

## RESEARCH ON THE USE OF BLACK WALNUT (*JUGLANS NIGRA* L.) PROTECTIVE CURTAINS IN THE CONTEXT OF CURRENT CLIMATE CHANGE

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### Abstract

*In recent decades, climate change has become an observed reality of extreme weather events, representing the greatest threat facing humanity and the environment. An unbalanced distribution of Romania's green cover in the current climate change, requires as a long-term solution the planting of protective forest curtains to maintain the sustainability of the agricultural sector. Selecting genotypes with high resistance not only protects agricultural crops, but also contributes to the creation of natural barriers against wind and soil erosion, directly improving the quality of the environment and ensuring the protection of agricultural infrastructures and local ecosystems. In this context, the present study aims to analyze and highlight the role and importance of the black walnut species (*Juglans nigra* L.) with resistance and suitability for protective curtains. The selection and conservation of black walnut genotypes that show high adaptability and resistance to climatic variations are essential for the development of sustainable and efficient protective curtains. These vegetal curtains have the role of reducing the negative effects of climate change on agricultural crops and ecosystems, thus contributing to ensuring the sustainability of agriculture and environmental protection. The results obtained highlighted the fact that the implementation of activities to identify and conserve resistant genotypes not only protects agricultural crops, but also contributes to the creation of natural barriers against wind and soil erosion, directly improving the quality of the environment and ensuring the protection of agricultural infrastructures and local ecosystems.*

*Keywords: agricultural crops, climate changes, ecology, protection curtains.*

### 1. INTRODUCTION

In recent decades, climate change has become an observable reality, defined as long-term changes in average meteorological values that have come to redefine local, regional and global climates across the Earth. The major effect of climate change on ecosystems can be attributed to extreme weather conditions, increasing temperatures (global warming), major variations in precipitation and an increase in the frequency of cold waves, frost days, droughts and floods (Roussos, 2020).

As for the Romania country, climate data indicate that if until 2005, it experienced an increase of about +0.5°C in the average annual temperature (Hălbac-Cotoară-Zamfir et al., 2019), the value has exceeded +1.0°C deviation annually in the last 20 years accompanied by new seasonal and precipitation patterns that affect, among others, biodiversity, green spaces and ecosystems (Tache et al., 2024).

According to Food and Agriculture Organization Statistics (FAO, 2025), the year 2024 is considered the warmest with annual average temperatures reaching new records, approaching the critical warming threshold by +3.27°C compared to a baseline climatology, corresponding to the period 1951-1980 and long-term non-uniform changes in the precipitation pattern. Multiple analyses of the impact of climate change on Romania, given that our country has faced catastrophic phenomena and calamities in recent decades (drought, floods, torrents, erosion and landslides with destructive effects on localities, routes, land and agricultural crops) have highlighted the fact that these situations also occur because the share of forests in the country's surface is low (27.8%, about 6.43 million hectares), with an uneven and improper distribution, in most cases without taking into account the relief, hydrographic networks, climate characteristics of the areas, etc. (Mateoc-Săzrb et al., 2014; Mănescu et al., 2015; Cheval et al., 2022).

One of the main ways of ecological reconstruction and creating a long-term natural balance to mitigate or minimize these negative phenomena produced by climate change is considered to be the establishment of protective curtains, mainly with forest species (Mănescu et al., 2015; Trifan et al., 2024). Protective curtains in the agricultural system are also part of the development strategy and fit the modern legislation of the country on integrated environmental management for the sustainable development of agriculture in Romania (Otiman et al., 2014; Halbac-Cotoara-Zamfir et al., 2021).

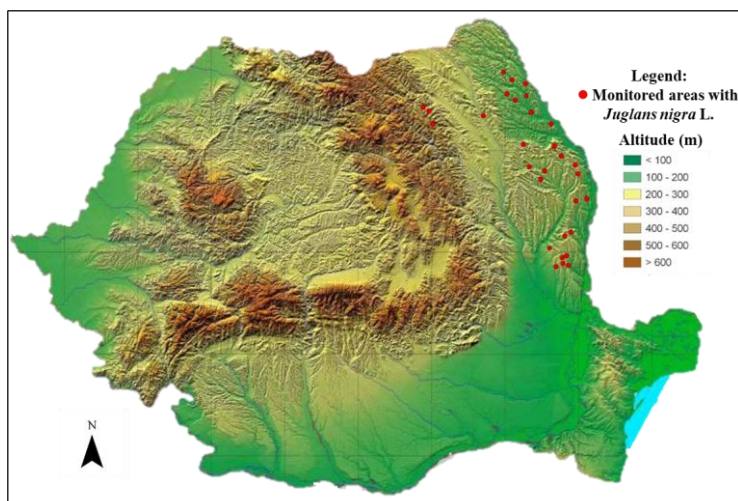
Known for its durability and economic value, the *Juglans nigra* L. (black walnut) represents a valuable resource from both an ecological and an economic point of view, with significant potential to contribute effectively to agroforestry systems, as an ornamental tree in green spaces, for the rehabilitation and restoration of degraded lands or for the production of wood and fruits. The selection and conservation of black walnut genotypes that show high adaptability and resistance to climatic variations are essential for the development of sustainable and efficient protective curtains (Rédei et al., 2019; Nicolescu et al., 2020). Black walnut (*Juglans nigra* L.) is a very important tree species, naturally distributed around the globe from Europe to North America, in Romania occupying an area of 2100 ha (Stănescu et al., 1997; Nicolescu et al., 2020). The qualities that recommend this species in the context of climate change are the fact that this black walnut has rapid growth in the first years of life, and its height and diameter reach their peak before the age of 30-35 years old. It is resistant to storms, pollution and is not affected by any major pest or disease in Europe. Propagation is easy by planting or direct seeding, in monocultures or mixed stands (Nicolescu, 1998; Hrib et al., 2017).

In the context of the major impact of climate change superimposed on the pressure caused by habitat destruction and environmental pollution, the present study aims to analyze and highlight the role and importance of the black walnut species (*Juglans nigra* L.) with resistance and suitability for protective curtains, thus contributing to ensuring the sustainability of agriculture and environmental protection. The main objective of this work was to evaluate the phenotypic variability and performance of some genotypes of *Juglans regia* L, both from the spontaneous flora and for those cultivated, under stress conditions such as drought, extreme temperatures and variable humidity.

## 2. MATERIALS AND METHODS

In order to identify and evaluate the native biotypes of *Juglans nigra* L. and the valuable genotypes for their introduction into the protection curtains, the main research methods used were direct observation in the field or through documentation and botanical methodology (Dulloo et al., 2010). The study was carried out over a period of two consecutive years (2023-2024) in three geographical

areas with abundant genetic and phenotypic resources of black walnut in Northeastern Romania: the Central Moldavian Plateau (Iași County), the Jijia Plain (Botoșani County) and the Piedmont Hills Region (Suceava County) (Figure 1).



**Figure 1. Geographical distribution in which specimens of the *Juglans nigra L.* species have been identified in the North-Eastern region of Romania**

The climatic characterization of the studied area was carried out using data from the meteorological station of the Research Station for Fruit Growing Iași (*FieldClimate* system), as well as data contained in the Catalog of the National Meteorological Administration. The meteorological data of the studied years 2023-2024 were compared with a database stored in MS Office Excel, consisting of daily values of meteorological parameters, recorded over a period of 50 years (1972-2022), used as multi-annual reference values.

The activities to identify black walnut genotypes in the established locations were carried out through frequent field trips involving observations and measurements. The determination of the areas was carried out using GPS maps (Burda and Koniakin, 2018).

The measurement of the trunk diameter of the black walnut genotypes was carried out using a digital caliper (INSIZE 1106-501, Ivančice, Czech Republic), at the standard height of 1.3 meters from the ground (diameter at breast height, DBH). The caliper was positioned around the trunk, making two perpendicular measurements (at 90° to each other), and the average value was recorded (Sun et al., 2018).

The average age (AA) of each monitored tree was estimated based on trunk diameter at breast height (DBH) measurements according to the following formula (Ares and Brauer, 2004):

$$AA = DBH \text{ (cm)} / \text{annual growth rate (cm/year)}, \text{ where:}$$

AA- the average age; DBH- diameter at breast height; Annual growth rate for *Juglans nigra L.* is considered 0.7984 cm/year.

The assessment of the vitality and phytosanitary condition of the trees was made on the basis of evaluation criteria through observations and visual analyses (Rangelov, 2017) on a scale of 1-5 as follows: trees without obvious signs of infestation or disease were given higher scores (4 or 5), while those affected by pathogens or pests, with visible symptoms, received lower scores (1 or 2). Another evaluation criterion was the general appearance of the plants, including vigor, crown density and leaf color. Trees with dense crowns, green and healthy foliage, without signs of

defoliation or discoloration, were considered healthy specimens and received a high score, and in contrast, trees with wilted leaves, thinned crowns or with portions of dry branches were evaluated with a low score, reflecting low vitality. Signs of abiotic stress, such as leaf drying, necrosis or defoliation caused by drought, extreme temperatures or nutritional deficiencies, were also carefully monitored.

The research methodology also consisted of the bibliographic study of other scientific documents, data collection, study and classification of documentary sources, as well as content analysis.

### 3. RESULTS AND DISCUSSIONS

Climate, together with soil factors, is the determining factor in the growth or decline of agro-ecosystems. In this context, the permanent monitoring of the impact of climate change on crops implies the need to improve scientific knowledge, so that the management of climate characteristics includes the current and constant evaluation of climate data, as well as the analysis of risk factors and opportunities (Pallardy, 2010). Regarding the evolution of the average monthly temperature during the period under study, it had an increasing trend and from a seasonal point of view, significant warming was observed in the early spring and late autumn seasons (Figure 2).

The changes highlighted in the climatic regime in the N-E area of Romania fall within the context of global warming, but with specific features of the geographical region to which it belongs. The multiannual average temperature recorded in the period 2023-2024 was 12.5°C, with a positive deviation from the median of the standard reference interval (1972-2022) in each month of the year that ranged between +0.1°C (June) and +5.9°C (February).

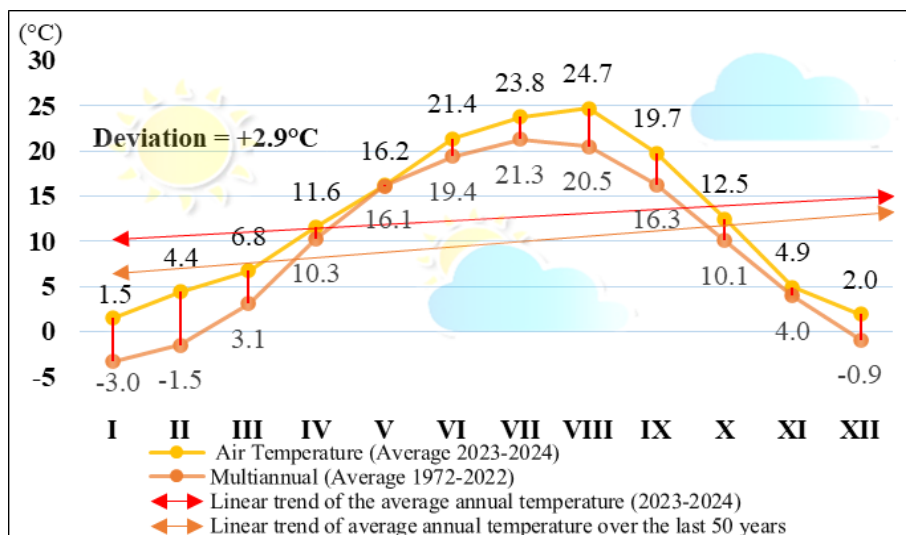


Figure 2. Monthly temperature variations (°C) recorded during 2023-2024, compared to the multiannual zonal average over the last 50 years (Northeastern area of Romania)

The analysis of climate data shows a significant warming, especially in the 2024 when the highest temperatures were recorded, both during summer and winter. This increase directly affects the duration and intensity of the agricultural season, influencing the productivity and phenology of plants in the region. Also, the annual fluctuations observed highlight a seasonal variability specific to the area.

The monthly distribution of precipitation in the two years of study (Figure 3) ranged between 10.1 mm (August) and 86.3 mm (July), totaling 447.9 mm. Although the total amount of precipitation was -70.0 mm below the reference interval, its distribution was uneven throughout the growing season, with abundant amounts recorded only in short periods of time and followed by periods of major deficit.

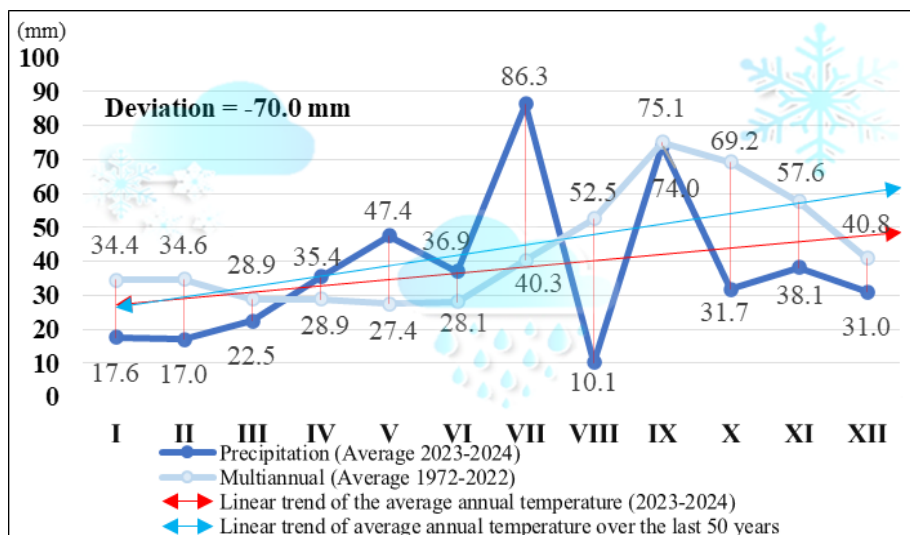


Figure 3. Monthly precipitations variations (mm) recorded during 2023-2024, compared to the multiannual zonal average over the last 50 years (Northeastern area of Romania)

The implementation of activities for the identification and conservation of resistant genotypes focused on the Northeastern area of Romania, a region characterized by climatic and ecological diversity (Mihai et al., 2022). Following the monitoring and identification works, this area proved to be an ideal setting for the identification of local black walnut (*Juglans nigra* L.) genotypes, which have developed adaptation mechanisms to specific climatic variations. In this context, the Northeastern area becomes a relevant platform for studying the adaptability of genotypes, and the available local resources facilitate the collection and analysis of the necessary data.

The locations where specimens of the species *Juglans nigra* L. were identified in the Northeastern region of Romania belong to the counties: Iași, Vaslui, Botoșani and Suceava (Table 1). The geographical distribution of the species highlights a significant presence in hilly and plain areas, indicating its adaptability to various climatic and edaphic conditions specific to these regions.

The results suggest an important capacity of resilience of the *Juglans nigra* L. genotypes from this region, which allows them to tolerate climatic fluctuations and to efficiently use soil resources, which underlines their potential for cultivation in regional silvicultural practices. The studied black walnut specimens had an average age of 5 to 45 years and a DBH of 2 to 26 cm. As a vitality of the general health, an average score of 3 was obtained (Table 1). Thus, the specimens showed a natural tendency to uneven growth, with numerous lateral branches, a weak apical dominance and significant variability in terms of crown shape and growth vigor.

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**Table 1. Distribution of areas with black walnut (*Juglans nigra* L.) genotypes and their characterization in selected regions of Northeastern Romania**

No.	Geographical location	GPS coordinates	Area (ha)	DBH (cm)	AA (years)	Vitality
1.	Central Moldavian Plateau	47°07' N, 27°31' E	0.30	18.00	35.00	4
2.	Central Moldavian Plateau	47°07' N, 27°31' E	1.70	12.00	35.00	3
3.	Central Moldavian Plateau	47°07' N, 27°31' E	0.70	10.00	20.00	3
4.	Central Moldavian Plateau	47°07' N, 27°31' E	0.20	14.00	18.00	3
5.	Central Moldavian Plateau	47°07' N, 27°31' E	1.00	18.00	35.00	3
6.	Central Moldavian Plateau	47°07' N, 27°31' E	0.20	16.00	30.00	2
7.	Central Moldavian Plateau	47°07' N, 27°31' E	0.30	20.00	35.00	3
8.	Central Moldavian Plateau	47°07' N, 27°31' E	0.20	15.00	30.00	3
9.	Central Moldavian Plateau	47°07' N, 27°31' E	0.10	20.00	10.00	3
10.	Central Moldavian Plateau	47°07' N, 27°31' E	0.10	14.00	25.00	3
11.	Bârlad Plateau	46°13' N, 27°40' E	0.80	12.00	25.00	3
12.	Bârlad Plateau	46°13' N, 27°40' E	0.90	12.00	25.00	3
13.	Bârlad Plateau	46°13' N, 27°40' E	1.20	12.00	25.00	3
14.	Bârlad Plateau	46°13' N, 27°40' E	0.20	14.00	18.00	3
15.	Bârlad Plateau	46°13' N, 27°40' E	0.10	26.00	45.00	3
16.	Bârlad Plateau	46°13' N, 27°40' E	0.70	12.00	23.00	3
17.	Bârlad Plateau	46°13' N, 27°40' E	0.20	10.00	16.00	3
18.	Bârlad Plateau	46°13' N, 27°40' E	0.10	12.00	25.00	3
19.	Bârlad Plateau	46°13' N, 27°40' E	0.20	10.00	20.00	3
20.	Bârlad Plateau	46°13' N, 27°40' E	0.50	12.00	25.00	3
21.	The plain of Jijia	47°44' N, 26°41' E	1.50	3.00	5.00	3
22.	The plain of Jijia	47°44' N, 26°41' E	0.40	12.00	25.00	3
23.	The plain of Jijia	47°44' N, 26°41' E	1.40	2.00	5.00	4
24.	The plain of Jijia	47°44' N, 26°41' E	0.40	8.00	15.00	3
25.	The plain of Jijia	47°44' N, 26°41' E	0.10	14.00	18.00	3
26.	The plain of Jijia	47°44' N, 26°41' E	0.60	16.00	25.00	3
27.	The plain of Jijia	47°44' N, 26°41' E	0.10	14.00	25.00	3
28.	Piedmont Hills	47°48' N, 25°49' E	0.10	16.00	25.00	3
29.	Piedmont Hills	47°48' N, 25°49' E	0.10	8.00	14.00	3
30.	Piedmont Hills	47°48' N, 25°49' E	0.20	15.00	10.00	3
	<b>Average</b>		<b>0.49</b>	<b>13.23</b>	<b>22.90</b>	<b>3.03</b>
	<b>Min</b>		<b>0.10</b>	<b>2.00</b>	<b>5.00</b>	<b>2.00</b>
	<b>Max</b>		<b>1.70</b>	<b>26.00</b>	<b>45.00</b>	<b>4.00</b>
	<b>STDEV</b>		<b>0.47</b>	<b>4.78</b>	<b>9.23</b>	<b>0.32</b>
	<b>COVAR</b>		<b>96.04</b>	<b>36.09</b>	<b>40.31</b>	<b>10.54</b>

#### 4. CONCLUSIONS

The quantification of agroclimatic resources in Northeastern Romania can be framed in the global context of current climate change through the increase in average annual temperature, abnormal distribution or major deficit of precipitation.

The general appearance of the trees, their ability to adapt to climatic variations, and their functional capacity make black walnut an ideal species to create effective protective curtains in different ecological conditions, with an essential role in protecting agricultural lands against extreme weather phenomena, such as strong winds and prolonged periods of drought.

Future recommendations aim to test the performance of some black walnut genotypes identified in this study under field conditions, providing essential information for the development of sustainable

agricultural and ecological protection strategies. The implementation of this activity will contribute to improving agroforestry practices and strengthening long-term ecological protection measures, thus supporting adaptation to climate change and the conservation of natural resources.

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## 6. REFERENCES

- Ares, A., Brauer, D. (2004). Growth and nut production of black walnut in relation to site, tree type and stand conditions in south-central United States. *Agroforestry systems*, 63, 83-90.
- Burda, R.I., Koniakin, S.N. (2018). Spontaneous dispersion of species of the genus *Juglans* L. in the forests and parks of Kyiv. *Russian Journal of Biological Invasions*, 9, 95-107.
- Cheval, S., Bulai, A., Croitoru, A.E., Dorondel, Ș., Micu, D., Mihăilă, D., Țișcovschi, A. (2022). Climate change perception in Romania. *Theoretical and applied climatology*, 149(1), 253-272.
- Dulloo, M.E., Hunter, D., Borelli, T. (2010). Ex situ and in situ conservation of agricultural biodiversity: major advances and research needs. *Notulae Botanicae Horti Agrobotanici Cluj-Napoca*, 38(2), 123-135. <https://doi.org/10.15835/nbha3824878>.
- Food and Agriculture Organization (2025). Available online: <https://www.fao.org/faostat/en/#data/OCL> (accessed on 31 March 2025).
- Hălbac-Cotoară-Zamfir, R., Keesstra, S., Kalantari, Z. (2019). The impact of political, socio-economic and cultural factors on implementing environment friendly techniques for sustainable land management and climate change mitigation in Romania. *Science of the Total Environment*, 654, 418-429. <https://doi.org/10.1016/j.scitotenv.2018.11.160>.
- Halbac-Cotoara-Zamfir, R., Rusu, T., Halbac-Cotoara-Zamfir, C. (2021). Water Harvesting and Conservation in Romania. *Handbook of Water Harvesting and Conservation: Case Studies and Application Examples*, 455-468. <https://doi.org/10.1002/9781119776017.ch31>.
- Hrib, M., Podrázský, V., Matějka, K., Viewegh, J. (2017). Effect of black walnut (*Juglans nigra*) on the understorey vegetation - a case study of South Moravian forests (Czech Republic). *Journal of Forest Science*, 63(3), 136-148. <https://doi.org/10.17221/68/2016-jfs>.
- Mateoc-Săzrb, N., Mă, C., Mateoc, T., Arcadie, E.B., Cristina, A.F. (2014). Study concerning the importance of forest curtains in the diminution of climate change risks in Romania. *Lucrări Științifice Management Agricol*, 16(1), 229-236.
- Mănescu, C., Cristina, A. F., Mateoc, T., Sirb, G. S., Saida, D., Mateoc-Sîrb, N. (2015). Improving Romania's green cover by planting forest protection curtains, in the context of current climate changes. *Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development*, 15(4), 153-158.
- Mihai, G., Alexandru, A.M., Nita, I.A., & Birsan, M.V. (2022). Climate change in the provenance regions of Romania over the last 70 years: Implications for forest management. *Forests*, 13(8), 1203.
- Nicolescu, V.N. (1998). Considerations regarding black walnut (*Juglans nigra*) culture in the North-West of Romania. *Forestry: An International Journal of Forest Research*, 71(4), 349-35. <https://doi.org/10.1093/forestry/71.4.349>.
- Nicolescu, V.N., Rédei, K., Vor, T., Bastien, J.C., Brus, R., Benčat, T., Štefančík, I. (2020). A review of black walnut (*Juglans nigra* L.) ecology and management in Europe. *Trees*, 34, 1087-1112. <https://doi.org/10.1007/s00468-020-01988-7>.
- Oțiman, P.I., Toderoiu, F., Alexandri, C., Florian, V., Gavrilăscu, C., Ionel, I., Sima, E., Tudor, M.M. (2014). Sustainable Development Strategy for the Agri-food Sector and Rural Area – Horizon 2030. *Procedia Economics and Finance*, 8, 510-517. [https://doi.org/10.1016/s2212-5671\(14\)00121-x](https://doi.org/10.1016/s2212-5671(14)00121-x).
- Pallardy, S.G., 2010. *Physiology of woody plants* (Ed. III). Missouri: Elsevier, University of Missouri, Columbia.

- Rangelov, V.P. (2017). Phytosanitary Assessment Of Trees In The Central Part Of City Of Vratsa. *Web of Scholar*, (6), 18-20.
- Rédei, K., Takács, M., Kiss, T., Keserű, Z.S. (2019). Ecology and Management of Black Walnut (*Juglans nigra* L.) in Hungary. *South-east European forestry: SEEFOR*, 10 (2), 187-191. <https://doi.org/10.15177/seefor.19-12>.
- Roussos, P.A. (2020). Climate change impacts on fruit trees and mitigation strategies of adverse effects. *AgroLife Scientific Journal*, 9(2), 269-276.
- Stănescu, V., Șofletea, N., Popescu, O. (1997). *Flora forestiera lemnoasa a Romaniei* [Woody forest flora of Romania]. Editura Ceres, București.
- Sun, L Fang, L., Tang, L., Liu, J. (2018). Developing portable system for measuring diameter at breast height. *J. B For. Univ.* 40, 82–89.
- Tache, A.V., Popescu, O.C., Petrișor, A.I. (2024). Planning Blue–Green Infrastructure for Facing Climate Change: The Case Study of Bucharest and Its Metropolitan Area. *Urban Science*, 8(4), 250. <https://doi.org/10.3390/urbansci8040250>.
- Trifan, D., Lungu, E., Ghiorghe, A.I., Șerban, D.G. (2024). The Importance Of Agroforestry Curtains For Anti-Erosion Protection And Increasing The Productivity Of Agricultural Crops. *Scientific Papers. Series A. Agronomy*, 67(1).