_2$ uptake activity, expressed through photosynthesis intensity, which is a key parameter for evaluating the carbon balance of grassland ecosystems and an essential element in analyzing measures related to combating global warming and mitigating climate change.

The diurnal variation of $CO_2$ fluxes at different times of the day has been monitored, mainly regulated by the biological processes of photosynthesis and respiration, as well as the diurnal fluctuations of soil respiration, which is a major component of the carbon cycle and reflects the metabolic activity of soil organisms and the root system. Grassland ecosystems occupy a central place in the carbon cycle, as they combine high dynamics of carbon exchange with the potential for long-term storage of organic carbon.

In this context, a study has been conducted on the capacity for carbon uptake and storage in natural and artificial grass stands. A relationship has been established between climate, species composition, and carbon accumulation in plants and soil. The obtained results clearly show that climatic factors—temperature and precipitation—play a decisive role in the intensity of carbon exchange within the ecosystem. Statistical analysis of the data has been performed.

Based on the overall experimental work, precise statistical processing of the results, and competent discussion, 15 conclusions have been drawn, which I accept as reliable, and the objectives and tasks of the dissertation have been successfully fulfilled. The references used include a total of 288 sources, of which 10 are in Cyrillic, and all others in Latin script.

**5. Contributions of the dissertation.**

The contributions are characterized by originality, significance, and potential for practical application.

## Scientific contributions

There are 9 scientific-theoretical contributions:

1. A concept for the spatial differentiation of agroclimatic conditions depending on altitude has been developed, demonstrating their influence on the duration of the vegetation period, temperature sums, and precipitation regime.
2. Theoretical understanding of the impact of climate change on grasslands has been enriched, identifying trends toward increasing temperatures, extended vegetation periods, and increased frequency of droughts.
3. Regularities in the spatial organization and structural-functional differentiation of grassland phytocoenoses depending on climatic factors have been established.
4. The relationship between species diversity, functional structure of plant communities, and their ecological stability and self-regulation has been demonstrated.
5. The role of main functional plant groups (grasses, legumes, and forbs) in the formation of productive and stable grassland ecosystems has been shown.
6. Theoretical knowledge of carbon cycle processes in grassland communities has been expanded through analysis of the relationship between photosynthesis, soil respiration, and carbon accumulation.
7. Relationships between climatic factors and the intensity of carbon exchange have been established, proving the leading role of temperature and moisture.
8. A distinction between grasslands with high instantaneous productivity and those with high potential for long-term carbon storage has been substantiated.
9. The concept of mountain grassland communities as stable carbon reservoirs in the context of global climate change has been further developedScientific-applied contributions

**There are 10 scientific-applied contributions**:

1. A comprehensive agroclimatic assessment of regions at different altitudes has been carried out, applicable to land-use planning and management.
2. The risk of drought in lowland areas has been assessed, and zones with more favorable water regimes have been identified, which has practical significance for adaptive grassland management.
3. An approach for assessing the ecological stability of grassland ecosystems based on species diversity, structural characteristics, and climatic conditions has been proposed.
4. The potential of different grassland communities for $CO_2$ accumulation has been quantitatively evaluated, enabling its use in developing climate regulation measures.
5. The seasonal dynamics of soil organic carbon have been established, applicable for monitoring and assessment of soil fertility and carbon balance.
6. The influence of climatic factors on photosynthetic activity and soil respiration has been demonstrated, which can be used in developing sustainable ecological practices.
7. A regression model has been developed to assess the influence of climatic

and ecological factors on carbon exchange in grassland communities.
8. Phytocoenoses with high potential for long-term carbon storage suitable for various restoration practices have been identified.
9. The importance of maintaining high biodiversity and sustainable grassland management for optimizing the carbon balance has been established.
10. The obtained results can be used in developing strategies for climate change adaptation and sustainable management of agroecosystems.

**6. Critical remarks and questions.** None.

**7. Published articles and citations.**

A total of 3 scientific publications related to the dissertation have been published.

The submitted abstract accurately reflects the structure and content of the dissertation.

**CONCLUSION:**

Based on the research methods learned and applied by the PhD candidate, the properly conducted experiments, and the conclusions and generalizations made, I consider that the presented dissertation meets the requirements of the Law on the Development of Academic Staff in the Republic of Bulgaria and the Regulations of the Agricultural University for its implementation, which gives me grounds to evaluate it **POSITIVELY**.

I would like to propose to the esteemed Scientific Jury to also vote positively and to award / not to award GEORGI KRAEV STANCHEV
the educational and scientific degree "Doctor" in the scientific specialty "Forage Production and Grassland Management."

**Date:** 04.05.2026

Plovdiv