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MORPHOLOGICAL CHARACTERISTICS OF ROUGH LICORICE (GLYCYRRHIZA ASPERA L.)

Kudratova Sabina Jamol qizi
Master's Student, Department of Ecology,
National University of Uzbekistan
E-mail: kudratovasabina568@gmail.com, Tel.: +998 94 989 22 34

Alikarieva Durdona Mirmakhmudovna
PhD in Biological Sciences, Department of Ecology,
National University of Uzbekistan
E-mail: alikarievadurdona@mail.ru, Tel.: +998 99 877 07 08

Abstract
Glycyrrhiza aspera L. is a perennial xerophytic species belonging to the family Fabaceae and is widespread across the steppe and semi-desert regions of Central Asia. The purpose of this study was to identify, describe, and systematize diagnostically significant morphological traits of the species, taking into consideration its adaptations to arid environmental conditions. A comprehensive field-based morphological analysis was conducted, which included a detailed examination of the stems, leaves, shoots, generative organs, fruits, and the root system. The results showed that G. aspera is characterized by dense pubescence covering all vegetative organs, imparipinnate leaves composed of 7–13 leaflets, raceme-type inflorescences, a cylindrical and pubescent calyx, as well as curved, densely pubescent pods. The well-developed root system—consisting of a strong taproot and horizontally spreading rhizomes—contributes to effective vegetative reproduction and enhances the plant's competitive capacity within arid ecosystems. The obtained findings are significant for botanical systematics, pharmacognostic research, and the rational and sustainable utilization of this species as a valuable medicinal raw material.

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Keywords: Glycyrrhiza aspera; Fabaceae; morphology; rough licorice; diagnostic traits; arid regions; morphological analysis; medicinal plants.

Research Objective:
To conduct an extended morphological analysis of *Glycyrrhiza aspera* L., including a detailed description of its vegetative and generative organs, comparison of diagnostic traits with closely related species, and assessment of adaptive features to arid environmental conditions.

Introduction

Glycyrrhiza aspera L., commonly known as rough licorice, is an important species of the genus *Glycyrrhiza*, characteristic of steppe and semi-desert ecosystems of Central Asia. The plant has attracted the attention of researchers due to its biological, morphological, and pharmacological properties [1,2,5]. Under natural conditions, *G. aspera* forms stable coenopopulations, facilitated by its well-developed root system, high drought tolerance, and ability for vegetative reproduction [8,9,10]. The morphological features of the species serve not only as taxonomic characteristics but also as adaptive mechanisms ensuring survival in the extreme conditions typical of arid regions.

A number of studies [3,4] emphasize that the morphological variability within the genus *Glycyrrhiza* allows for distinguishing species and determining their medicinal properties. In this context, the objective of the present study was to conduct a comprehensive investigation of the morphology of *G. aspera*, including an extended characterization of its vegetative and generative organs, as well as the identification of traits that ensure the plant's adaptation to arid climatic conditions.

Materials and Methods

Object of Study: Populations of *Glycyrrhiza aspera* L. growing in the botanical garden of Tashkent city and in natural arid habitats of the region.

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Research Methods:

1. Field morphological description of stems, leaves, shoots, inflorescences, fruits, and the root system according to botanical standards [6].
2. Measurement of morphological organs (length, width of leaflets, stems, inflorescences, fruits) using a ruler and caliper.
3. Photographic documentation of all morphological structures for further analysis.
4. Comparative analysis of *G. aspera* traits with closely related species of *Glycyrrhiza* spp., based on the data of Li & Li (2018) and Brown (2019) [3,7].
5. Data processing using descriptive morphological analysis with consideration of ecological growth conditions.

Results and Discussion

Results. **Stem and Shoots.** Glycyrrhiza aspera is a perennial plant reaching 50–120 cm in height. The stems are erect, cylindrical, rigid, and covered with dense short pubescence. The stem surface is rough, which represents a diagnostic feature of the species. Branching is moderate; lateral shoots predominantly develop in the lower and middle parts of the stem, enhancing the plant's stability under wind loads.

Leaves. The leaves are alternate, imparipinnate, and consist of 7–13 leaflets. The leaflets are oval or elliptical, 1.5–3 cm long, with dense pubescence on both surfaces, especially on the underside. The petiole is short, and the margins are entire. The pubescence reduces evaporation and protects the plant from overheating, serving as an important adaptive feature.

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Figure 1. Morphological structure of Glycyrrhiza aspera L.

Inflorescences and Flowers. The inflorescences are axillary racemes, 4–10 cm long. The flowers are light lilac in color, with a structure typical of the Fabaceae family: standard (banner), wings, and keel. The calyx is cylindrical and densely pubescent, protecting the reproductive organs from wind and solar radiation.

Figure 2. Inflorescences of Glycyrrhiza aspera L.

Fruits and Seeds. The fruit is a legume; narrow, curved, covered with dense pubescence and short awl-shaped projections, 15–30 mm long. Each fruit contains 3–7 seeds, which are round or slightly flattened, brown or olive-colored, with a smooth and glossy coat.

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Root System. The root system is well-developed, taproot-type with extensive horizontal rhizomes reaching considerable depths. It ensures vegetative reproduction and the formation of dense coenopopulations.

Table 1. Morphological characteristics of Glycyrrhiza aspera L.

Organ	Characteristics	Size	Pubescence	Features
Stem	Erect, cylindrical	50–120 cm	Dense, short	Rough surface, moderate branching
Leaves	Imparipinnate, 7–13 leaflets	1.5–3 cm	Dense, especially on the underside	Short petiole, entire leaflet margins
Inflorescences	Axillary racemes	4–10 cm	Pubescent pedicels and calyx	Light lilac flowers
Fruit	Narrow, curved legume	15–30 mm	Dense, with small spines	3–7 seeds, smooth coat
Root	Taproot with horizontal rhizomes	Deep, strong	Absent	Vegetative reproduction

Discussion

The analysis of natural populations of Glycyrrhiza aspera L. revealed a pronounced relationship between the plant's morphological characteristics and the parameters of its habitat. In arid biocenoses, the species forms either sparse or dense tufted groups, locally dominating areas with light to medium-loam soils. The soils where the most developed individuals were observed are characterized by low organic matter content and high stoniness, confirming the species' ability to survive under conditions of limited nutrient and water availability.

The root system of Glycyrrhiza aspera L. exhibits high ecological plasticity and pronounced xeromorphy. The primary taproot can penetrate to a depth of 1.5–2 m, ensuring access to deep soil moisture during prolonged drought periods. Simultaneously, the plant develops an extensive system of horizontal rhizomes, enabling rapid regeneration of aboveground biomass after mechanical damage, grazing, or partial substrate disruption. Such a root structure is a characteristic

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adaptation of Glycyrrhiza species to arid habitats and ensures population stability under sharp fluctuations in moisture and temperature.

The degree of pubescence of plant organs varies depending on insolation and slope exposure. On south- and southwest-facing slopes, leaves and shoots exhibit denser pubescence, indicating the functional role of trichomes in reducing transpiration and protecting tissues from overheating. In more shaded microhabitats, plants have slightly larger leaflets and stems with less pronounced roughness.

Morphological differences in generative organs were also observed depending on habitat conditions. In drier biotopes, inflorescences are shorter, and the number of flowers per raceme is slightly lower than in moderately moist conditions. This suggests potential adaptive regulation of the plant's reproductive investment to maintain viability under stressful conditions. Fruits with more pronounced pubescence predominantly develop on plants growing in wind-exposed open areas, possibly providing additional protection for seeds against moisture loss and mechanical damage.

Comparative analysis with closely related species showed that G. aspera occupies an intermediate position between G. glabra and G. uralensis in terms of xeromorphy. However, the dense pubescence of all organs distinguishes the studied species, making it the most resistant to extreme temperature fluctuations. These differences are significant for the diagnosis of Glycyrrhiza species and for the identification of plant material in pharmacognostic practice.

Conclusion

The extended morphological analysis of Glycyrrhiza aspera L. allowed us to:

1. Identify and describe a comprehensive set of morphological traits, including stems, leaves, inflorescences, fruits, and the root system.
2. Determine diagnostically significant features of vegetative and generative organs.
3. Highlight adaptive traits that ensure the species' survival under arid climatic conditions.

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The key morphological characteristics of the species are dense pubescence, imparipinnate leaves, racemose inflorescences, curved pubescent legumes, and a well-developed root system with rhizomes. These results can be applied in systematic and pharmacognostic studies, as well as in the collection of medicinal plant raw materials.

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