

ELYMUS L. GENUS – SPECIES DIVERSITY, CONSERVATION AND IMPLICATIONS FOR AGRICULTURAL ECOSYSTEMS

Ioana Maria PLEȘCA¹, Tatiana BLAGA¹, Lucian DINCĂ²

e-mail: ioana0407@yahoo.com

Abstract

In recent years, botanical collections are being used extensively as primary resources for numerous research studies. “Alexandru Beldie” Herbarium is part of the patrimony of the National Institute for Research and Development in Forestry “Marin Drăcea” and is registered in Index Herbariorum under the acronym BUCF. Created nine decades ago, the collection currently comprises approximately 40000 mounted specimens, with emphasis on the Romanian flora. The purpose of this work study was to create an updated electronic database of *Elymus* L. genus stored in the BUCF Herbarium and to provide a short description of the most relevant weeds with notes on their distribution, ecology and implications for agricultural ecosystems.

The *Elymus* genus comprises 120 vouchers and is represented by eleven species and one subspecies. Among them were found three rare taxa for the vascular flora of Romania: *Elymus farctus* subsp. *bessarabicus* (Savul. & Rayss) Melderis, *E. panormitanus* (Parl.) Tzvelev and *E. pycnanthus* (Godr.) Melderis. The Herbarium also stores a historical record, an *E. hispidus* (Opiz) Melderis specimen dated over two hundred years. Almost all plants are very well preserved being kept in their entirety and correctly attached to the voucher. *Elymus* representatives are widespread across the country and are found primarily in open woodlands, meadows and agricultural fields where are problematic weeds of cultivated crops. Specimens of *Elymus* genus stored in the herbarium were mainly collected from forest areas, but they can also be used as reference material in agricultural studies.

Key words: *Elymus*, herbarium, specimen, voucher, weed

Elymus L. (*Triticaceae*, *Poaceae*) is a genus with a cosmopolite distribution (from arctic regions up to tropical ones), comprising approximately 150 species (Dubcovsky J. *et al*, 1997; Okito P. *et al* 2009; Sun G., Salomon B., 2009; Zhou Q. *et al*, 2016). Its taxonomy is considered as extremely complex and controversial as it was revised numerous times (Salomon B., 1994; Assadi M., 1996; Banfi E., 2018). As such, numerous taxa considered as a member of the *Elymus* genus were relocated based on morphologic, anatomic or cytological studies to related genus such as *Agropyron*, *Anthosachne*, *Elytrigia*, *Leymus*, *Thinopyrum*, *Triticum*, etc. (Banfi E., 2018). As a consequence, the *Elymys* nomenclature is difficult due to its numerous synonyms (Mizianty M., Szczepaniak M., 1997).

In recent years, data from herbarium collections have been employed extensively as primary resources for a wide range of investigation (Meineke E.K. *et al*, 2018), from biogeographical patterns to environmental changes (Lavoie C., 2013).

“Alexandru Beldie” Herbarium is one of the most important botanical collections from

Romania. It was created nine decades ago by the renowned botanist Alexandru Beldie and comprises around 40000 mounted specimens, with emphasis on the Romanian flora.

The herbarium is currently part of “Marin Drăcea” National Institute for Research and Development in Forestry and is also included in the international scientific circuit (registered in Index Herbariorum under the acronym BUCF) (Chisăliță I. *et al*, 2017; Dincă L. *et al*, 2018).

According to the last update of its inventory, the Herbarium contains: 19 species of *Androsace* genus (Dincă L. *et al*, 2017), 15 species of *Ornithogalum* genus (Enescu, R., Dincă L., 2017), 69 species of *Potentilla* genus (Crișan, V. *et al*, 2017), 15 species of *Veronica* genus (Dincă L. *et al*, 2017), 7 species of *Lycopodium* genus (Vechiu E. *et al*, 2018), 21 species of *Agrostis* genus (Cântar I.C., Dincă L., 2018), 80 species of *Trifolium* genus (Cântar I.C., Dincă L., 2018), 41 species of *Polygonum* genus (Vechiu E. *et al*, 2018), the 6 species of *Vaccinium* genus (Scărlătescu *et al*., 2017) and the 19 species of *Scorzonera* genus (Dincă L., Cântar I.C., 2017).

¹ “Marin Drăcea” National Institute of Research and Development in Forestry, Bacău

² “Marin Drăcea” National Institute of Research and Development in Forestry, Brașov

MATERIALS AND METHOD

In order to establish the number of taxa belonging to the *Elymus* genus from "Al. Beldie" Herbarium, the entire material available was analyzed, including the related *Agropyron* and *Triticum* genera, as a part of its members are presently considered as belonging to *Elymus*. The species scientific nomenclature follows The Plant List international database (<http://www.theplantlist.org>).

The data about each specimen was recorded in a table: scientific name, collection name, exact place of harvesting (country, county, locality, mountains, forest, etc.), collection time (year, month, day), the name of the person who has collected or identified the plant and the conservation degree.

A numerical scale designed into four levels was used to assess the conservation of each specimen: 1 (well conserved plant, entire and correctly attached to the voucher), 2 (plant detached from the voucher with striped but present parts), 3 (detached plant with missing parts), 4 (detached and fragmented plant with over 50% of its parts missing) (Vasile D. et al., 2017). An excerpt of the inventory is rendered in *Table 1*.

Subsequently, the species were described based on the bibliographic study analysis. For the most relevant species, their chorologic, morphologic and ecologic particularities have been emphasized, as well as their implications in agricultural ecosystems.

Table 1

Elymus genus inventory (excerpt from the data base)

Drawer no.	Plate No.	Herbarium/ Botanic Collection/ Institution	Specie's name	Harvest date	Harvest place	Collected/ Determined by:	Conservation degree (1..4)
14	39	Flora Exsiccata Austro-Hungarica	<i>Elymus hispidus</i> (Opiz) Melderis	1812.01.01.	Hungary	J. Wagner	1
14	70	Museum Botanicum Universitatis Cluj	<i>Elymus farctus</i> (Viv.) Runemark ex Melderis	1924.06.10.	Dobrogea, Caliacra	I. Prodan, E.I. Nyarady	1
14	2	Al. Beldie Herbarium, Bucharest	<i>Elymus caninus</i> (L.) L.	1947.09.22.	Bucegi	Al. Beldie	1
14	23	"Regele Carol II" Polytechnic School, Botanic Laboratory, Bucharest	<i>Elymus trachycaulus</i> (Link) Gould ex Shinners	1983.07.22.	Suecia, Monte Suljatten Jemtlandiae	Conrad Indebetou	1
15	66	Herbier A. Autheman	<i>Elymus elongates</i> (Host) Runemark	1888.07.01	Martigues, Etang de Caronte	Autheman	1
15	70	J. Dorfler, Wiener botanischer Tauschverein	<i>Elymus pycnanthus</i> (Godr.) Melderis	1894.07.12.	Flora Anglica: Bristol	J.W. White, F.L.S.Clifton	1
15	65	J. Vetter Herbarium	<i>Elymus tauri</i> (Boiss. & Bal.) Melderis	1890.08.01	Piohlero, Elmalu	J.Vetter	1
15	62	ICS Herbarium	<i>Elymus repens</i> (L.) Gould	1937.09.13.	Maxim – Buzau Forest	C.C.Georgescu	2
15	60	Hortus Botanicus Universitatis Craiovensis	<i>Elymus repens</i> (L.) Gould	1966.06.29.	Distr. Craiova, Radovan	D. Cirtu	1
15	32	Herbarul Scoalei Politehnice Bucuresti	<i>Elymus repens</i> (L.) Gould	1893..07.06.	Torda	Wolff	1
14	19	Flora Bulgarica Exsiccata	<i>Elymus caninus</i> (L.) L.	1932.08.08.	Macedonia	B. Stefanaff et T. Georgieff	1

RESULTS AND DISCUSSIONS

“Al. Beldie” Herbarium contains 120 *Elymus* L. vouchers and is represented by the following species: *Elymus caninus* (L.) L., *E. elongates* (Host) Runemark, *E. fractus* (Viv.) Runemark ex Melderis, *E. fractus* subsp. *bessarabicus* (Savul. & Rayss) Melderis, *E. hispidus* (Opiz) Melderis, *E. panoramitanus* (Parl.) Tzvelev., *E. pungens* (Pers.) Melderis, *E. pycnanthus* (Godr.) Melderis, *E. repens* (L.) Gould, *E. mutabilis* (Drobow) Tzvelev, *E. tauri* (Boiss. & Bal.) Melderis and *E. trachycaulus* (Link) Gould ex Shinners.

The most numerous recordings were signaled for *E. repens* (49 vouchers), *E. hispidus* (32 vouchers), *E. caninus* (15 vouchers) and *E. fractus* (10 vouchers). Furthermore, three taxa included in the National Red List of rare species are also present, namely: *E. fractus* subsp. *bessarabicus*, *E. pycnanthus* and *E. panormitanus* (Olteanu M. et al, 1994).

***Elymus repens* (L.) Gould** (syn. *Agropyron repens*) commonly known as quack grass or couch grass has a very wide spreading area, covering Europe, Asia, America and Africa (Szczepaniak M., 2009).

In Romania, it occupies a varied array of habitats (meadows, fields, dry shores, roadsides, shrubberies and forests), from the plain area up to the inferior mountain one (Anghel G., Morariu I., 1972). It is considered to be one of the most problematic weeds worldwide when associated with agricultural crops (Holm L.G. et al., 1977). It is a perennial plant, with a long and very ramified rhizome with aerial sprouts that can reach 80-100 cm in height. Its spike is compound, with multiflora bristles, laterally compressed, located with the broad part towards the rachis.

The species is characterized by a very high morphologic variability, with the floral literature describing a considerable number of intraspecific units (Palmer J.H., 1963).

Extremely important is the fact that its rhizome is used for preparing a medicinal tea with diuretic properties (Al-Snafi A. E., 2015).

Elymus hispidus (syn. *Agropyron intermedium*) grows in central and southern parts from Europe from where it extends towards Central Asia (Mizianty M., Szczepaniak M., 1997). It is morphologically similar to *E. repens* in that it develops long and creeping rhizomes, but unlike it, its lemma is entirely glabrous (*figure 1*).



Figure 1. *Elymus hispidus*

Elymus caninus (syn. *Agropyron caninus*) has a native Euro-Asiatic areal, but narrower than the previous species. On the West side, its areal starts from Iceland and Great Britain from where it rapidly advances towards East countries up to South Siberia. The South limit ends in the North of the Mediterranean Sea from where it grows up to subarctic regions (Yan C., Sun G., 2012). In Romania it habituates on forests, forest clearings, shrubberies, debris, grass cliffs and more frequently in the mountain level. It is a plant without long stools and with aristate glumes that can reach 10 mm in length (*figure 2*).



Figure 2. *Elymus caninus*

It shows also great morphological variability, the varieties and forms that are distinguished mainly by the number of floras in a spikelet, the length of lemma awn, leaf and sheaths pubescence (Mizianty M., 2005).

Elymus fractus (syn. *Agropyron junceum*) is present in coastal areas from Europe, Asia Minor and Africa. In our country, it can be found in Constanța County where it prefers sandy stations from the sea litoral. A vigorous plant, its rhizome is long, repent, with long spikes bonded to the axes that can reach 17-30 mm. It adapts well on sandy soils with salt excess (Gorham J. *et al*, 1986), being used for obtaining hybrids from the wheat that manifests the highest resistance to large salt concentrations (Forster B.P. *et al*, 1988).

Elymus farctus subsp. *bessarabicus* is reported only on the Black Sea coasts (Dewey D.R., 1970). In Romania, it appears sporadically together with a typical species from which it is hard to differentiate. This subspecies is characterized by spikelets shorter than the rachis internodes.

Elymus panormitanus (syn. *Agropyron panormitanus*) can be found in the Mediterranean region, Crimea, Syria and Algeria. It was signaled

in our country in Caraș-Severin and Mehedinți, where it prefers shaded forests. From a morphologic point of view, it is similar to *E. caninus*, with the difference that it has an inferior, arista and longer glumes.

Elymus pycnanthus has dense spikes and large spikelets. The leaves have pronounced nerves, while overlapping sheaths margins lack cilia. The rachis is rigid, with short internodes.

The plant's harvesting period. The specimens were gathered over 180 years. The oldest voucher from the herbarium dates back to 1812 and belongs to an *E. hispidus* sample originating from Flora Exsiccata Austro-Hungarica.

Most of the vouchers dating before 1900 were donated or bought through exchanges from over 15 similar foreign institutions such as Flora Britannica, Flora der Mark, Flora Norvegica, Societas Helvetica, Flora Hispanica Exsiccata, Flora von West-Ungarn, Flora Exsiccata Austro-Hungarica, etc.

After the year 1900, most of the herbarium materials were harvested within 1930-1939 and 1940-1949 (figure 3). Their number amounts to almost half of the entire collection.

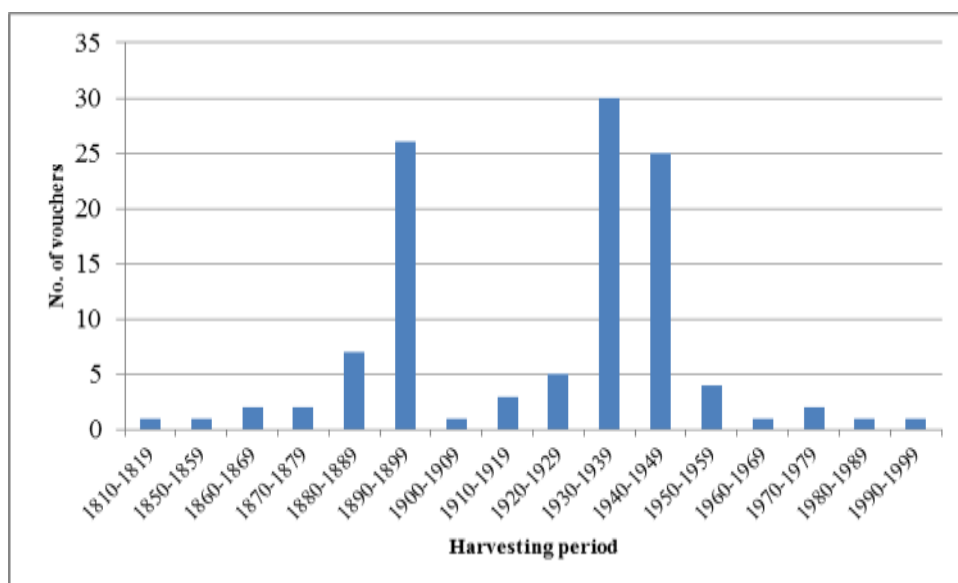


Figure 3. Harvesting periods of *Elymus* plants from "Alexandru Beldie" Herbarium

Species gathered from our country predominate in the collection (namely from Alba, Argeș, Brașov, Caraș Severin, Cluj, Constanța, Dâmbovița, Dolj, Ilfov, Prahova, Mehedinți, Mureș, Timiș, and Tulcea counties). The plants were harvested from renowned specialists among which we mention C.C. Georgescu (16 vouchers), Al. Beldie (13 vouchers) and Wolff (10 vouchers).

Amongst the 120 vouchers analyzed, 99,2% have obtained the first grade in regard to their

conservation state. This is a favorable statistic, given the advanced age of many of the vouchers.

CONCLUSIONS

The geographic distribution of *Elymus* species in Romania shows very diverse patterns, from wide (eg. *E. repens*, *E. caninus*) to narrow ranges (eg. *E. fractus*, *E. panormitanus*). In addition, some species occupy a wide altitudinal range, while others are restricted to coastal areas.

Apart from the great variation in geographic distribution patterns, *Elymus* species present a large variability in morphological traits. As such, they occupy very diverse habitats, primarily open woodlands, meadows or agricultural fields where they have a negative impact on cultivated crops. On the other hand, some members possess useful genes for wheat breeding programs.

Among the main representatives, we have also detected three 'rare species for the Romanian flora (*E. farctus* subsp. *bessarabicus*, *E. pycnanthus* and *E. panormitanus*).

The storage conditions of the *Elymus* genus in the "Al. Beldie" Herbarium is remarkable, considering the age of specimens. Because of their historical relevance, vouchers can offer numerous research opportunities. Additionally, the agricultural sector can also benefit from stored and preserved vouchers, as they can help reconstruct the spread of invasive weeds or other species.

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