

Chorological data regarding the presence of *Corylus colurna* species in Romania

Daniel RĂDUȚOIU, Sina COSMULESCU*

University of Craiova, Horticulture Faculty, A.I. Cuza Street, 13, Craiova,
Romania; sinacosmulescu@hotmail.com (*corresponding author); radutoiu02daniel@gmail.com

Abstract

The Turkish hazel or Turkish filbert (*Corylus colurna*) is a less widespread tree species in Romania. Data on the presence of *C. colurna* species in the Romanian flora are quite rare. The article's aim is to analyse the scientific information and those of the main herbariums regarding the presence of *C. colurna* species on the Romanian territory. The presence of the species on the Romanian territory was signalled about 122 years ago in the paper "Conspectus of Romanian Flora". Subsequent scientific information identifies the species in different locations, especially in the southwest of Romania, in dendrological and natural parks. Scientific importance of the species lies in its rarity, the species has an area limit on Romanian territory and in the value, it gives to natural ecosystems in which it grows. The practical value is given by its edible fruits, valuable from a food or medicinal point of view and by its agronomic characteristics. As a result, the biodiversity conservation strategy should include forest protected areas as important objectives.

Keywords: chorological data; *Corylus colurna*; distribution; plants; Romania

Introduction

Corylus genus belongs to Corylaceae family (Dihoru, 1975; Beldie, 1977; Ciocărlan, 2000, 2009) or Betulaceae family (Prodan, 1939; Georgescu, 1952; Prodan and Buia, 1966; Resmerița, 1970). *Corylus* genus represents a diverse group of useful woody plants, ranging from small, multi-stemmed shrubs to tall, stately trees, all of which produce edible nuts (Molnar, 2011). *Corylus* genus is widely distributed across temperate regions of the Northern Hemisphere, with species found in Japan, Korea, and China, through Tibet, India, Northern Iran, Turkey, the Caucuses, Europe, and North America (Molnar, 2011). *Corylus colurna* L. (Turkish hazel or Turkish filbert) and *C. avellana* L. (Common hazel) are the most common hazel species in Europe (Riethmueller *et al.*, 2014). *C. avellana* L., which has a wide distribution, while, *C. colurna* L., restricted to the Balkans, Romania, and Northern Turkey (Thompson *et al.*, 1996). In spontaneous flora of Romania, *Corylus* genus is represented by 2 species: *C. avellana* L. and *C. colurna* L. In southern regions of Romania there is also *C. maxima* Mill. cultivated as well, a taxon synonymous with *C. avellana*, the difference between them being at the level of involucre (Mehlenbacher, 1991; Thompson *et al.*, 1996; Erdogan and Mehlenbacher, 2000a, b). The spreading of *C. colurna* in Romania is quite small, only in Banat and Oltenia and Vâlcan Mountains is its northern limit of the area (Boruz *et al.*, 2013). *Corylus avellana* is commonly found in both national and European levels. *C. avellana* is widely distributed in Europe, in natural stands ranging from

Scandinavia to the south of the continent (Palmé and Vendramin, 2002). In the north it can be found in Norway up to 67°N, although its northern limit decreases further to the east (Deacon, 1974). It is the first species to colonize the European continent since the last ice age, as evidenced by studies on pollen and chloroplast (Palmé and Vendramin, 2002; Boccacci and Botta, 2009). *C. colurna* is a calcicolous species that has its origin in the Balkans (Boruz *et al.*, 2013) and is a member of the Europe-Siberia flora region (Molnar, 2011). *C. avellana* is the only cultivated species and contains a great amount of genetic diversity (Rovira, 1997). *C. colurna* is one of the common species in Turkey (Aydinoglu, 2010). Beside scientific information, also valuable information on the presence of certain species in certain ecological areas is obtained from herbarium collections. Herbal collections have a scientific, didactic, educational, and also informative value. The collection of plants began in the 16th century. Later, J.P. Tourefort (ca 1700, France) used the term “herbarium” for plants (Bridson and Forman, 1999). One of the oldest herbariums in South-Eastern Europe, a pre-Linnaean herbarium dating from 1734, is in the botanical collection of the Natural History Museum within Brukenthal Museum (Sibiu, Romania). Their purpose is important because they provide information about plants and their area of spread during long periods that help to carry out studies in taxonomy, biodiversity, ecology, anatomy, morphology etc. (Vechiu and Dinca, 2019). Evidence of the hazelnut species spread is the information presented in various herbariums. The aim of this article is to analyse the scientific information and the main herbariums regarding the presence of *C. colurna* species on the Romanian territory.

Materials and Methods

The material used to carry out this paper consisted in specialized sections that contained the species *Corylus colurna* in the floristic list or in the composition of some phytocenoses, according to the herbarium data from the main herbariums in the country (Bucharest, Cluj-Napoca, Iași and Craiova). The material is based also on the analysis of the data obtained following the trips made in different resorts where they are vegetating. The acronyms used for the herbariums consulted are: BUCA (Herbarium of Biology Institute of the Romanian Academy), CL (Herbarium of “Babeș-Bolyai” University Cluj-Napoca), I (Herbarium of “Al. I. Cuza” University Iași) and CRA (Herbarium of Craiova University). A data base for *C. colurna* was realized, focusing on the following data: plate number; Herbarium/Botanic Collection/Institution; Species name; Harvesting date; Harvesting place; the person who has collected the plant; conservation grade, coded with numbers from 1 to 4 (1 = well preserved plant, 2 = plant with parts detached from the plate, but still present, 3 = plant detached from the plate, with missing parts and 4 = plant detached and fragmented, with over 50% of its parts missing) (Vechiu and Dinca, 2019). For localities mapping was used the UTM Code, according to Lehrer and Lehrer (1990). The distribution maps of the species were obtained using Corolog 2010 Program, realized in Biology Institute of Bucharest. The program uses a data base access, with information from literature, herbarium and field and two types of maps, the maps of annual average temperature and precipitation in Romania. The Stereo 70 coordinates corresponding to the points where plant material was collected were inserted in the table.

Results and Discussion

C. colurna (Turkish hazel) is a less widespread tree species in Romania. Data on the species *C. colurna* in the Romanian flora are sporadic until the publication of the paper “Conspectul Florei României” (Grecescu, 1898) which speaks of *C. colurna* as a fairly common species in the Balkan Peninsula, which is found only in Mehedinti to Verciorova and Banat. Prodan (1939) in the paper “Flora for determining and describing the plants growing in Romania” states that there are 3 species of *Corylus* in the Romanian flora (*C. avellana*, *C. colurna* and *C. maxima*) and in *C. maxima* he gives *C. tubulosa* Willd. as synonymous. In Flora României

(volume I, 1952, pp. 197-202), Georgescu (1952) mentions the same 3 species: *C. avellana*, *C. colurna* and *C. maxima*. In 2 of them he presents intraspecific variability. In *C. colurna* the variety *glandulifera* (C. Koch) A. DC is mentioned, and in *C. avellana*, the typica form C. K. Schn. Laubholz. with the subforms: *brachychlámys* Spach and *schizochlámys* Spach. About *C. maxima* it is only stated that it is cultivated, but rarely. Prodan and Buia (1966) in "The small illustrated flora of Romania" in *Corylus* genus they mention 3 species. In each species the main morphological characters, the flowering and fruiting period and the ecology are presented, and in *C. avellana* the cenotic affiliation is also given. Beldie (1977) also quotes 2 species (*C. avellana* and *C. colurna*) in the paper "Flora of Romania - illustrated determinator of vascular plants" (pp. 79-80). Each key taxon has the main differentiating characters, lifespan, biological form, height, flowering period, spread over areas and floors of vegetation, resorts where they can be found, soil type, trophicity and geo-element. In "The illustrated flora of Romania Pteridophyta & Spermatophyta" shows the presence of 3 species, 2 spontaneous (*C. avellana* and *C. colurna*) and one cultivated (*C. maxima*). Among the analysed plants by the authors new data on the chorology of their *Corylus* species were also found in various synthesis papers that had as object of study the flora and vegetation of a certain territory. Information on the spread of *C. avellana*: Pop (1968) in the Crisurilor Plain is frequently presented; Resmeriță (1970) in the Vlădeasa Massif; in the Eastern Carpathians (Oprea and Sîrbu, 2009); Rodna Mountains by Coldea (1990) etc. *C. avellana* species has a good representation in the literature. It was mentioned by Cârțu (1969) from in Amaradia river basin, by Cârțu (1972) in the area between Jiu-Desnățui-Craiova and the Danube, by Năstase (1982) in Bucovăț forest, by Karácsonyi (1995) in Satu-Mare county, by Oroian (1998) in Mureș Gorge, between Toplița and Deda, by Negrean *et al.* (2017) in Salaj county. These last authors also identified the *C. colurna* species in several points: Șimleul Silvaniei N, Măgura Șimleului, Băile Iaz. Data on the presence of *C. colurna* in Romania are rare. Near Oravița (Romania) exists a big stand (80 ha) of *C. colurna*, the maximum data of age was 329 years (Richter, 2016). *C. colurna* was identified in the Iron Gates Park (Mehedinți) and Cheile Nerei-Beușnița National Park (Caraș-Severin) by Borlea *et al.* (2006) in the forest of Domogled (Băile Herculane, Romania) by Manoiu *et al.* (2015) and Ștefan *et al.* (2013). *C. colurna* was also identified in arranged dendrological parks, parks that include a several plants, very rare, in Bistrița (Rusu and Gavriiloaie, 2011), in "Bazoș Arboretum" protected area (Cadaru *et al.*, 2014), in Cheile Nerei-Beușnița Site (Biri *et al.*, 2016). Turkish hazel is a tolerant semi-shade tree species that can create mixed stands with other species and has a low level of invasion potential (Šeho *et al.*, 2019).

Table 1. Table 1 *Corylus colurna* inventory in Romania

Plate no	Herbarium/ Botanic collection/ Institution	Harvesting date	Harvesting place	Collected/ Determined by:	Conservation Degree	COD_UTM	Stereo70	
							X (N)	Y (E)
1	I20946	August 23, 1965	Dolj County, Craiova town, Parcul Poporului - public park	Leg. et det. Nicolăescu. Revised Topa	1	GQ21	404569.4953	311780.9795
1	I33672/ Flora Romaniae Exsiccata nr. 392	May 27, 1923	Caraș-Severin County, Domogled Mountain, forest	Leg. et det. Borza & Nyarady	1	FQ28	297836.6474	377959.5701
1	I38321	July 23, 1972	Caraș-Severin County, Băile Herculane town, Domogled Mountain, forested limestone cliffs	Leg. et det. Sârbu	1	FQ18	296893.0355	378553.3915
1	I44603 / Flora Exsiccată Forestieră a R.P.R. nr. 55	October 12, 1959	Caraș-Severin County, Berzasca village, on Sirina river valley	Leg. Grapini, det. Beldie.	1	EQ74	258778.9364	355521.1017

1	I44604 / Flora Romaniaae Exsiccata nr. 392.	October 6, 1922 May 27, 1923	Caraș-Severin County, Silvam formans in Domogled Mountain, alt cca 700-900 m	Leg. Borza, Borza & Nyarady	1	FQ18	296893.0355	378553.3915
3	I44605, I44606, I72701 / Flora Romaniaae Exsiccata nr. 392b.	March 31, 1945	Timis County, Culta in horto Muhle oppidi Timisoara. Arbor 12 m alt.	Leg. Bujorean. Revised Borza	1	ER16	206586.4622	478873.4057
1	Herbarul Grădinii Botanice Iași / Flora Romaniaae Exsiccata nr. 392b.	March 31, 1945	Timis County, Culta in horto Muhle oppidi Timisoara. Arbor 12 m alt.	Leg. Bujorean. Revised Borza	3	ER16	206586.4622	478873.4057
1	Herbarul Grădinii Botanice Iași	June 21, 1973	Caraș-Severin County, Băile Herculane town, in Crucea Alba forest	Leg. et det. Goga	1	FQ17	297012.6274	379327.0347
2	Herbarul Grădinii Botanice Iași	May 27, 1951	Cluj County, Borșa	Leg. et det. Țopa	1	GS09	397770.7925	604459.5031
1	Herbarul Grădinii Botanice Iași	June 18, 1951		Leg. et det. Celan	1			
1	BUCA150593	July 03, 1931	Caraș-Severin County, Domogled Mountain	Leg. et det. Grintescu	1	FQ28	297836.6474	377959.5701
1	BUCA131847	March 2, 1966	Romania, district Mehedinți	Leg. Dihoru	1	FQ16		
1	BUCA131628	June 26, 1964	Oltenia Region, Tr. Severin district, SE of Ilovița forest, N Vârciorova	Leg. et det. Roman	1	FQ15	300683.1994	363968.9998
3	BUCA044836 / Flora Romaniaae Exsiccata nr. 392b.	March 31, 1945	Timiș County, Culta in horto Muhle oppidi Timisoara. Arbor 12 m alt.	Leg. Bujorean. Revised Borza	3	ER16	206586.4622	478873.4057
1	BUCA/Flora Romaniaae Exsiccata nr. 392	May 27, 1923	Caraș-Severin County, Domogled Mountain, forest	Leg. et det. Borza & Nyarady	1	FQ28	297836.6474	377959.5701
1	BUCA	March 26, 1948	Mehedinți District, in a forest on Marcopriciu, towards Varciorova	Leg. Ularu	1	FQ15	312713.0338	391274.319
1	BUCA / Flora Exsiccata Forestiera a R.P.R. nr. 55	October 12, 1959	Caraș-Severin County, Berzasca, on Sirina river valley	Leg. Grapini, det. Beldie.	1	EQ74	258778.9364	355521.1017
1	BUCA011749	September 09, 1949	Hunedoara Region, Simeria Dendrological Park		1	FR57	346196.3421	486659.6678
2	CL661848	July 28, 2003	Romania, Banat region, Mehedinți	Leg. et det. Negrean	1	FQ04	282570.2909	348429.2714

			District, Cazanele Mari, Ciucarul Mare Mount Peak					
	CL642553	May 25, 1988	Banat Reion, Caraş-Severin district, Domogled Mt., in the forest above Băile Herculane town	Leg. et det. Groza	1	FQ17	296345.3594	380056.3988
1	CL389671	August 29, 1948	Oltenia region, Gorj district, Chestnut forest in Tismana village	Leg. Borza	1	FQ59	337669.2452	400170.29
1	CL617491	May 20, 1939	Cazane	Leg. Pop. det. Schneider	1	FQ04	284783.8028	352200.8366
1	CL558359 / Flora Exsiccata Forestiera a R.P.R. nr. 55	October 12, 1959	Caraş-Severin County, Berzasca, on Sirina river valley	Leg. Grapini, det. Beldie	1	EQ74	258778.9364	355521.1017
1	CL649436	August 28, 1983	Domogled Mountain, above Băile Herculane town	Leg. Boscaiu	1	FQ17	296345.3594	380056.3988
1	CL617403	May 19, 1939.	Above Băile Herculane town	Leg. Pop. det. Schneider	1	FQ17	296345.3594	380056.3988
9	CL80911, CL82357, CL95249, CL95250, CL95257, CL95258, CL95268, CL95266, CL95267	May 20, 1920	Caraş-Severin County, Băile Herculane town, limestone cliffs on Suscului Peak	Leg. Borza	1	FQ17	296345.3528	380056.3952
2	CL215680, CL215681	June 29, 1948.	Banat region, Caraş district, on Beul sec river valley	Leg. Borza et Buia	1	FQ06	246161.9903	385618.3098
3	CL55918, CL207860, CL617404	March 31, 1945	Timis County, Culta in hortu Muhle oppidi Timișoara. Arbor 12 m alt.	Leg. Bujorean. Revised Borza	2	ER16	206586.4622	478873.4057
1	CL589654	August 23, 1942	Banat region, Caraş district, on Beul sec river valley	Leg. Borza et Ogruțan	1	FQ06	246161.9903	385618.3098
1	CL215200	September 09, 1949	Hunedoara region, Simeria Dendrological Park		1	FR57	346196.3421	486659.6678
1	CL591886	May 19, 1939	Banat region, Severin district, above Băile Herculane town	Leg. Borza et Todor	1	FQ17	296345.3594	380056.3988
1	CL133814 / Flora Romaniae Exsiccata nr. 392	May 27, 1923	Caraş-Severin County, Domogled Mountain, forest	Leg. et det. Borza & Nyarady	1	FQ28	297836.6474	377959.5701
2	CL21506, 21509		Cerna river Valley	Leg. Pavai	1	FQ39	302949.8893	391210.8189

1	CRA / Flora Romaniae Exsiccata nr. 392	May 27, 1923	Caraș-Severin County, Domogled Mountain, forest	Leg. et det. Borza & Nyarady	1	FQ28	297836.6474	377959.5701
1	CRA / Flora Exsiccata Forestiera a R.P.R. nr. 55	October 12, 1959	Caraș-Severin County, Berzasca village, on Sirina river valley	Leg. Grapini, det. Beldie.	1	EQ74	258778.9364	355521.1017
1	CRA18152	April 17, 2004	Mehedinți County, Comănești Hills	Leg. I. Costache	1	FQ47	331161.1437	385725.9954

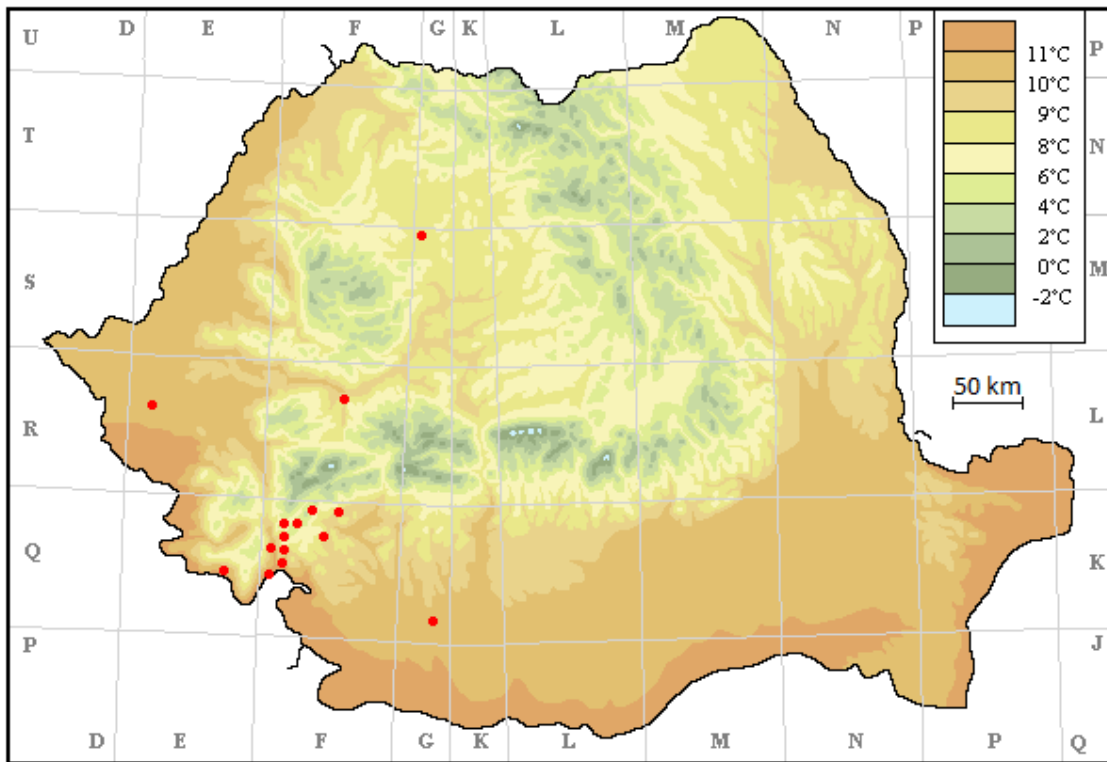


Figure 1. Distribution of species *C. colurna* correlated with annual average temperature

Herbarium data with this taxon are also scarce (Table 1). Herbarium material from Iași (I), Cluj (CL), Bucharest (BUCA) and Craiova (CRA) shows that the oldest plant, belonging to *C. colurna* species, was collected in 1920 from Caraș-Severin County, Băile Herculane (calcareous rocks on Suscului peak) by Al. Borza (Figure 1). Also, during period 1920-1930, information appears regarding the identification of some *C. colurna* specimens on the territory of Caraș-Severin county, evidence introduced in the herbariums in Iași and Bucharest. Most plants were harvested during 1940-1949 and are preserved in the herbariums of Bucharest, Cluj and Iași. The last plant preserved in Craiova herbarium was harvested in 2004, from Mehedinți area, Dealul Comăneștilor, by Iulian Costache. The place of sampling is located in Romania (Figures 1 and 2). The plants were collected mainly from the southwestern part of Romania. The county from which most specimens were collected is Caraș-Severin, especially in the areas of Mount Domogled, above Băile Herculane; Mehedinți - Cazanele Mari, Ciucarul Mare peak, Comăneștilor Hill, in the forest on Marcopriciu, towards Vârciorova; Hunedoara - Simeria Dendrological Park, Gorj - Tismana, Dolj - Craiova. The analysis of the data shows that the distribution of *C. colurna* in Romania is quite small, only in Banat and Oltenia (ie southern Banat, Mehedinți Mountains, Mehedinți Plateau and Motru Hills) (Boruz *et al.*, 2013) and is found in different parks,

in areas favourable for the cultivation of this species. The presence of *C. colurna* species is also indicated by Bușe Dragomir and Nicolae (2014) in the Iron Gates park, Mehedinți. Turkish hazel has been found sporadically in forest habitats in Central, Eastern and Western Serbia (Mitrovic *et al.*, 2001). Therefore, the remaining Turkish hazel populations in different locations are of critical importance, and the genetic conservation of this species plays a key role in the sustainable development of forests. *Corylus* species have scientific and practical importance. *C. colurna* has no relevant economic importance, but agronomic characteristics are very important, it does not produce basal shoots, an important aspect for hazelnut cultivation (Avanzato, 2008). Biodiversity conservation strategy should include forest protected areas as important objectives (Borlea *et al.*, 2006). The people who collected and identified the plants are Romanian specialists, famous botanists: A. Borza, E.J. Nyárády, A. Nicolaescu, E. Topa, I. Sârbu, V. Grapini, A. Beldie, G. Bujorean, I. Goga, E. Țopa, M. Celan, G. Grintescu, G. Dihoru, N. Roman, G. Bujorean, I. Ularu, G. Negrean, Gh. Groza, E. Pop, E. Schneider, Monica Boșcaiu, E. Pop, Al. Buia, G. Bujorean, P. Ogrușan, I. Todor, Hb. Pavai, I. Costache.

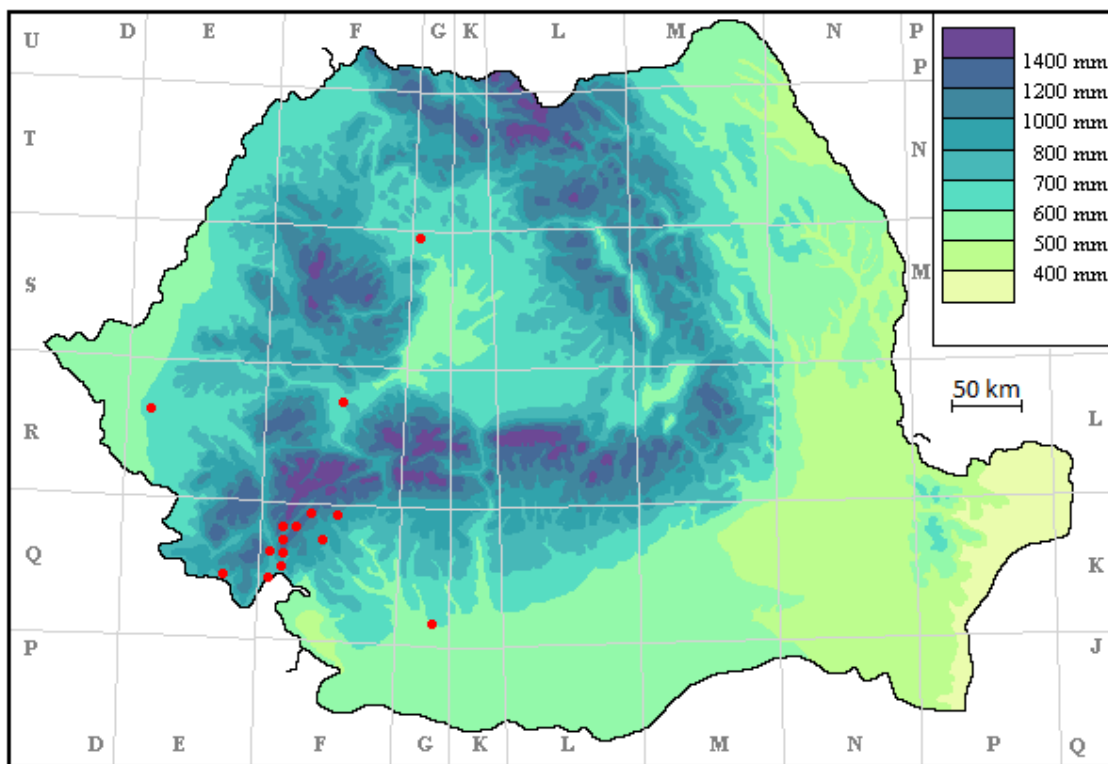


Figure 2. Distribution of species *C. colurna* correlated with annual average precipitation

Conclusions

In conclusion, the presence of *C. colurna* species on the Romanian territory is signalled about 122 years ago in the paper “Conspectus of Romanian Flora”. Subsequent scientific information identifies the species in different locations, especially in the South-Western Romania, in dendrological and natural parks. Scientific importance of *C. colurna* species lies in its rarity, the species has an area limit on the territory of Romania and in the value, it gives to the natural ecosystems in which it grows. The practical value is given by the edible fruits,

valuable from a food or medicinal point of view and by its agronomic characteristics (it does not produce basal shoots).

Authors' Contributions

Conceptualization of research (SC, DR); Design of the experiments (SC); Contribution of experimental materials (DR); Analysis of data and interpretation (SC, DR); Preparation of the manuscript (SC, DR). Both authors read and approved the final manuscript.

Acknowledgements

Thanks to our colleagues who have provided chorology information from different collections: M. Pușcaș (Al. Borza Botanical Garden, Cluj-Napoca), A. Oprea (A. Fătu Botanical Garden, Iași), Irina Blaj (Curator of Herbarium, Alexandru Ioan Cuza University Iași), S. Ștefănuț (Romanian Academy, Biology Institute).

Conflict of Interests

The authors declare that there are no conflicts of interest related to this article.

References

- Avanzato D (2008). Farming affects plant genetic erosion: policy actions to prevent it. Scientific Papers of the Research Institute for Fruit Growing Pitești, Romania XXIV:9-14. <http://agris.fao.org/agris-search/search.do?recordID=DJ2012060153>
- Aydinoğlu AC (2010). Examining environmental condition on the growth areas of Turkish hazelnut (*Corylus colurna* L.). African Journal of Biotechnology 9:6492-6502. <http://www.academicjournals.org/AJB>
- Beldie AI (1977). Flora României. Determinator ilustrat al plantelor vasculare [Flora of Romania. Illustrated determinant of vascular plants]. Editura Academiei Române, Bucuresti.
- Biri IA, Teodosiu M, Turcu DO, Merce O, Loren A, Apostol J, Marcu C (2016). 24000 ha of primary beech forests, the Romanian proposal in UNESCO World Heritage. Bucovina Forestieră 16:107-112.
- Boccacci P, Botta R (2009). Investigating the origin of hazelnut (*Corylus avellana* L.) cultivars using chloroplast microsatellites. Genetic Resources and Crop Evolution 56:851-859. <https://doi.org/10.1007/s10722-009-9406-6>
- Borlea GF, Radu S, Stana D (2006). Forest biodiversity preservation in Romania. Notulae Botanicae Horti Agrobotanici Cluj-Napoca 34:21-26. <https://doi.org/10.15835/nbha341258>
- Boruz V, Dihoru G, Răduțoiu D (2013). Areal limit in the Romanian territory: 7. *Corylus colurna*. Journal of Horticulture, Forestry and Biotechnology 17(4):5-9.
- Bridson D, Forman L (1999). The herbarium handbook. Royal Botanic Gardens. Kew, Richmond, Surrey, United Kingdom.
- Bușe Dragomir L, Nicolae I (2014). Ecophysiological aspects regarding the sibleac, associations from Iron Gates Natural Park. Annals of the University of Craiova Agriculture, Montanology, Cadastre Series 44(1):33-38.
- Cadar N, Merce O, Turcu DO, Cântar IC (2014). Management measures in Bazos Arboretum protected area. Journal of Horticulture, Forestry and Biotechnology 18(3):30-33.
- Cârțu D (1972). Vegetația lemnoasă dintre Jiu-Desnățui-Craiova și Dunăre [The woody vegetation in the area between Jiu-Desnățui-Craiova and the Danube]. Studii și Cercetări 213-222.

- Cârțu M (1969). Materiale pentru flora și vegetația Bazinului hidrografic al Amaradiei [Materials for the flora and vegetation of Amaradia River Basin]. Annals of the University of Craiova I(XI): 37-44.
- Ciocârlan V (2000). Flora ilustrată a României. Pteridophyta et Spermatophyta [The illustrated flora of Romania. Pteridophyta et Spermatophyta]. Editura Ceres, București.
- Ciocârlan V (2009). Flora ilustrată a României. Pteridophyta et Spermatophyta [The illustrated flora of Romania. Pteridophyta et Spermatophyta]. Editura Ceres, București.
- Coldea G (1990). Munții Rodnei. Studiu geobotanic [Rodna Mountains. Geobotanical study]. Editura Academiei Române, București.
- Deacon J (1974). The location of refugia of *Corylus avellana* L. during the Weichselian glaciation. New Phytologist 73:1055-1063. <https://doi.org/10.1111/j.1469-8137.1974.tb01331.x>
- Dihoru G (1975). Învelișul vegetal din muntele Siriu [Vegetal cover of Siriu mountain]. Editura Academiei Române București.
- Erdogan V, Mehlenbacher SA (2000a). Interspecific hybridization in hazelnut (*Corylus*). Journal of the American Society for Horticultural Science 125:489-497. <https://doi.org/10.21273/JASHS.125.4.489>
- Erdogan V, Mehlenbacher SA (2000b). Phylogenetic relationships of *Corylus* species (Betulaceae) based on nuclear ribosomal DNA ITS region and chloroplast matK gene sequences. Systematic Botany 25:727-737. <https://doi.org/10.2307/2666730>
- Georgescu CC (1952). Betulaceae. In Săvulescu & al. Flora R.P.R. Edit. Acad. Române. București pp 189-217.
- Grecescu D (1898). Conspectul florei României: Plantele vasculare indigene și cele naturalizate ce se găsesc pe teritoriul României, considerate sub punctul de vedere sistematic și geographic [The Romanian flora perspective: Indigenous and naturalized vascular plants found on the Romanian territory, considered from a systematic and geographical point of view]. Tipografia Dreptatea, București.
- Karácsonyi C (1995). Flora și vegetația județului Satu Mare [Flora and vegetation of Satu Mare county]. Editura Muzeului Sătmărean. Satu Mare.
- Lehrer A, Lehrer M (1990). Cartografierea faunei și florei României (Coordonate arealografice) [Mapping of the Romanian fauna and flora (Area coordinates)]. Editura Ceres. București
- Mănoiu VM, Crăciun AI, Spiridon RM (2015). The geocological structure typical for the depression basin of the Băile Herculane resort, Romania. Proceedings of ADVED15 International Conference on Advances in Education and Social Sciences, Istanbul, Turkey pp 116-126.
- Mehlenbacher SA (1991). Hazelnuts (*Corylus*). Acta Horticulturae 290:791-838. <https://doi.org/10.17660/ActaHortic.1991.290.18>
- Mitrovic M, Stanisavljevic M, Ogasanovic D (2001). Turkish tree hazel biotypes in Serbia. Acta Horticulturae 556:191-196. <https://doi.org/10.17660/ActaHortic.2001.556.27>
- Molnar TJ (2011). *Corylus*. In: Wild Crop Relatives: Genomic and Breeding Resources. Springer, Berlin, Heidelberg pp 15-48.
- Năstase A (1982). Catalogul colecției botanice a muzeului Olteniei din Craiova, județul Dolj. (I). [Botanical collection catalogue of Oltenia Museum in Craiova, Dolj County]. Oltenia Studii și Comunicări Istorie, Etnografie, Științele Naturii pp 229-264.
- Negrean G, Karácsonyi C, Szatmari PM (2017). Patrimoniul natural al Sălajului. Vol. I. Flora, microbiota și vegetația [The Natural Heritage of Sălaj county. Vol. I. Flora, microbiota and vegetation]. Editura Someșul, Satu Mare.
- Oprea A, Sirbu C (2009). Diversitatea floristică a munților Stânișoarei. (Carpații Orientali) [Floristic diversity of Stânișoara mountains. (Eastern Carpathians)]. Editura Universității A. I. Cuza, Iași.
- Oroian S (1998). Flora și vegetația defileului Mureșului între Topolnița și Deda [Flora and vegetation of Mureș River Gorge between Topolnița and Deda]. Casa de Editură Mureș. Tg. Mureș.
- Palmé AE, Vendramin GG (2002). Chloroplast DNA variation, postglacial recolonization and hybridization in hazel, *Corylus avellana*. Molecular Ecology 11(9):1769-1779. <https://doi.org/10.1046/j.1365-294X.2002.01581.x>
- Pop I (1968). Flora și vegetația Câmpiei Crișurilor. Interfluviul Crișul Negru-Crișul Repede [Flora and vegetation of Crișurilor Plain. Crișul Negru-Crișul Repede Inter-rivers]. Editura Academiei Române, București.
- Prodan I (1939). Flora pentru determinarea și descrierea plantelor ce cresc în România [Flora for determination and description of plants growing in România]. Tipografia Cartea Românească Cluj.
- Prodan I, Buia AI (1966). Flora mică ilustrată a României (ed V) [The illustrated small flora of Romania (5th ed)]. Edit. Agro-Silvică, București.

- Resmeriță I (1970). Flora, vegetația și potențialul productiv pe masivul Vlădeasa [Flora, vegetation and productive potential on Vlădeasa massif]. Editura Academiei Române.
- Richter E (2016). *Corylus colurna* stand near Oravita, Romania. Revista Pădurilor 131:19-26.
- Riethmueller E, Toth G, Albert, A, Sonati M, Kery A (2014). Antioxidant activity and phenolic composition of *Corylus colurna*. Natural Product Communications 9:679-682.
- Rovira M (1997). Genetic variability among hazelnut (*C. avellane* L.) cultivars. Acta Horticulturae 445:45-50. <https://doi.org/10.17660/ActaHortic.1997.445.6>
- Rusu C, Gavriloaie C (2011). Unele considerații cu privire la vegetația ariilor protejate din municipiul Bistrița (Bistrița-Năsăud, România) [Some considerations regarding the vegetation of protected areas in Bistrița municipality (Bistrița-Năsăud, Romania)]. Ecoterra 27:45-48.
- Šeho M, Ayan S, Huber G, Kahveci G (2019). A review on Turkish hazel (*Corylus colurna* L.): a promising tree species for future assisted migration attempts. South-east European Forestry 10:53-63. <https://doi.org/10.15177/see4or.19-04>
- Ștefan C, Chisaliță I, Moatar M, Stanciu SM, Fora CG, Banu C, Olaru D (2013). Future plans for developing the forestry and countryside and in the Natural Reserve Domogled. Journal of Horticulture, Forestry and Biotechnology 17:324-328.
- Thompson MM, Lagerstedt HB, Mehlenbacher SA (1996). Hazelnuts. In: Janick J, Moore JN (Eds) Fruit breeding: nuts. Wiley, New York pp 125-184.
- Vechiu E, Dinca L (2019). Characterization of *Cornus* plant present in Al. Beldie herbarium. Research Journal of Agricultural Science 51:169-175.



The journal offers free, immediate, and unrestricted access to peer-reviewed research and scholarly work. Users are allowed to read, download, copy, distribute, print, search, or link to the full texts of the articles, or use them for any other lawful purpose, without asking prior permission from the publisher or the author.

License - Articles published in *Notulae Botanicae Horti Agrobotanici Cluj-Napoca* are Open-Access, distributed under the terms and conditions of the Creative Commons Attribution (CC BY 4.0) License.

© Articles by the authors; UASVM, Cluj-Napoca, Romania. The journal allows the author(s) to hold the copyright/to retain publishing rights without restriction.