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GONIOLIMON SPECIOSUM (L.) BOISS. (LIMONIACEAE) IN THE AKMOLA REGION (KAZAKHSTAN)

Abstract*: the biological features of Goniolimon speciosum (L.) Boiss growing in the conditions of the Akmola region (Kazakhstan) were studied. Due to their morphological and anatomical features, G. speciosum plants are able to grow under conditions of water deficit and increased soil salinity. G. speciosum has a powerful root system, a rosette of basal bare leaves, branched peduncles with corymbose-paniculate inflorescences. The type of leaf structure is dorsoventral, the stomatal apparatus is of the anomocytic type. On both sides of the leaf blade there are salt glands that secrete salt solutions, and the release of salts by such glands is observed in 7–9-day-old seedlings. The seed size is 0,3–0,5 mm. Seeds (both unstratified and laboratory stratified) showed high germination. Plants of this species are vulnerable in places of growth due to the increasing anthropogenic pressure on the steppe vegetation. Therefore, the problem of preserving the habitats of G. speciosum in this region, as well as further study of the biology, biochemistry, and plant resources of this species, is topical.*

Keywords*: Goniolimon speciosum, the northern part of Kazakhstan, plant morphology, seed germination, salt glands.*

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GONIOLIMON SPECIOSUM (L.) BOISS. (LIMONIACEAE) В АКМОЛИНСКОЙ ОБЛАСТИ (КАЗАХСТАН)

***Аннотация**: изучены биологические особенности растений вида Goniolimon speciosum (L.) Boiss., произрастающих в условиях Акмолинской области (Казахстан). Благодаря своим морфологическим и анатомическим особенностям растения G. speciosum способны расти в условиях водного дефицита и повышенной засоленности почвы. G. speciosum имеет мощную корневую систему, розетку прикорневых голых листьев, разветвленные цветоносы с щитковидно-метельчатыми соцветиями. Тип строения листа дорсовентральный, устьичный аппарат аномоцитного типа. По обеим сторонам листовой пластинки расположены солевые железы, выделяющие растворы солей, причем выделение солей такими железами наблюдается у 7–9-дневных проростков. Размер семян 0,3–0,5 мм. Семена (как нестратифицированные, так и лабораторно стратифицированные) показали высокую всхожесть. Растения этого вида уязвимы в местах произрастания из-за возрастающей антропогенной нагрузки на степную растительность. Поэтому актуальна проблема сохранения местообитаний G. speciosum в этом регионе, а также дальнейшее изучение биологии, биохимии и ресурсов растений этого вида.*

***Ключевые слова**: Goniolimon speciosum, северная часть Казахстана, морфология растений, всхожесть семян, солевые железки.*

Goniolimon speciosum (L.) Boiss) is a mountain-steppe species that grows in forb-fescue vegetation [6; 9]. The area of growth of the *G. speciosum* is the South of Europe, Central Asia, Mongolia, Siberia, Northwest China [7; 18; 19]. In Kazakhstan, *G. speciosum* grows on open steppe stony slopes, alkaline soils and clay outcrops [5; 17].

In some regions of Russia adjacent to Kazakhstan, *G. speciosum* is a rare species [9]. The reduction in the range of this species is determined by the increased anthropogenic pressure on vegetation (grazing, plowing the steppes, collecting plants in bouquets), as well as by the peculiarities of the biology of reproduction. Propagated

only by seeds, but the seeds do not ripen every year. Seeds require long-term cold stratification. Plants are drought-resistant and winter-hardy, but rot due to waterlogging [1].

Goniolimon speciosum belongs to the *Goniolimon E. Boisser* genus, *Limoniaceae Linczevski* family, *Caryophyllales Perleb* order [2]. According to M.S. Baitenov (2001) [2], 11 species of this genus grow in Kazakhstan, including 3 endemic species.

Goniolimon speciosum is a perennial herbaceous plant, 30–40 cm tall, with leaves collected in a rosette. The root is thick and vertical. The leaves are light green, broadly lanceolate or obovate, 7–12 cm long, 1–4 cm wide, rounded at the apex with a sharp, drawn point. Plants have 1–2 glabrous flower-bearing stems. Spikelets are collected in dense tiled-two-row 2–11 spikes. The spikes form a corymbose inflorescence. The calyx is funnel-shaped, the petals are purple-pink. The fruit is an oblong ovoid capsule with wings [11; 15; 19].

Goniolimon speciosum is not included in the State Pharmacopoeia and is not used in official medicine, but it is quite widely used in folk medicine. Powder or decoction of the roots is used in the treatment of gastrointestinal diseases, internal bleeding, benign tumors of the uterus, as well as in violation of water-salt metabolism. A decoction of the roots is also used for inflammation of the mouth and throat, to treat areas affected by gangrene and eczema. It is effective as a tonic and astringent, relieves irritation of the mucous membranes [3; 6; 14].

Since *Goniolimon speciosum* plants are of practical importance and are used for therapeutic purposes in folk medicine, they require further research on the isolation and identification of biologically active compounds.

The purpose of the article is to study the biological features of *Goniolimon speciosum* plants growing in the northern part of Kazakhstan.

The climate of the region is sharply continental. Summers are short and warm, winters are long and frosty, with strong winds and snowstorms. The minimum air temperature reaches – 48°C, the maximum – up to 44°C [20].

The taxonomic identification was carried out according to S.K Cherepanov (1995) [3]. The study of morphological and anatomical features of plants was carried

out according to the following methods [12]. Micropreparations were examined under a binocular microscope and a MICMED light microscope.

In the conditions of Northern Kazakhstan *G. speciosum* grows scattered in the steppe zones on open rocky slopes, sandy soils. The plants are very hardy in the conditions of Northern Kazakhstan. It is able to endure a lack of moisture in the hot summer period and a high level of solar insolation. However, this species is vulnerable, as it is located in places of intensive cattle passing.

Fig. 1. *Goniolimon speciosum*

The height of *G. speciosum* plants reaches 25–40 cm. The leaves are collected in a large dense rosette. Branched peduncles grow from the center of the rosette with spike-shaped inflorescences at the ends (fig. 1). A flower-bearing stem is 13–20 cm tall, strong.

The leaves are obovate or oblong-elliptical with a pointed apex. On the surface of the leaves there are salt crystals. The inflorescence is paniculate-corymbose, formed by funnel-shaped flowers (6–7 mm in diameter). The flowers are white or light purple in color. Plants have a thick tap root (fig. 1).

Plants are often used as an ornamental plant, as well as in dry compositions. The plant flowers in July-August.

The area of the leaf blade is 3,6 ± 0,56 cm^2. The upper and lower surfaces of the leaf are not hairy. At the end of flowering, the leaves acquire a brownish-green color, along the edges – a reddish-pink color.

Goniolimon speciosum is characterized by a dorsoventral type of leaf structure, in which both the upper and lower sides of the leaf can be clearly distinguished. The leaf is amphistomatic, that is, the stomata are located on the both the surfaces of the leaf. The number of stomata on the adaxial and abaxial surfaces is 200 and 150 per 1 mm^2, respectively. A large number of stomata, as a morphological sign of xeromorphism, may be an adaptive mechanism for reducing moisture evaporation in arid habitats [4].

According to A.P. Shennikov (1950) [17], *Goniolimon speciosum* belongs to the group of sclerophilic xerophytes. These are dryish, tough plants with leaves that do not store water, with well-developed mechanical and integumentary tissues. Due to this, the leaves are hard and tough, and even with a loss of water up to 25%, such plants do not lose turgor. The high osmotic pressure of the cell sap allows them to increase the sucking power of the roots, which helps to obtain water even from rather dry soils. The stomata apparatus of *G. speciosum* is of an anomocytic type. The epidermal cells have highly tortuous walls, thereby increasing the adhesion force of the cells and further increasing the strength of the tissue.

On the surfaces of the leaves salt crystals are located. They are excreted by the special glands. According to this feature, *G. speciosum* belongs to crinohalophytes (salt-releasing plants) [13].

Seeds of *G. speciosum* are oblong, pointed at the end, with a central groove. The seeds are 0,3–0,5 mm in size. The seed color is light brown (fig. 2). Seeds ripen in August.

Fig. 2. Seeds of *G. speciosum*

Fig. 3. 5-day-old seedling

G. speciosum

The seeds of *G. speciosum* require long-term cold stratification for germination [8]. In our experiments, the seeds were subjected to stratification: the seeds were kept for 3 months at a temperature of +5° C. Then we germinated control seeds (without stratification) and stratified seeds on filter paper in Petri dishes at a temperature of 18–20° C.

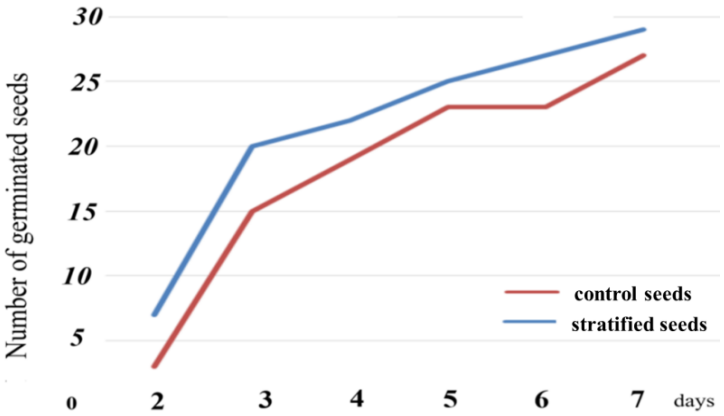

Fig. 4. Dynamics of *G. speciosum* seed germination

Laboratory germination of seeds of the two groups was high, and (on the 7th day) it was in control seeds and stratified seeds 90 and 93%, respectively (fig. 4). We found that already in 7–9-day-old seedlings, salt crystals stood out on the surfaces of young leaves.

Salts were isolated both on the lower and upper side of the leaf blade in plant seedlings (fig. 5). This property of *G. speciosum* to release excess salts with special salt glands on the surface of the leaves allows it to grow on salt marshes and highly saline soils.

Salt glands are known to be typical epidermal trichomes that are not associated with the conducting system of the organs on which they are located. They serve to remove from the plant (against the concentration gradient) an excess of mineral salts that enter through the xylem from the soil, which allows plants to tolerate very high salinity of substrates.The secretion of salts by salt glands can reach a very high intensity [10].

Fig. 5. Leaf upper epidermis of 12-day-old *G. speciosum* plant with salt crystals

Thus, *G. speciosum* has a powerful root system, a rosette of basal, hairless leaves, branched peduncles with corymbose-paniculate inflorescences. Leaf is of amphistomatous type, that is, stomata are present on both sides of the leaf blade. Salt glands are located on both sides of the leaf blade, and the formation of such glands is observed in young seedlings (7–9 days), which are able to release salts on the surface of their leaves. The type of leaf structure is dorsoventral, the stomatal apparatus is of the anomocytic type. Seeds *G. speciosum* are light brown in color, oblong in shape, pointed at the end, 0,3–0,5 mm in size. Seeds of (unstratified and stratified) in laboratory conditions showed high germination (90 and 93%, respectively).

Goniolimon speciosum is a sclerophilic xerophyte. Due to its morphological and anatomical features, the goniolimon is beautifully adapted to growing conditions and is able to endure water deficiency, excessive solar insolation and a high level of salinity in the soils of the region. However, it should be noted that this species is a vulnerable species due to the increasing anthropogenic pressure on the steppe vegetation. Therefore, the problem of preserving the habitats of this species in the region, as well as further study of the biology, biochemistry and resources of *Goniolimon speciosum* plants as a source of biologically active substances, is relevant.

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