

UDC 582.824.3: 58.009
AGRIS F40

<https://doi.org/10.33619/2414-2948/95/02>

**BIOECOLOGICAL CHARACTERISTICS OF SPECIES
OF THE *Hypericum* L. GENUS IN FLORA OF AZERBAIJAN**

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**БИОЭКОЛОГИЧЕСКАЯ ХАРАКТЕРИСТИКА ВИДОВ
РОДА *Hypericum* L. ФЛОРЫ АЗЕРБАЙДЖАНА**

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Abstract. The Republic of Azerbaijan with a rich biodiversity occupies a special place in the Caucasus region. There are about 5000 higher plant species in the country (belonging to 1142 genera), which makes up 66% of the total number of plant species growing in the Caucasus. Among the widespread plant species in this rich nature, the *Hypericum* genus which belongs to the Hypericaceae family takes special place. Although the vast majority of species belonging to the Hypericaceae family are perennial, annual grass, shrub (47%), among them are semi-shrubs and, in rare cases, low trees (*H. bequaertii* De Wild., *H. revolutum* Vahl, *H. canariense* L. (5%) and aquatic (*H. elodes* L.) plants. *Hypericum* genus, which has about 500 species, 70 subspecies, 3 varieties and 11 hybrids in the world are represented by 19 species, 1 subspecies and 1 variety in the flora of Azerbaijan. The present article is part of a complex experimental study which comprises bioecological research studies of *Hypericum* L. in flora of Azerbaijan.

Аннотация. Азербайджан с богатым биоразнообразием занимает особое место в Кавказском регионе. В стране насчитывается около 5000 видов высших растений (принадлежащих к 1142 родам), что составляет 66% от общего числа видов растений, произрастающих на Кавказе. Среди распространенных видов растений в этой богатой природе выделяется род *Hypericum*, относящийся к семейству Нергисовые и занимающий особое место. Хотя подавляющее большинство видов, принадлежащих к семейству Нергисовые являются многолетними и однолетними травами и кустарниками (47%), среди них встречаются полукустарники и в редких случаях невысокие деревья (*H. bequaertii* De Wild., *H. revolutum* Vahl, *H. canariense* L. (5%) и водные растения (*H. elodes* L.). Род Зверобой, насчитывающий около 500 видов, 70 подвидов, 3 разновидности и 11 гибридов, во флоре представлен 19 видами, 1 подвидом и 1 разновидностью. Настоящая статья является частью комплексного экспериментального исследования, включающего биоэкологические исследования *Hypericum* L. во флоре Азербайджана.

Keywords: *Hypericum*, species diversity, semi-shrubs, bioecological research.

Ключевые слова: зверобой, разнообразие видов, полукустарники, биоэкологические исследования.

We studied the research of various scientists in the study of the genus *Hypericum* L. and at the end of our research we relied on the system of the British scientist N. Robson, who studied the genus through anatomical, karyological and phylogenetic studies (<http://www.worldfloraonline.org>). Prominent botanist divided the *Hypericum* genus into 30 sections and 6 subsections according to the structure of vegetative, generative organs and translucent glands. Accordingly, we considered it expedient to place the *Hypericum* species distributed in the flora of Azerbaijan on these sections (<https://www.europlusmed.org/>). In addition to the morphological features noted above, this opinion is confirmed by the results of a molecular phylogenetic analysis of herbarium specimens collected in the botanical and geographical regions of the Republic [1, 2].

In the study of the bioecology of species of this genus, their phenology plays an important role. In our research, phenological observations were conducted for 3 years, and the resulting figures are shown on average. As a result of these observations, the beginning and end of the vegetation period in St.-John's-wort species, the appearance of the first sprout, the development of the flower group, budding, blossoming, the time of budding of each flower, as well as the stages of seed and fruit ripening were studied. Although the vast majority of species belonging to the genus *Hypericum* are pollinated by insects (entomophilous), self-pollination and wind pollination also occur among these species. Reproduction of the representatives of genus takes place through seeds or short roots [3].

Although the work of many scientists is devoted to the study of bioecological features of the genus *Hypericum* L., the bioecological features of species distributed in the flora of Azerbaijan have not been sufficiently studied. For this purpose, research was conducted on the genus of St. John's wort collected from different botanical and geographical regions of Azerbaijan under natural conditions in 2015-2022. As a result of the research, the bioecological features of the species belonging to the genus were studied and the regularities of the distribution of the species in the high belts, their attitude to climatic factors, phenology and ecological groups were determined (<https://www.gbif.org/>). The "Life Forms" systems of C. Raunkiaer and I. Serebryakov were used to determine the life forms of the species included in the genus [4].

According to their attitude to moisture and adaptation, species belonging to the genus are divided into 3 groups: xerophytes (*H. helianthemoides* (Spach) N. Robson., *H. asperuloides* Czern. ex Turcz., *H. lydium* Boiss., *H. linarioides* Bosse, *H. elongatum* Ledeb., *H. perforatum* L., *H. scabrum* L., *H. nummularioides* Trautv., *H. karjaginii* Rzazade., *H. theodorii* Woronow, *H. elegans* Steph.), mesoxerophytes (*H. hirsutum* L., *H. formosissimum* Takht., *H. pseudolaeve* N. Robson, *H. xylosteifolium* (Spach) N. Robson, *H. davisii* N. Robson) and mesophyte (*H. androsaemum* L., *H. venustum* Fenzl., *H. tetrapterum* Fries) (Figure 1).

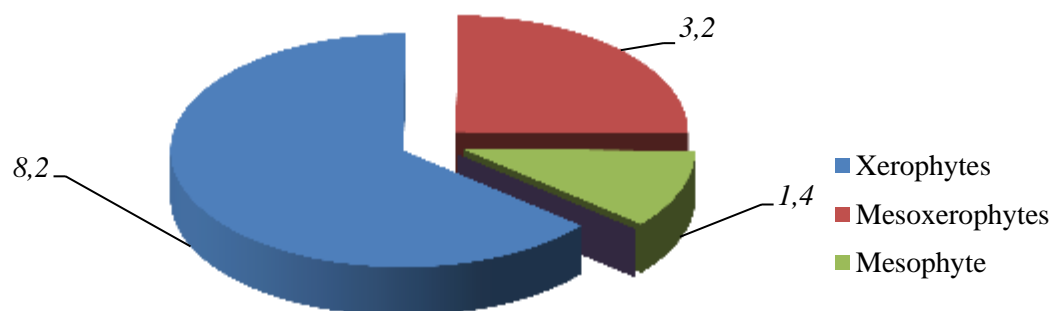


Figure 1. Ecological groups of species of genus *Hypericum* L. in relation to humidity

We gave the classification of the life forms of the species of the *Hypericum* genus distributed in the Republic of Azerbaijan on the basis of the division of the Danish scientist C. Raunkiaer (1934). According to this division, all species of the *Hypericum* L. genus distributed in the flora of Azerbaijan are hemicryptophytes (stem dries out in unfavorable conditions, the living part of the plant remains underground and remains with dried leaves until the new vegetation): *H. hirsutum*, *H. perforatum*, *H. asperuloides*, *H. tetrapterum*, *H. scabrum*, *H. elongatum*, *H. nummularioides*, *H. helianthemoides*, *H. androsaemum*, *H. linarioides*, *H. theodorii*, *H. xylosteifolium*, *H. davisii* and etc. [3, 5].

According to the classification of the system of life forms by I. G. Serebryakov (1964), most of the species of the *Hypericum* genus (with the exception of semishrub species *H. asperuloides*, *H. androsaemum*, *H. xylosteifolium*, *H. nummularioides*) found in the flora of Azerbaijan are perennial grass plants.

According to the substrate on which they grow, species of this genus can be divided into the following bioecological groups:

1. Calcipetrophytes — which spreads in a group on sandy and stony soils: *H. lydium* Boiss., *H. formosissimum* Takht., *H. linarioides* Bosse., *H. theodorii* Woronow., *H. tetrapterum* Fries., *H. xylosteifolium* (Spach) N. Robson., *H. elegans* Steph., *H. venustum* Fenzl. and so, on species belong.

2. Argillophytes — plants which growing on clay substrates: *H. davisii* N. Robson., *H. pseudolaeve* N. Robson., *H. karjagini* Rzazade.

3. Petrophytes (Greek “petros” — stone, “phyton” — plant) — those that creep on stony substrates and in rock crevices: *H. androsaemum* L., *H. helianthemoides* (Spach) Boiss., *H. scabrum* L., *H. nummularioides* Trautv., *H. elongatum* Ledeb.

4. Forest — steppe species: *H. hirsutum* L., *H. perforatum* L., *H. asperuloides* Czern. ex Turcz.

The vast majority of wild herbs common in the flora of Azerbaijan belong to the ecological group of calcipetrophytes. Species of the genus found in the flora of Azerbaijan are distributed from the lower mountain range to the high mountain range but are more common in the lower and middle mountain ranges. In order to clarify the distribution patterns of *Hypericum* species depending on the height gradient, we used the scheme adopted by L. I. Prilipko in 1954 in our research. There are 10 (*H. hirsutum* L., *H. elegans* Steph., *H. androsaemum*, *H. asperuloides*, *H. karjagini* Rzazade, *H. davisii* N. Robson, *H. tetrapterum* Fries., *H. xylosteifolium* (Spach) N. Robson., *H. perforatum* L., *H. scabrum* L.) species in the lower and middle, 3 (*H. helianthemoides* (Spach) Boiss., *H. formosissimum* Takht., *H. theodorii* Woronow) in middle, 4 (*H. linarioides* Bosse., *H. nummularioides* Trautv., *H. pseudolaeve* N. Robson, *H. elongatum* Ledeb.) in subalpine, 2 (*H. venustum* Fenzl., *H. lydium* Boiss.) in the high mountain belt (Figure 2).

Although most species belong to both low and middle mountain ranges, some found in only one belt. According to this mountain belts were compared and the Sørensen-Czekanowski similarity coefficient was used to determine the taxonomic composition of species living in these belts:

$$I_s = 2a / ((a + b) + (a + c))$$

a — total number of species, b — number of species in the first mountain range, c — number of species in other mountain ranges.

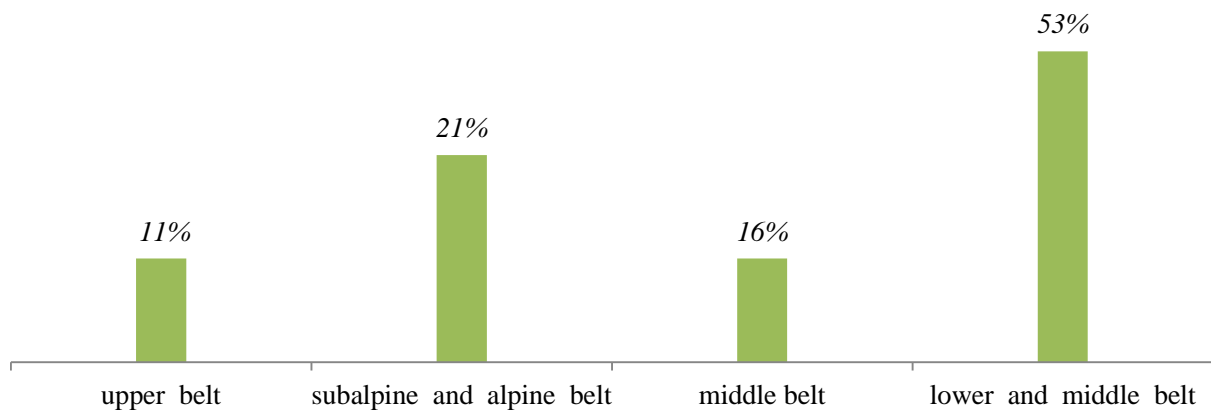


Figure 2. Distribution patterns of *Hypericum* species depending on the height gradient

This similarity coefficient of the lower and middle mountain belt was found to be $I_s=0,74\%$, between the lower and upper belt is $I_s=0,76\%$ and between the subalpine and upper belt $I_s=0,86\%$.

Material and methods

As a research material, herbarium specimens belonging to the genus of *Hypericum* L. distributed in the botanical-geographical regions of Azerbaijan and collected in different ecological conditions in 2015-2022, numerous herbarium specimens stored at the Institute of Botany of the Azerbaijan National Academy of Sciences (BAK), the Berlin Botanical Garden and Museum (BGBM), as well as in various herbarium funds of the world (GBIF) were used. Stationary surveys were conducted in all available areas from low mountain belt to high mountain belt in the administrative districts on different routes in 2015-2022. The study of bioecological features of the species of this genus was carried out on the F. Babayev's methods, the classification of life forms is implemented based on I. Serebryakov and C. Raunkiaer's system.

Conclusion

It was determined that 19 species, 1 subspecies and 1 species diversity of the *Hypericum* L. genus (St. John's wort) belonging to 7 sections are widespread in Azerbaijan.

On the basis of a new taxonomic composition with the addition of *Hypericum* species not shown in the "Flora of Azerbaijan" and new diagnostic signs not used before a determinant table has been drawn up for the species included in the genus.

Also, species phenology has been studied. As can be seen from the phenological observations, the vegetation of *Hypericum* species in natural and ecological conditions begins in April-June, the blossoming period in May-July, and the development of the fruit lasts from early August to late September.

According to the distribution patterns of species depending on altitude was determined that this species can be found from the lower mountain range to the high mountain range and an electronic map was compiled based on GPS coordinates.

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*Работа поступила
в редакцию 30.08.2023 г.*

*Принята к публикации
07.09.2023 г.*

Ссылка для цитирования:

Fatdayeva A. Bioecological Characteristics of Species of the *Hypericum* L. Genus in Flora of Azerbaijan // *Бюллетень науки и практики*. 2023. Т. 9. №10. С. 18-22. <https://doi.org/10.33619/2414-2948/95/02>

Cite as (APA):

Fatdayeva, A. (2023). Bioecological Characteristics of Species of the *Hypericum* L. Genus in Flora of Azerbaijan. *Bulletin of Science and Practice*, 9(10), 18-22. <https://doi.org/10.33619/2414-2948/95/02>