

WHAT CAN WE LEARN ABOUT BROMUS GENUS PRESERVED IN "ALEXANDRU BELDIE" HERBARIUM?

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Abstract: *Through the success of some famous botanists, the "Alexandru Beldie" Herbarium gained a symbolic allure by preserving and keeping in the attention of the researchers a lot of important and special species, belonging to certain genres of plants and which is currently hosted by National Institute of Research and Development in Forestry "Marin Drăcea", from Bucharest. Genus Bromus, also called the genus of herbs, making apart from this herbarium. Thus, this article presents some important aspects related to this genus. Methods and materials used the collection of vouchers as well as the information processed in excel to create a database. Moreover, for each sample in the collection, the year and place of harvesting were used, as well as the person who handled the collection of these taxa. With the help of the obtained data, it was possible to draw the analysis regarding the key periods in which the plants were harvested and also their diversified distribution regarding the place of harvesting. The obtained results consisted in the identification of the number of plants collected in small spreaded intervals of 9 years and the use of 4 degrees of conservation of the species, surpassing the quality of their maintenance throughout these years. The degree of novelty is represented by the description for the first time of this genus within this herbarium. The content is elaborated by a unique analysis, including details related to the history of the genus Bromus as well as the present benefits. The originality of the work is shown by the fact that at the process of collecting the plants it was realized by famous botanists, reflecting the influence on the biodiversity and who have put all the necessary bases in order to obtain the characteristics of the Genus Bromus. The importance of this paper work comes from perspective of contents presented in this spectacular herbarium, which hosts a lot of plants species from different genres, also Genus Bromus. Also, some species were transfered from another herbariums belonging of International Institutions, which is also a good thing for improving the „Alexandru Beldie" Herbarium.*

Keywords: *genre, herbarium, Bromus Genus, harvesting period, degree of conservation.*

INTRODUCTION

In 1929, with the help of some specialists in botany, it was established the "Alexandru Beldie" Herbarium which in present, is well-kept in the appropriate conditions at the "Marin Drăcea" National Institute of Research and Development in Forestry, from Bucharest. This herbarium is registered in Herbariorum Index having the BUCF international code and it is composed by approximately 40.000 vouchers (DINCĂ M. et al., 2018; VECHIU et al., 2018). The herbarium content covers a lot of genres of plants among which we can mention the number of species from each genus: the 69 species of *Potentilla* genus (CRIȘAN, V. et al., 2017), the 15 species of *Veronica* genus (DINCĂ et al., 2017), the 19 species of *Centaurea* genus (DINCĂ et al., 2017), the 19 species of *Scorzonera* genus (Dincă and Cântar I.C. 2017), the 15 species of *Ornithogalum* genus (ENESCU R. and DINCĂ L. 2017), the 80 species of *Trifolium* genus (CÂNTAR I. et al, 2018), and the 16 species of *Abies* genus (ENESCU, C et al., 2018) and the 41 species of *Polygonum* genus (VECHIU et al., 2018).

MATERIAL AND METHODS**How is organised a typical collection from such an important herbarium?
Bromus Genus– materials and methods used**

Bromus Genus from "Alexandru Beldie" Herbarium was completed well through amount of work from the botanist, and they improve this genus with a lot of effort for collecting the plants. In the field, they have used as materials some depreciated papers, but with significant notes, which brought good result in the research. Now, these papers were transcribed into Excel spreadsheets and all the information was used for creating an original database. The vouchers collection was also an good material, beside both of these mentioned above.

Table 1.

Excerpt of *Bromus* Genus from inventory of "Al. Beldie" Herbarium (INCDS București)

Drawer number	Voucher number	Herbarium/ Botanic collection/ Institution	Species name	Harvesting date	Harvesting place	Collected/ Determined by:	Conservation Degree (1-4)
64	1	Guzzino Nicasio, Flora Sicula	<i>Bromus maximus</i> Desf.	1889.04.01.	Palermo	Guzzino	1
64	7	A Museo Botanico Universitatis Clusiensis (in Timisoara) edita	<i>Bromus hordeaceus</i> L. var <i>bujoreani</i> Borza	1941.06.13.	Timiș district Torontal, Timișoara 90 metres altitudine	G. Bujorean	1
64	8	Herbarium of Politechnic School from Bucharest	<i>Bromus mollis</i> L.	1935.07.01.	Bărgăului Edge	C.C. Georgescu	1
64	9	A Museo Botanico Universitatis Clusiensis (in Timisoara) edita	<i>Bromus hordeaceus</i> L.	1940.05.25.	Ifov District, Pantelimon, 85 metres	P. Cretzoiu, I. Morariu	1
64	10	ICEF, Institute of Researches and Forestry Experimentation	<i>Bromus hordeaceus</i> L.	1936.07.05.	Călugărească Valley	At. Haralamb, J. Newirth	1
64	14	The herbarium of the Institute of Forestry Researches/ The Minister of Agriculture and Silviculture	<i>Bromus mollis</i> L.	1952.05.19.	Mt. Cioclovina	St. Purcean	1
64	15	The Herbarium of Cluj University	<i>Bromus hordeaceus</i> L.	1929.05.31.	Dolj district., Craiovitei Pond, 85 metres	E. I. Nyárady	1
64	17	A Museo Botanico Universitatis Clusiensis (in Timisoara) edita	<i>Bromus hordeaceus</i> L.	1939.05.16.	Iași district, Bahlui, Beldiman Inn, 40 m	M. Răvăruț	1

The informations were passed through an detailed analysis which are exemplified in the table from below. For each sample from this collection was created an systematization including year of harvesting, place of harvest and the person who participate at drawing collection. Also, for enhance the possibility of viewing the periods when the plants were

collected and the places of harvesting, it was drawn some specific points with coordinates, to evidenciate more nicely the exactly places of collecting these miraculous plants, from *Bromus* Genus. This aspect is important for untrained people, to find better the place and to study these areas easier.

As we observe the drawer number is unchanged and the collection is improved by another Herbariums, Botanic collection and Institutions through the richness of plants, which were transferred in "Al.Beldie" Herbarium and this became more and more appreciated for his symbolic value. In the below paragraphs we will discuss a little bit about the importance of these species.

RESULTS AND DISCUSSION

What about the importance of the species from *Bromus* Genus? Are they important or not for community?

Bromus Genus contains a lot of grassed, classified in the *Bromeae* Family. They have a lot of names during the history and some of them are commonly known as brome grasses, bromes, cheat grasses or chess grasses. In the scientific literature the estimation containing the number of species have grown from 100 to 400, which is an significant one. The taxonomists recognise from this number, only 160-170 plants. Subfamily *Pooideae* is represented by the cool-season grass lineage, and *Bromus* is a fully part of it which includes approximatively 3300 species. The tribe *Bromeae* is the only which carry species from *Bromus* genus. Today, the important thing is related for the economic part and this genus is closely appropriate to the wheat-grass lineage which includes important genera as *Triticum* (wheat), *Hordeum* (barley) and *Secale* (rye) (<https://en.wikipedia.org/wiki/Bromus>). From the point of ecology, the usage of *Bromus* species is practiced in the world of Lepidoptera Order, where some caterpillars use *Bromus* as a source of food, an example being the chequered skipper (*Carterocephalus palaemon*). Nowadays, the economic value of *Bromus* species is considered to be low in human lifestyle (<https://en.wikipedia.org/wiki/Bromus>). It is known that some populations from Northern Mexico, called Tarahumara Indians have used the grains of *Bromus* species for the aid of fermentation, being a good source of humus for their cultures. Some of taxa are cultivated for forages (*Bromus riparius*) especially in the North America. Unfortunately, some species (*B. sterilis*, *B. diandrus*) called poverty brome and ripgut brome, are not as useful as fodder, because they content is rich in silica and their leaves sclerotize fast and can be dangerous for the animals. Furthermore, these bromes can't be used as ornamental plants because of their character of invasive weeds. Their appearance doesn't look so well, most of species have an irregular form or sometimes they have an non-descriptive appearance. In the Western North America, from British Columbia to California, the cheatgrass (*Bromus tectorum*), it became invasive and also being a particular case of troublesome weed.



Figure 1. Vouchers with *Bromus* samples preserved in “Alexandru Beldie” Herbarium (*Bromus arvensis* (left up), *Bromus inermis* (right up), *Bromus japonicus* (left down), *Bromus sterilis* (right down))

Bromus arvensis is distributed , in disturbed areas, along roadsides and can be found on salty soils, clay, sand, silt, but prefer fine-textured soils. The most part of the habitat is occupied in southern and central Europe, but now, this species prefer the temperate regions including Asia and North America, being naturalized. The grass can be a soil improver and also an good species for erosion control. This plant is a component of creation mixed prairie communities, being an aggressive species in the terms of consuming the soil nutrients, reducing the plant communities and biodiversity. The plant is a common component of many mixed prairie communities. It is an aggressive species that out-competes desirable vegetation for water and soil nutrients, thus reducing plant biodiversity (<https://www.invasiveplantatlas.org/subject.html?sub=5192>).

Bromus inermis have an invasive character and it's a perennial grass which had an extensive impact for grasslands of North America. This species invaded disturbed prairies and it was introduced in repeated times for livestock graze and soil retention. It had negative impacts on growth of some native plants by using all the resources from soils (water and nutrients). *B. inermis* have an significant impact for some arthropod species from North American communities of prairies, especially in moving up their native behaviour (<http://www.iucngisd.org/gisd/species.php?sc=1223>).

Athysanus argentarius or silver leaf-hopper is an insect introduced in Europe and it is pretty found in lands covered by bromes. Other insect such as *Phoetaliotes nebrascensis* or large headed grasshopper and winged wainscot (*Leucania multilinea*) is feeding on *Bromus spp.* Also, it helps rabbits and hooved herbivores in digestion, gastrointestinal tracts and so on. In present, *B. inermis* is planted for reducing the soil erosion after fires or for improving forage. The smooth brome is rich in proteins and can be used as pasture, hay or silage for animals. Furthermore, it can be used well in a cropping system which includes alfalfa or other legumes. With her massive root system, *B. inermis* have a good contribution in erosion control (USDA, 2007).

Bromus japonicus, or the Japanese brome, is an annual brome grass being native to Eurasia but has been naturalized in the United States and southern Canada, being rare in the Yukon. This species have negative impact in terms of biodiversity and grassland communities, because *B. japonicus* is an invasive species and can double the herbaceous biomass, reducing the plant species from functional group. The utilization of *B. japonicus* consists in an inexpensive alternative to seed cakes, bran and grains for doing wet baits for locusts (VERESCAGIN, 1942). It can provides forage for grazing animals, but it matures faster than perennial grasses and its presence put in danger the maximum forage production, being necessary an change in livestock management. Rodents such as jumping mice (*Zapus hudsonius luteus*) use it as food the achenes or seeds of Japanese brome (WRIGHT and FREY, 2014). *B. sterilis* or barren brome occupies in ruderal situations, on roadsides and wastelands, but it is also increasingly abundant in arable areas where cultivation is practiced. It can be found in the major soil types (loams, clays, and sands with different pH : acid, neutral and alkaline) growing well in dry or moist soil. Barren brome can tolerate drought and powerful winds but not maritime exposure. *B. sterilis* is seen to be a noxious horticultural and agricultural weed in the Mediterranean region (TALEB, 1997). The agricultural crops which have been affected are barley, wheat and crops in rotation with cereals.

When *Bromus* species from “Al. Beldie” Herbarium were harvested?

Based on the methodology from above as we can see in the figure number 2, the number of *Bromus* has grown progressively, most of the harvested plants being collected massive between years 1930-1949. The higher number was registered in period 1940-1949, with a number of 84 vouchers. So, the botanists have done a lot of efforts to collect them, although it was the inter-war period. The oldest *Bromus* collected is a *Bromus racemosus* L. harvested in 1854 by Wolff in Kolosvos and the newest sample is taken by a *Bromus molliformis* L. harvested in 1994.

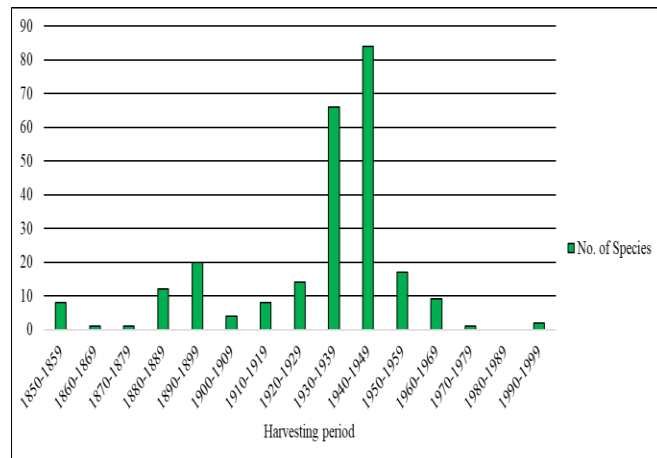


Figure 2. Harvesting period of *Bromus* samples from “Al. Beldie” Herbarium

The representative areal of *Bromus* species and the harvesting place of samples

The harvesting place of samples were collected from all the entire Romanian relief forms including valleys (Bogdan Valley, Călugărească Valley, Popii Valley etc.), mountains (Bucegi, Retezat), forests (Cernica, Tusks of Babeş etc.), districts (Mihăeşti, Săbed, etc.). Also, there are some taxa collected from previous installed Romanian territories such as Durostor (Bulgaria), Hungary, Austria, Palermo (Italy), Kerault (France), and so on. In the figure 3, we can see the entire distribution of *Bromus* collection in Romania. It covers a lot of counties situated in the Romanian Plaine, from south part such as Argeş, Buzău, Caraş-Severin, Constanţa, Dolj, Giurgiu, Gorj, Ilfov, Olt, Prahova, Teleorman.



Figure 3. Harvesting places of *Bromus* plants from Romania

Persons who contributed to the development of Bromus collection

Bromus collection from "Al.Beldie" Herbarium was improved and developed by Romanian and foreign specialists who dedicated their professionalism for research domain which is botany. Important Romanian names which definitively contributed to the development of *Bromus* collection were: Arvat, Badea, Beldie, Bujorean, Buia, Borza, Bunea, Cretzoiu, Coman, Chiriță, Georgescu, Haralamb, Haret, Olaru, Onică, Morariu, Pașcovschi, Păun, Petrini, Prodan and so on. The foreign specialists who have improved with many *Bromus* samples for development of the "Al. Beldie" Herbarium were: Beaudouin, Brandis, Crepin, Guzzino, Wolff.

Worldwide Bromus collection

Beside herbariums preserved in some institutions from Romania such as a Museo Botanico Universitatis Clusensis (in Timisoara), Herbarium of Politechnic School from Bucharest, the Herbarium of the Institute of Forestry Researches, the Herbarium of Cluj University and so on, which conserve whole plants at high degree (4), there are some another institutions from abroad that are conserving well the *Bromus* collection of plants, from different types of flora, among which we can mention: Dr. C. Baenitz, Herbarium Europaeum, Flora Hungarica, M.Gandoger-Flora Hispanica exsicata, Todaro Flora Sicula Exiccata, Flora Austriae inferioris, Plantes de France, Guzzino Nicasio, Flora Sicula.

CONCLUSIONS

The present article reveals the important aspects about the most important and emblematic herbarium from Romania. Also, it is presented a short analysis of *Bromus* Genus using specific materials. "Al.Beldie" Herbarium host a number of 40000 vouchers and 600 drawers. The systematization of analysis was made by some criteria such as harvesting periods, harvesting place, person who collected the plants, degree of conservation, numbers of vouchers and drawers. For *Bromus* it was estimated a number of 290 vouchers, from 36 taxa. Through the species that contributed at the increasing number we can mention: 26 vouchers of *Bromus hordeacens* L., 20 vouchers of *Bromus squarrosus* L., 29 vouchers of *Bromus sterilis* L., 32 vouchers of *Bromus tectorum* L., 22 vouchers of *Bromus japonicus* Thbg var. *Velutinus*, 24 vouchers of *Bromus inermis* L., 32 vouchers of *Bromus arvensis* L.. Based on the methodology mentioned above, most of the harvested plants being collected massive between years 1930-1949. The higher number was registered in period 1940-1949, with a number of 84 vouchers. The oldest *Bromus* collected is a *Bromus racemosus* L. harvested in 1854 by Wolff in Kolosvos and the newest sample is taken by a *Bromus molliformis* L. harvested in 1994. The plants have a spreaded areal which includes the Romanian territories, previous territories which didn't make apart from Romania or most of them are collected from Europe. The number of specialists who collected the plants is estimated at 32, formed by 26 Romanians and 7 foreign specialists from Austria, Belgium, France, Germany, Spain and so on. *Bromus* Genus were improved by the contribution of some institutions from abroad, which cover the presence of vouchers belonging to emblematic herbariums with origins from different types of flora such as: *Herbarium Europaeum*, *Flora Hungarica*, *M.Gandoger-Flora Hispanica exsicata*, *Todaro Flora Sicula Exiccata*, *Flora Austriae inferioris*, *Plantes de France*, *Guzzino Nicasio*, *Flora Sicula*.

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