

DATABASING THE ANTHEMIS GENUS STORED IN “ALEXANDRU BELDIE” HERBARIUM

B.I. PLEȘCA¹, Ioana-Maria PLEȘCA^{1*}, Maria DINCĂ¹

¹National Institute for Research and Development in Forestry “Marin Drăcea”, Romania

Corresponding author: ioana0407@yahoo.com

Abstract. Herbarium repositories have gained in the last year's considerable attention for biodiversity conservation purposes, as well as for scientific researches. “Alexandru Beldie” Herbarium is recognized for its vast amount of specimens, altogether representing historical evidence of the Romanian flora. The herbarium contains both common species as well as rare and endangered ones. *Anthemis* species present in the above-mentioned herbarium represent the object of this study. In order to create an updated database of this genus, 152 vouchers from the botanical collection were inventoried and analyzed. The vouchers were harvested between 1846 and 1993 by renowned Romanian and foreign botanists and have very good conservation status. The final database of *Anthemis* Genus includes ten different taxa with accepted status. In addition, three species inscribed in the Red List of superior plants from Romania were identified, namely *Anthemis macrantha* Heuff., *Anthemis cretica* L. and *Anthemis triumfettii* (L.) DC. The consulting of international databases has revealed that a part of the inventoried taxa is currently assigned as synonyms for *Cota*, *Achillea* and *Chamaemelum* species. *Anthemis* Genus has special importance in traditional medicine although it is a plant with reduced fodder value. Moreover, some representatives are agricultural weeds and have a high potential of spreading and causing serious problems in the agroecosystems.

Keywords: herbarium, biodiversity, *Anthemis*, voucher, conservation

INTRODUCTION

According to Romanian literature, *Anthemis* Genus contains approximately 100 species, from which 10 are present in our country (BUIA ET AL., 1965). International authors estimate a number of 175 initial species (LO PRESTI AND OBERPRIELER, 2009). Their habitat is mainly Mediterranean (NYARADY, 1964), European and Asian. The same author attributes the name of the Genus to the Greek word *anthemos*=with flowers. The name is related to the large number of flowers that are present for a very long period.

However, numerous studies show that this concentration is caused by adaptation, especially by the migration of the species from a humid-mountain climate towards a dry-warm climate (LO PRESTI AND OBERPRIELER, 2009).

The species from this genus are characterized by annual or perennial plants. The leaves are pennate, glabrous or pubescent. They showcase a solitary anthodium of average height. The flowers have a tubular shape and are yellow in color or even white (for the marginal ones). The fruit is represented by a cylindrical achene that is usually vallecular.

The Genus is used in naturist medicine as its aerial parts have antimicrobial and antioxidant properties (ALBAYRAK AND AKSOY, 2013; ORLANDO ET AL., 2019). These parts are used for producing essential oils (LO PRESTI, 2010) or other extracts for isolating different pathogens (BOUKHARY ET AL., 2019). Agriculture sees it as a weed that easily settles in cereal cultures or other crops. Numerous studies mention it among the most 10 found species (VEREȘ AND TÝR, 2011).

The species are found in meadows and pastures, in the following associations: *Anthemis ruthenica* with *Tragus racemosus* in the seaside area, *Poa minor* with *Achillea schurii* (*A. carpatica*) and *Festuca picta* (*A. carpatica*) in the Eastern Carpathians, *Juncus trifidus* (*Anthemis montana*) with *Carex curvula* in the Eastern Carpathians; *Poa*

bulbosa+*Artemisia austriaca*+*Cynodon dactylon* (*Anthemis arvensis*) in Muntenia (Pușcaru Soroceanu, 1963).

“Alexandru Beldie” Herbarium contains numerous plants gathered from our country (in Bucegi (CRISAN ET AL., 2020A), Vlasca (CIONTU AND DINCĂ, 2019), Buzău (CRISAN ET AL., 2020B)) or from abroad (Moldavia (VASILE AND DINCĂ, 2019A), Balkans (KACHOVA ET AL., 2020)). Among them we mention *Vaccinium* (SCĂRLĂTESCU ET AL., 2017), *Rubus* (DINCĂ ET AL., 2018A), *Alyssum* (CÂNTAR EL AL., 2018), *Amaranthus* (DINCĂ EL AL., 2018B), *Elymus* (PLEȘCA EL AL., 2019A), *Alnus* (DINCĂ AND PETICILĂ, 2019) and *Asperula* (PLEȘCA ET AL., 2020).

MATERIAL AND METHODS

The first step for obtaining information about the *Anthemis* Genus present in “Alexandru Beldie” Herbarium was to inventory the present vouchers. The result was a database with information gathered from each label. The data referred to the species, the name of the origin collection, the harvesting date and place and the team responsible for this activity. Furthermore, the vouchers were appreciated from a conservation perspective and placed on a scale from 1 to 4: 1 = very well preserved plant, kept in its entirety and correctly attached to the voucher, 2 = plant detached from the voucher, with detached parts but still present, 3 = plant detached from the voucher, with missing parts and 4 = detached and fragmented plant, with over 50% of its parts missing (TUDOR AND DINCĂ, 2019; VASILE AND DINCĂ, 2019B; VECHIU AND DINCĂ, 2019; DINCĂ AND VECHIU, 2020)

Like many other genres, *Anthemis* has suffered changes in its taxonomy. This resulted in an additional step of consulting available international databases (<http://www.theplantlist.org>, <http://www.worldfloraonline.org/>) in order to validate the information.

RESULTS AND DISCUSSIONS

A total number of 152 vouchers have been inventoried for the *Anthemis* Genus. The vouchers are in a very good conservation state, with 97% being in a good and very good state (figure 1).

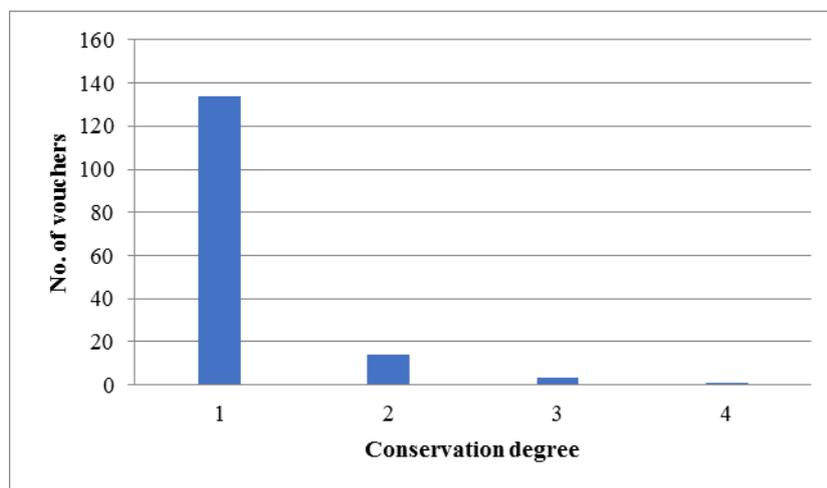


Figure 1. Conservation degree of Genus *Anthemis*

A number of 31 species, subspecies, forms and varieties were also identified, based on the original names inscribed on the vouchers' labels. The majority of vouchers belong to *Anthemis arvensis* L. (16), *Anthemis carpatica* W. (24), and *Anthemis tinctoria* L. (35). The inventory of species is rendered in Table 1.

Table 1

The *Anthemis* Genus inventory

No.	"Al. Beldie" Herbarium	http://www.worldfloraonline.org/	No of vouchers
1	<i>Anthemis alpina</i> L.	<i>Achillea oxyloba</i> (DC.) Sch.Bip.	1
2	<i>Anthemis altissima</i> L.	<i>Cota altissima</i> (L.) J.Gay	3
3	<i>Anthemis arvensis</i> L.	<i>Anthemis arvensis</i> L.	16
4	<i>Anthemis austriaca</i> Jack.	<i>Cota austriaca</i> (Jacq.) Sch.Bip.	11
5	<i>Anthemis boreana</i>	unresolved	1
6	<i>Anthemis brachycentros</i>	<i>Cota segetalis</i> (Ten.) Holub	1
7	<i>Anthemis carpatica</i> W.	<i>Anthemis cretica</i> subsp. <i>carpatica</i> (Willd.) Griens	24
8	<i>Anthemis cata</i> L.	unresolved	1
9	<i>Anthemis chia</i> L.	<i>Anthemis chia</i> L.	1
10	<i>Anthemis chrydantha</i>	unresolved	1
11	<i>Anthemis coelopoda</i> Boiss.	<i>Cota coelopoda</i> (Boiss.) Boiss.	1
12	<i>Anthemis montana</i> L.	<i>Anthemis cretica</i> L.	4
13	<i>Anthemis montana</i> L. f. <i>kitaibelii</i> Sprengel.	not mentioned	2
14	<i>Anthemis macrantha</i> Heuff.	<i>Cota macrantha</i> (Heuff.) Boiss.	4
15	<i>Anthemis mucronulata</i> Bert.	<i>Achillea barrelieri</i> ssp. <i>mucronulata</i> (Bertol.) Heimerl	2
16	<i>Anthemis neilreichii</i>	<i>Anthemis ruthenica</i> M.Bieb.	2
17	<i>Anthemis nobilis</i> L.	<i>Chamaemelum nobile</i> (L.) All.	3
18	<i>Anthemis pallida</i> DC.	unresolved	1
19	<i>Anthemis peregrina</i> L.	<i>Anthemis peregrina</i> L.	1
20	<i>Anthemis pseudocota</i> Vis.	<i>Cota segetalis</i> (Ten.) Holub	1
21	<i>Anthemis ruthenica</i> M. Bieb.	<i>Anthemis ruthenica</i> M. Bieb.	7
22	<i>Anthemis santolinoides</i> Munby	<i>Chamaemelum nobile</i> (L.) All.	1
23	<i>Anthemis secundiramea</i> Biv.	<i>Anthemis secundiramea</i> Biv.	1
24	<i>Anthemis tenuiloba</i> DC.	<i>Anthemis tenuiloba</i> DC.	1
25	<i>Anthemis tinctoria</i> L.	<i>Cota tinctoria</i> (L.) J.Gay	35
26	<i>Anthemis tinctoria</i> L. var. <i>fusii</i>	unresolved	1
27	<i>Anthemis tinctoria</i> L. var. <i>fusii</i> Gisele	unresolved	10
28	<i>Anthemis tinctoria</i> L. var. <i>pallida</i>	unresolved	1
29	<i>Anthemis tinctoria</i> L. var. <i>typica</i> Beck.	unresolved	2
30	<i>Anthemis triumfetti</i> (L.) DC.	<i>Cota triumfetti</i> (L.) J.Gay	3
31	<i>Anthemis tuberculata</i> Boiss. V. <i>discoidea</i> Boiss.	<i>Anthemis pedunculata</i> Desf.	1
32	unknown		8

Compared with other current databases, an important part of these species is no longer within the *Anthemis* Genus. Instead, they have become synonyms for some species from *Cota*,

Achillea, and *Chamaemelum* genres. In addition, part of these names could not even be found in these databases so they were treated as unresolved.

The plants were harvested and conserved during 1846-1967. The majority of them were collected between 1881-1900 (39 vouchers) and 1931-1950 (54 vouchers). The year could not be determined for 13 vouchers as it was not written or hard to decipher. The representation of vouchers per interval is rendered in Figure 2.

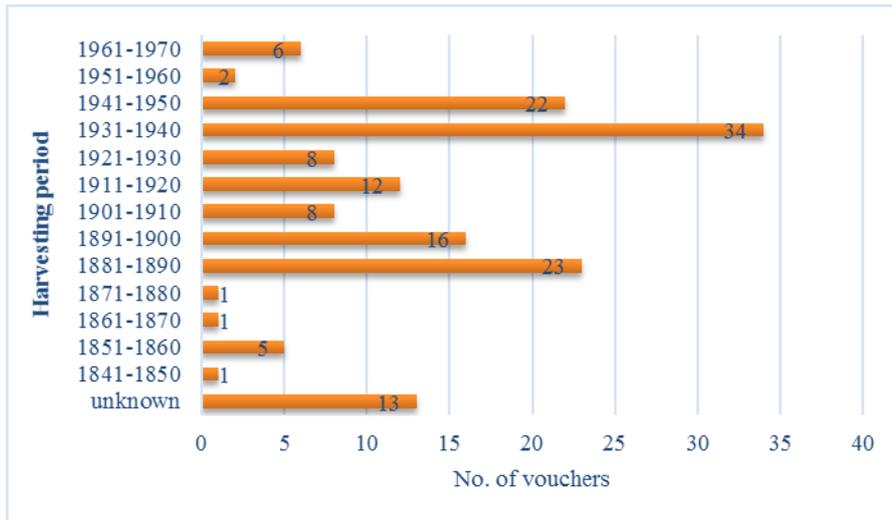


Figure 2. Harvesting interval of the herbarium plants

In regard to the origin country of the collected material, the majority comes from Romania (84 vouchers), while the remaining vouchers are from different European countries or from unknown locations (figure 3).

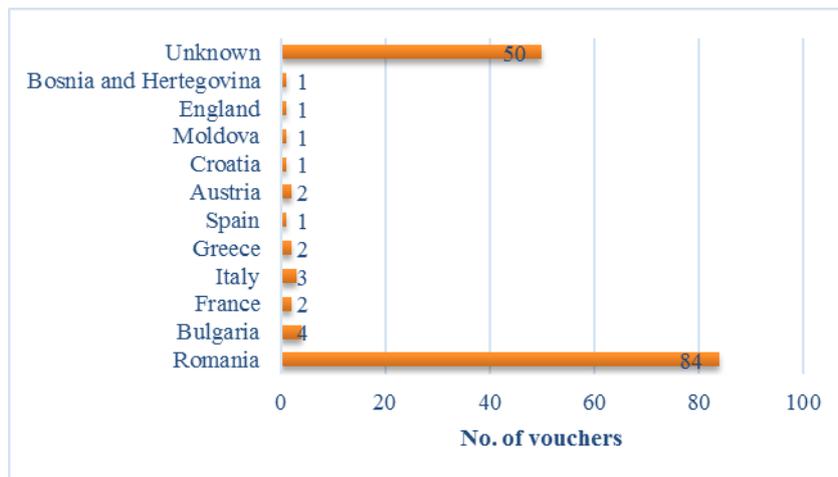


Figure 3. Origin countries of the collected plants

The plants collected from Romania originate from all areas of the country, especially from areas commonly frequented by the botanists who gathered them (figure 4).

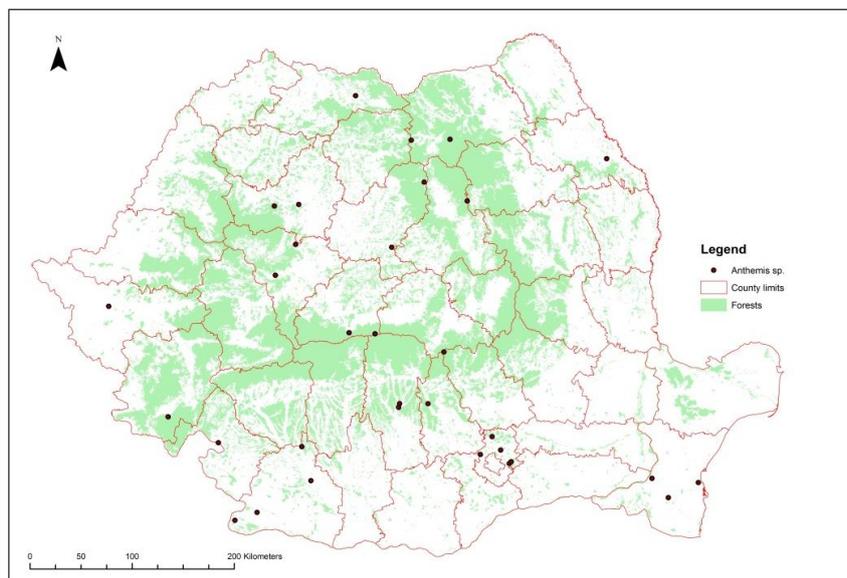


Figure 4. Places of harvesting for *Anthemis* species

The present collection from “*Alexandru Beldie*” Herbarium was created from more collections gathered over time, donated or by exchanges with other herbariums. As an origin point, the majority come from Romania, being comprised of collections from Bucharest’s Polytechnic School Herbarium and from the Forestry Research and Experimentation Institute’s Herbarium. Together they amount to 61 vouchers (66% of the total plants from Romanian collections). A number of 48 vouchers do not have an affiliation to a certain collection and amount to a third of its total.

The following paragraphs will describe the main species present in “*Alexandru Beldie*” Herbarium. The current name of the species is mentioned between brackets, as the Herbarium was not organized on these new names.

Anthemis arvensis L. (figure 5) is a common annual plant, found among cereals and wastelands, especially in the mountain area. The stem looks like an arch, is ramified, with glabrous or weakly pubescent branches that can reach 55 cm. The leaves are glabrous or weakly pubescent, pennate and sectate. The anthodium is long and pedunculated, with a diameter that can reach 20-30cm. The flowers have a tubular shape and are yellow or white (the ligulae ones). The achene is long up to 2.5 mm, elliptical and elongated, strongly grooved and bulging at the tip. The species is present from June up to September.

Agriculture considers it a weed and was rebutted for a long time through chemical fertilizers and pesticides. As such, its natural habitat was strongly fragmented, although it resisted in marginal areas of culture blocks (BAESSLER AND KLOTZ, 2006; ALBRECHT ET AL., 2008). In certain cases, it disappeared completely (FANFARILLO ET AL., 2019).

Anthemis carpatica W. (*Anthemis cretica* subsp. *carpatica* (Willd.) Grierson) has a mountain habitat, preferring stony and grassy places. The stem is erect but bent at the base, pubescent and can reach 30 cm in length. The leaves have a long stalk and are differentiated:

the base and inferior ones are doubly sectate and pennate, while the superior and middle third ones are simply pennate. The anthodium has a variable stem that can reach a diameter of 4.5 cm. The flowers are yellow and tubular in shape, with the ligate ones being white and up to 10-15 mm. The achene is long (2-3 mm), cylindrical and weakly sulcate. The flowers are present from May up to middle September (NYARADY, 1964).

“*Flora Muntilor Bucegi*” work mentions only the *pyrethroides* subspecies (Schur). The same author signals that these subspecies were noted under the name of *Anthemis carpatica* W. et. K.

Anthemis tinctoria L. (figure 6) is pretty common, especially in forest areas where it prefers sunny areas from cliffs and debris. The species is heliophile, saxicolous, and mezoxerophite-xerophite (BELDIE 1967). The stem is erect, slightly curved at the base and can grow up to 85 cm. The leaves are broadly ovate, sectate pennate and disposed alternately. The anthodium is pedunculated, long and with a diameter between 2 and 4 cm. The flowers are present from August up to September, are yellow and measure 10 mm in height and 3 mm in width (NYARADY, 1964). The species is characterized by the presence of 2-3 pennate leaves. The flowers are white and ligulae. The fruit is a strongly grooved, ribbed achene.

The species is used in the naturist medicine through the oils obtained by its fruits (ALIZADEH AND JAFARI, 2016).

“*Alexandru Beldie*” Herbarium also has in its collection species of *Anthemis tinctoria* var. *fusii* and var *fusii Giselle*. Beldie himself mentions the presence of *fusii* subspecies in Bucegi Mountains.

We can find the following species in the herbarium, if we consult the „*Red List of superior plants from Romania*” (OLTEANU EL AL., 1994):

Anthemis tinctoria L. var. *fusii* described in Flora R.P.R. (NYARADY, 1964) and characterized by its involucre dark brown folios. The plants are present in the mountain-sub-alpine habitat.

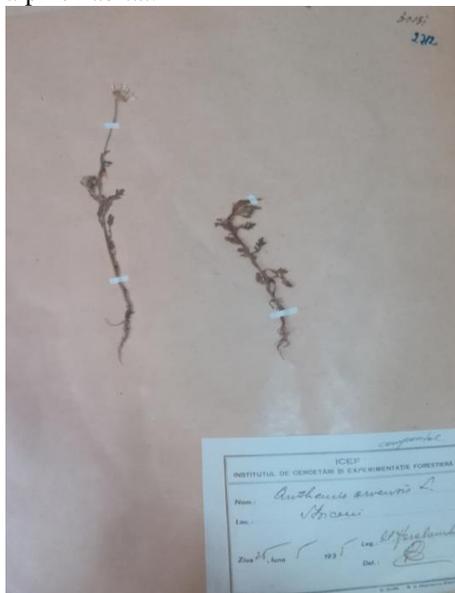


Figure 5. *Anthemis arvensis*

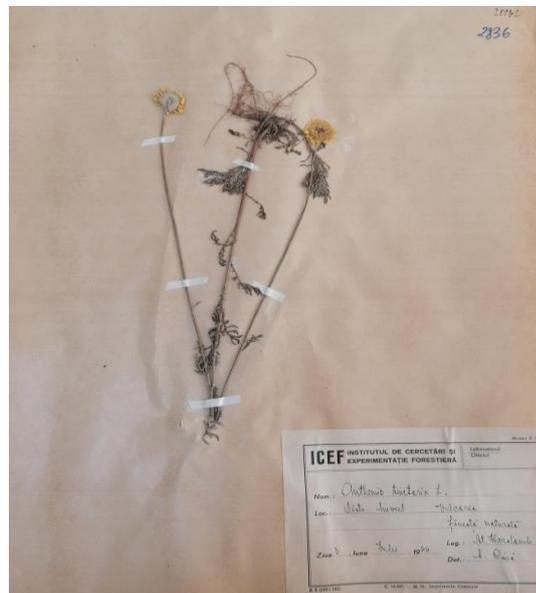


Figure 6. *Anthemis tinctoria*

Anthemis triumfettii (L.) DC. (*Cota triumfetti* (L.) J.Gay) (figure 7) has a more narrow spreading habitat, especially in the central and west parts of Romania. The plants present in the herbarium were collected from the Cluj area.

The species has erect, hairy stems that can reach 80 cm in height. The leaves are glabrous on the front, and pressed and shortly hairy on the back. The anthodium is pedunculated and with a diameter of 3-4 cm. The flowers have a tubular shape and are yellow-gold in color, with the ligulae ones being white. The achene is glabrous and edged, with a very short crown at the top (NYARADY, 1964).

Even though the species grows spontaneously, it is cultivated in some areas on small surfaces for its medicinal properties (ALIZADEH AND JAFARI, 2016).

Anthemis macrantha Heuff (*Cota macrantha* (Heuff.) Boiss.) (figure 8) is more vigorous than the previous species. The leaves are darker and more divided, while the ligulae flowers are bigger than *Anthemis triumfettii*. The species is more widespread in our country and in the Balkans where it has an endemic character.



Figure 7. *Anthemis triumfettii*



Figure 8. *Anthemis macrantha*

CONCLUSIONS

Anthemis Genus has high importance due to its usages, mainly because of its antioxidant and antimicrobial properties.

Agriculture offers it a lower value, considering it a weed that is commonly found in agricultural crops, orchards and vineyards. However, it participates in the composition of pastures from the seaside up to the alpine area, being consumed by animals even though it has

a low fodder value. An important moment for the diversity of these species was represented by the context in which agriculture shifted from the collective organization previous to 1990 towards the individual one in which property forms are divided. Further studies are required to see how the spreading of these species has been affected by this shift.

Grazing has become a current problem, regardless of the help offered by the state or of the creation of pasture management plans.

Moreover, future perspectives should focus on studying DNA in order to determine more exactly the species that do not have a clear origin within the herbarium as well as for updating the current taxa.

BIBLIOGRAPHY

- ALIZADEH M.A., JAFARI A.A., 2016 – Variation and relationships of morphological traits, shoot yields and essential oil contents of four *Anthemis* species. *Folia Horticulturae*, 28(2), 165-11, Poland.
- ALBAYRAK S., AKSOY A., 2013 – Evaluation of antioxidant and antimicrobial activities of two endemic *Anthemis* species in Turkey. *Journal of Food Biochemistry*, 37(6), 639-645, United States.
- ALBRECHT H., ANDERLIK, WESINGER G., KÜHN N., MATTHEIS A., PFADENHAUER J., 2008 – Effects of land use changes on the plant species diversity in agricultural ecosystems. In *Perspectives for Agroecosystem Management*, 203-235, Elsevier.
- BAESSLER C., KLOTZ S., 2006 – Effects of changes in agricultural land-use on landscape structure and arable weed vegetation over the last 50 years. *Agriculture, ecosystems & environment*, 115(1-4), 43-50, Netherlands.
- BUIA AL., NYARADY A., RAVARUT M., 1965 – *Botanică agricolă*, vol II, Editura Agro-Silvică, București, Romania.
- BELDIE AL., 1967 – *Flora Munților Bucegi*; Editura Academiei Române, București, Romania.
- BOUKHARY R., ABOUL-EL A.M., EL-LAKANY A., 2019 – Review on chemical constituents and biological activities of genus *Anthemis*. *Pharmacognosy Journal*, 11(5), India.
- CÂNTAR I.C., VECHIU E., DINCĂ L., 2018 – Plants conserved in "Alexandru Beldie" Herbarium - *Alyssum* genus. *Annals of the University of Craiova, Series Biology, Horticulture, Food produce processing technology, Environmental engineering*, 23(59), 352-358, Romania.
- CIONTU C.I., DINCĂ L., 2019 – Plants from former Vlaşca County that are present in "Alexandru Beldie" Herbarium. *Research Journal of Agricultural Science*, 51 (4), 254-261, Romania.
- CRISAN V., DINCĂ L., DECA S., 2020A – Plants from Jepi Mountains, Bucegi, present in "Alexandru Beldie" Herbarium. *Current Trends in Natural Sciences*, 9(17), 160-167, Romania.
- CRİȘAN V., DINCĂ L., DECA S., 2020B – Plants from Buzau County present in "Alexandru Beldie" and W.U. herbariums. *Research Journal of Agricultural Science*, 52 (2), 24-31, Romania.
- DINCĂ L., VASILE D., DINCĂ M., BLAGA T., 2018A – *Rubus* species present in Alexandru Beldie Herbarium. *Lucrări Științifice, Seria Horticultură*, 61(1), 61-70, Romania.
- DINCĂ L., DINCĂ M., PANTEA S.D., TIMIȘ-GÂNSAC V., ONEȚ C., 2018B – *Amaranthus* plant - between myth and usage. *Natural Resources and Sustainable Development*, 8(1), 9-16, Romania.
- DINCĂ L., PETICILĂ A., 2019 – How many alder species (*Alnus* sp.) exist? A statistic based on herbarium vouchers. *Scientific papers, Series B, Horticulture*, 63(1), 613-619, Romania.
- DINCĂ L., VECHIU E., 2020 – A statistic of *Campanula* species based on vouchers from different herbarium. *Annals of West University of Timișoara, ser. Biology*, 23 (1), 29-38, Romania.

- FANFARILLO E., KASPERSKI A., GIULIANI A., ABBATE G., 2019 – Shifts of arable plant communities after agricultural intensification: a floristic and ecological diachronic analysis in maize fields of Latium (central Italy). *Botany Letters*, 166(3), 356-365, Romania.
- KACHOVA V., DINCĂ L., CÂNTAR I., VECHIU E., 2020 – Plant species in Alexandru Beldie herbarium collected from the Balkan area. *Forest science Nauka za Gorata*, 56(1), 55-64, Romania.
- LO PRESTI R.M., OBERPRIELER C., 2009 – Evolutionary history, biogeography and eco-climatological differentiation of the genus *Anthemis* L. (*Compositae*, *Anthemideae*) in the circum-Mediterranean area. *Journal of Biogeography*, 36(7), 1313-1332, United Kingdom.
- LO PRESTI R.M., 2010 – Geological Vs. Climatological Diversification in the Mediterranean Area: Micro-and Macroevolutionary Approaches in *Anthemis* L. (*Compositae*, *Anthemideae*). Logos Verlag Berlin GmbH, Germany.
- OLTEAN M., NEGREAN G., POPESCU A., ROMAN N., DIHORU G., SANDA V., MIHĂILESCU S., 1994 – Lista roșie a plantelor superioare din România. Studii, sinteze, documentații de ecologie, 1, 1-52, Romania.
- ORLANDO G., ZENGIN G., FERRANTE C., RONCI M., RECINELLA L., SENKARDES I, ... & MENGHINI L., 2019 – Comprehensive Chemical Profiling and Multidirectional Biological Investigation of Two Wild *Anthemis* Species (*Anthemis tinctoria* var. *Pallida* and *A. cretica* subsp. *tenuiloba*): Focus on Neuroprotective Effects. *Molecules*, 24(14), 2582, Switzerland.
- NYARADY E.I., 1964, Flora Republicii Populare Române-volumul IX, Editura Academiei Române, București, Romania.
- PLEȘCA I.M., BLAGA T., DINCĂ L., 2019 – *Elymus* L. Genus - species diversity, conservation and implications for agricultural ecosystems. *Lucrări Științifice, Seria Agronomie*, 62(2), 103-108, Romania.
- PLEȘCA I.M., BLAGA T., DINCĂ L., 2020 – *Asperula* L. species preserved in 'Alexandru Beldie' Herbarium. *Bulletin UASVM Horticulture* 77(1), 92-97, Romania.
- PUȘCARU SOROCEANU E. (redactor), 1963 – Pășunile și fânețele din R.P.R. Editura Academiei R.P.R.
- SCĂRLĂTESCU V., VASILE D., DINCĂ L., 2017 – The importance of *Vaccinium* species collection. *Research Journal of Agricultural Science*, 50 (1), 194-201, Romania.
- TUDOR C., DINCĂ L., 2019 - What can we learn about *Bromus* genus preserved in "Alexandru Beldie" herbarium? *Research Journal of Agricultural Science*, 51 (4), 218-225, Romania.
- VASILE D., DINCĂ L., 2019A – Specii de plante din Republica Moldova păstrate în colecția ierbarului "Alexandru Beldie". *Buletin Științific. Revista de Etnografie, Științele Naturii și Muzeologie (Serie Nouă)*, 43(30), 6-16, Romania.
- VASILE D., DINCĂ L., 2019B – Algae from the "*Cryptogamae Germaniae, Austriae* and *Helvetiae Exsiccatae Fasc*" collection gathered by W. Migula. *Journal of Horticulture, Forestry and Biotechnology*, 23(3), 107-112, Romania.
- VECHIU E., DINCĂ L., 2019 – Characterization of *Cornus* plant present in "Al. Beldie" herbarium. *Research Journal of Agricultural Science*, 51 (3), 169-175, Romania.
- VEREȘ T., TÝR Š., 2011 – Top 10 of the most dangerous weed species in the spring barley canopies during the last decade in the Slovak Republic. *Research Journal of Agricultural Science*, 43(2), 119-122, Romania.

*** <http://www.theplantlist.org>

***<http://www.worldfloraonline.org/>