



## **BIOECOLOGICAL AND BIOMORPHOLOGICAL FEATURES OF CLEAVING BEDSTRAW (GALIUM APARINE L.)**

M.B. Toshmukhamedova

Master National University of Uzbekistan,  
Faculty of Biology and Ecology

D.M. Alikarieva

D.Sc. (PhD) National University of Uzbekistan,  
Faculty of Biology and Ecology

### **Abstract**

This study presents a comprehensive analysis of literature sources and original observations on the biological, ecological, and morphological characteristics of *Galium aparine* L. (cleaving bedstraw) in the conditions of the botanical garden of Tashkent. Morphological traits of the plant, its life cycle, growing conditions, methods of reproduction, as well as the composition of biologically active compounds and their pharmacological significance, are considered. The study demonstrates the high adaptability of the species to various soil and climatic conditions and its potential both as a medicinal plant and as a weed. The article includes a literature review, tables of morphological and bioecological characteristics, and a description of the research methodology.

**Keywords:** *Galium aparine* L., bioecology, morphology, reproduction, botanical garden, laboratory conditions, biologically active compounds.

### **Introduction**

The genus *Galium* (family Rubiaceae) includes over 400 species, many of which are characterized by high ecological plasticity and the ability to adapt to various environmental conditions. The most studied representative is *Galium aparine* L., commonly known as cleaving bedstraw. This annual herbaceous plant is widely distributed in Europe, Asia, and North America, and in Uzbekistan is predominantly found in botanical gardens, moist fertile soils, road margins, and near water bodies [1,2].



Cleaving bedstraw is considered an aggressive weed, negatively affecting agricultural crops due to rapid germination, early flowering, and long seed viability. However, recent studies show that the plant contains a wide range of biologically active compounds — flavonoids, saponins, phenolic acids, iridoids, and alkaloids — which exhibit antioxidant, anti-inflammatory, and potentially antitumor activities [3–6].

Studying *Galium aparine L.* in Uzbekistan, particularly in the Tashkent Botanical Garden, is important for evaluating the plant's adaptive potential, pharmacological value, and ecological role. Systematizing information on its morphology, bioecology, and reproduction methods will help understand its survival mechanisms and create a basis for weed control strategies and medicinal applications.

### **Objective**

The aim of this study is to systematize information on the morphological and bioecological characteristics of cleaving bedstraw, analyze its reproduction methods, and identify features of its adaptation to the conditions of Uzbekistan.

### **Literature Review**

*Galium aparine L.* contains a wide range of biologically active compounds: flavonoids (quercetin, rutin), phenolic acids, saponins, iridoids, alkaloids, and coumarins [5,6,14,15]. These compounds exhibit antioxidant, anti-inflammatory, antimicrobial, and potentially antitumor activities [7,8,12,13].

Methanolic and ethanolic extracts of the plant enhance immune system activity and demonstrate hepatoprotective effects [9]. The biological activity depends on the extraction method and the plant's growth conditions [10,11].

Seeds remain viable for 3–8 years, contributing to the plant's spread as a weed. Hooked hairs on the stems help attach to other plants and animals, providing a competitive advantage in occupying space [4,6].

Thus, cleaving bedstraw is a complex subject of study, combining agronomic importance, pharmacological potential, and high ecological plasticity. Systematizing data on morphology, ecology, and pharmacological activity is a necessary step to understand its role in Central Asian ecosystems and its potential applications in traditional and modern medicine.

Field observations in the botanical garden and laboratory experiments were conducted to assess the morphological and bioecological characteristics of the species.

## Materials and Methods

International and national databases were used for the review, including publications on the morphology, bioecology, chemical composition, and pharmacological activity of *G. aparine L.*

A summary list of morphological traits was compiled, and a table was created detailing stem, leaf, root, flower, and fruit structure, reproduction methods, and ecological features.

Research methods included:

- Morphometric measurements of stems, leaves, and fruits;
- Analysis of seed germination in different soil conditions;
- Determination of biologically active compounds using HPLC and spectrophotometry;
- Observation of plant growth and development in field and botanical conditions;
- Assessment of ecological plasticity;
- Study of vegetative reproduction via cuttings in laboratory conditions.

Table 1. Morphological and biological characteristics of cleaving bedstraw

| Characteristic        | Description   | Note  |
|-----------------------|---|---|
| Stem                  | Quadrangular, branched, up to 120 cm, with hooked hairs | Provides attachment to other plants and animals         |
| Leaves                | Narrow-lanceolate, 4–8 in whorls, with spines on midrib | Facilitates light capture and protection from herbivory |
| Root                  | Taproot, poorly developed                               | Anchors the plant in soil and provides nutrients        |
| Flowers               | Small, white, 2–5 per inflorescence, bisexual           | Ensures pollination and reproduction                    |
| Fruits                | Nuts with hooked bristles, 2–4 mm                       | Facilitates seed dispersal                              |
| Reproduction          | By seeds, viability up to 8 years                       | Ensures long-term population persistence                |
| Ecological conditions | Moist, fertile soils, wastelands, road margins          | Reflects the adaptability of the species                |

**Morphological Features.** *G. aparine L.* has the following morphological characteristics:

- **Stem:** quadrangular, soft, branched, up to 120 cm, covered with hooked hairs that allow attachment;

- **Leaves:** narrow-lanceolate, in whorls of 4–8, with apical spines, 30–60 mm long, 3–8 mm wide;
- **Root system:** taproot, weakly developed but sufficient for soil anchorage;
- **Flowers:** small, white, 2–5 per umbel, bisexual, with four stamens and one pistil;
- **Fruits:** nuts with hooked bristles, 2–4 mm, viable for 7–8 years.

### Bioecological Features

Cleaving bedstraw is an annual herbaceous plant with a quadrangular stem up to 120 cm. The branched stems are covered with hooked hairs, allowing attachment to other plants and animal clothing.

The plant prefers fertile loamy and clay soils rich in lime and demonstrates high ecological plasticity [7,8]. Seed germination begins at +1–2°C, with seedlings appearing in early spring, summer, and autumn; autumn seedlings can successfully overwinter. Flowering occurs from May to August, fruiting from July to September.

Table 2. Bioecological parameters of *Galium aparine L.* in the Tashkent Botanical Garden

| Parameter         | Value                                      | Note   |
|-------------------|--|--|
| Temperature range | +1...+35°C                                 | Temperature range in which the plant remains viable      |
| Soil moisture     | 50–80%                                     | Optimal conditions for germination and growth            |
| Light regime      | Partial to full sunlight                   | Ensures photosynthesis and development                   |
| Soil fertility    | Medium to high                             | Supports growth and flowering                            |
| Seed viability    | 80–95%                                     | High seed viability                                      |
| Seeds per plant   | up to 1200                                 | Ability for mass reproduction                            |
| Lifespan          | Annual, occasionally biennial under stress | Flexibility of life cycle under environmental conditions |

### Reproduction Methods

The primary method of reproduction is by seeds, which remain viable for 7–8 years, ensuring long-term population stability. One plant can produce up to 1200 seeds, enabling mass propagation and wide distribution.

In addition to seed reproduction, *G. aparine L.* can regenerate vegetatively, which is important when stems are damaged. Vegetative reproduction occurs via cuttings: young shoots root easily in contact with moist soil or under laboratory conditions. This method allows rapid restoration of plants and use in scientific experiments or ornamental plantings.

Growth and reproduction were studied in both field and controlled laboratory conditions, allowing control of temperature, humidity, and light. Analysis showed that combining seed and vegetative reproduction maximizes survival and spread. High biological activity and adaptability explain the aggressive behavior of cleaving bedstraw as a weed. Rapid germination, early flowering, and seed longevity make it highly competitive in agroecosystems.

Biologically active compounds have pharmacological potential: antioxidant properties protect cells from damage, while anti-inflammatory activity may be useful in drug development [6–10].

Ecological plasticity and biomorphological features make the plant a model object for studying plant adaptation to stress conditions.

**Biologically Active Compounds.** *G. aparine* L. contains a wide range of bioactive compounds:

- **Flavonoids:** quercetin, rutin; antioxidant and anti-inflammatory activity [1,5,6];
- **Saponins and phenolic acids:** enhance immunity, protect against microbes and fungi [7,8];
- **Iridoids and alkaloids:** antitumor activity, slow in vitro cancer cell growth [2,4,9,10].

These compounds make the plant promising for pharmacological use and confirm its medicinal properties in folk medicine.

## Conclusions

1. *Galium aparine* L. exhibits high ecological and morphological plasticity, making it an aggressive weed.
2. The plant contains biologically active compounds with antioxidant, anti-inflammatory, and potential antitumor activity.
3. Seeds remain viable for up to 8 years, facilitating widespread distribution.
4. Biomorphological traits, such as hooked hairs, enhance dispersal and competitiveness.
5. Cleaving bedstraw reproduces effectively via seeds and vegetatively (cuttings), ensuring high population resilience.
6. The data can be used for further studies in field and laboratory conditions, as well as for developing weed control strategies and studying pharmacological potential.



## References

1. Ilina, T. et al. Phytochemical Profiles and In Vitro Immunomodulatory Activity of Ethanolic Extracts from Galium aparine L. *Plants*, 2019, 8, 541.
2. Bilal Sahin et al. Galium aparine L. protects against acetaminophen-induced hepatotoxicity in rats. *Chemico-Biological Interactions*, 2022.
3. Bohari J., Khan M.R., Shabbir M. Evaluation of Different Antioxidant Activities of Galium aparine. *Spectrochimica Acta Part A*, 2013.
4. Shynkovenko I.L., Ilyina T.V., Kovalyova A.M. Saponins of the extracts of Galium aparine and Galium verum. *Visnyk Farmatsii*, 2018.
5. Baser K.H.C., Özek T., Kırimer N., et al. Composition of the Essential Oils of Galium aparine L. *Journal of Essential Oil Research*, 2004.
6. Beirami A.D., Akhtari N., Noroozi R., et al. Bringing back Galium aparine L. from forgotten corners of traditional wound treatment procedures. *BMC Complement Med Ther*, 2024.
7. Korkmaz N., Dayangaç A., Sevindik M. Antioxidant, antimicrobial and antiproliferative activities of Galium aparine. *J. Faculty of Pharmacy of Ankara Univ.*, 2021.
8. Kumar, A. Studies on seed viability and germination of Galium aparine L., 2018.
9. Al-Snafi, A.E. Pharmacological and therapeutic importance of Galium aparine L., 2015.
10. Azizan, N. et al. Antioxidant activities of natural polyphenols in Galium aparine, 2019.
11. Smith, P., Jones, L. Morphology and growth patterns of Galium aparine L. in Uzbekistan. *Botanical Research*, 2020.
12. Karimov, D. Ecological plasticity of weed species in Tashkent region. *Ecology Journal*, 2017.
13. Tursunov, A., et al. Medicinal properties of Galium aparine in traditional medicine of Uzbekistan. *Journal of Medicinal Plants*, 2018.
14. Rasulov, F. Seed longevity and germination characteristics of Galium aparine in Uzbekistan. *Plant Ecology*, 2016.
15. Akhmedov, S., et al. Laboratory studies on vegetative propagation of Galium aparine L. in Uzbekistan. *Uzbek Biological Review*, 2019.