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ON THE FLOWERING BIOLOGY OF *BETA COROLLIFLORA* AND *HABLITZIA TAMNOIDES* (BETOIDEAE, CHENOPODIACEAE)

The article presents some data on *Beta corolliflora* and *Hablitzia tamnoides* (Betoideae, Chenopodiaceae) flowering biology. In both species similar peculiarities were revealed in the sequence of flowers opening in the inflorescence clusters, in the dichogamy with pronounced protandry form, and in flower opening mechanisms in staminate stage. The article is illustrated with original photographs.

Beta corolliflora, *Hablitzia tamnoides*, *flowering biology*

Հակոբյան Ժ. Ա. *Beta corolliflora* և *Hablitzia tamnoides* (Betoideae, Chenopodiaceae) տեսակների ծաղկման կենսաբանությունը: Հոդվածում ներկայացված են որոշ տվյալներ *Beta corolliflora* և *Hablitzia tamnoides* տեսակների (Betoideae, Chenopodiaceae) ծաղկման կենսաբանության վերաբերյալ: Երկու տեսակների մոտ նմանատիպ առանձնահատկություններ են հայտնաբերվել՝ ծաղկաբույլի գլոմերուլներում ծաղիկների բացման հաջորդականության, ծաղկի արտահայտված պրոտանդրիայի ձևի, առեջային փուլում ծաղկի բացման մեխանիզմի վերաբերյալ: Հոդվածը պատկերված է բնօրինակ լուսանկարներով:

Beta corolliflora և Hablitzia tamnoides, ծաղկման կենսաբանություն

Акопян Ж. А. К биологии цветения *Beta corolliflora* and *Hablitzia tamnoides* (Betoideae, Chenopodiaceae). В статье приводятся некоторые данные о биологии цветения *Beta corolliflora* и *Hablitzia tamnoides* (Betoideae, Chenopodiaceae). Выявлены сходные особенности у обоих видов в последовательности раскрывания цветков в клубочках соцветия, в форме дихогамии с выраженной протандрией и в механизмах раскрывания цветка в тычиночной фазе. Статья иллюстрирована оригинальными фотографиями.

Beta corolliflora, *Hablitzia tamnoides*, *биология цветения*

Introduction

Beta corolliflora Zossimovich ex Buttler and *Hablitzia tamnoides* M. Bieb. are the most common species of subfamily Betoideae Ulbr. **(**Chenopodiaceae Vent.), represented in the flora of Armenia by two genera, viz. *Beta* L. with five species and unispecific *Hablitzia* M. Bieb. *B. corolliflora* occurs in Lori, Ijevan, Aparan, Sevan, Yerevan and Darelegis floristic regions, on meadows, forest edges, grassy slopes, sometimes on ruderal places, of 1600 to 2700 m a.s.l. *H. tamnoides* is widespread in Armenia and grows in 9 of 12 floristic regions of the country (except Upper Akhuryan, Shirak and Gegham) from 1000 to 1600 m a.s.l., in shady broad-leaved forests, in shaded areas of rocks and gorges, along river thickets. Both species are native to Caucasus region, North-West Anatolia and North-East Iran.

B. corolliflora refers to hemicryptophytes with annual monocyclic monocarpic shoots and special type of storage root, and *H. tamnoides* – to very rare in Chenopodiaceae life form, a vine with scrambling annual, monopodial, extremely elongated shoots and fleshy storage roots. Despite the *Beta* and *Hablitzia* life forms differences, some investigated peculiarities of the bio-morphology of *H. tamnoides*, in particular, in germination and juvenile rosette-form stages (Akopian, 2012), bring it closer to ones of the genus *Beta* representatives. For the aim of *B. corolliflora* and *H. tamnoides* flowering biology observation and compare the present study was conducted.

Materials and Methods

The observations on *Beta corolliflora* and *Hablitzia tamnoides* flowering biology were conducted in natural habitats in Aparan, Sevan and Darelegis floristic regions of Armenia and in Yerevan Botanical Garden on the living plant collection samples of the “Flora and Vegetation of Armenia” Plot, grown from seeds or replanted from nature. Flower biology, including the daily rhythm and mechanisms of blooming, seasonal flowering rhythm and forms of pollination were studied. When observing the functioning of a single flower, the terms of the beginning and duration of the staminate and pistillate stages in dichogamy were determined. The macro-morphology of reproductive structures and its details were studies using

the Stereo Microscope MBC-9. The main stages in the process of flower blooming, inflorescence and flower details were photographed with a SONY DSC-W150 digital camera.

Results and discussion

Beta corolliflora is perennial herbaceous plant with angular stems and fusiform woody root. Generative shoots (fig. 1a) are 50-150 cm tall with petiolate lower leaves and shortly petiolate or sessile upper ones, in the axils of which along the entire shoot the inflorescences are formed. Inflorescences are compound, dichasial, sympodially branching, with leaf-shaped bracts. The flowers are perfect with simple cup-shaped perianth, broadly open during the flowering, gathered in axillary, sessile, three flowered clusters.

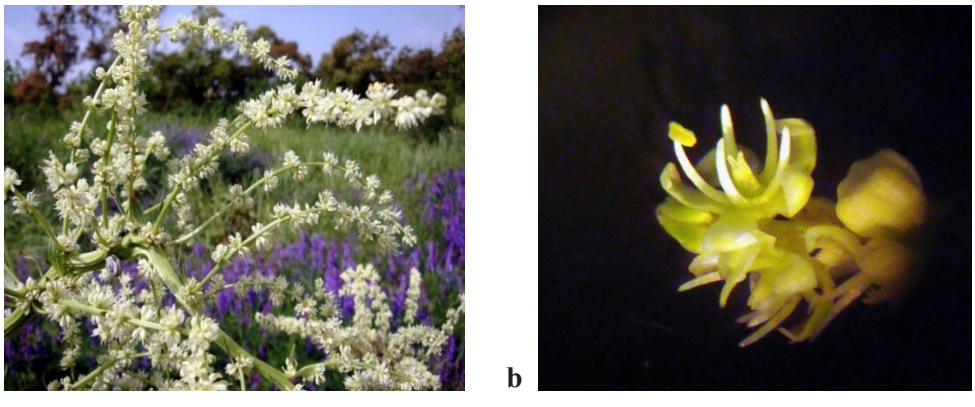

Fig. 1. *Beta corolliflora* in blooming (a); middle flower (× 6) in the three-flowered cluster of *B. corolliflora* inflorescence (b)

Tepals are 3-3.5 mm long, petaloid, broadly elliptical, whitish-cream, transparent at the entire margins, in fruits enlarged, green. Five stamens are opposed to the tepals and basally inserted on a glandular ring-shaped disk. Anthers 1.2-1.3 long, each anther consists of two elongated oval thecae (lobes), fused in the middle part by connective; stigmas 3, ovary semi-inferior. Fruiting perianth is woody at the base. The flowers of *B. corolliflora* are the largest of all species of the genus *Beta*.

B. corolliflora plants bloom in their second year. In natural habitats the flowering begins at the end of May-June, and in the introduction conditions in the Yerevan Botanical Garden a month earlier. The first flowers bloom in the central parts of the generative shoots. The blooming of flowers in the clusters begins with a middle flower, followed by the surrounding flowers (fig. 1b). The flowers are protandric, duration of the single flower blooming lasts about 72 hours. Opening of a flower begins in the morning with the asynchronous spreading of tepals. One of the tepals, as well as the stamen adjacent to it, is usually ahead of the rest (Fig. 2 a, b). It should be noted that tepal and adjacent stamen moving is simultaneous.

The mechanism of flower opening with the simultaneous spreading movements of tepals and stamens is also described for *B. vulgaris* (Tabenitsky, 1968). By noon, the stamens in the flower of *B. corolliflora* lengthen, slightly bend, and deviate from the stigma (fig. 2 c). In 45-60 minutes after the flower bud opening, when the stamens in 4-5 times exceed the stigmas, the anthers dehisce (fig. 2 d). The anthers are movable on their filaments: they change their direction, vertical in buds, and during the spread of the pollen are perpendicular to filaments. The type of anther dehiscence is longitudinal, latrorse. The pollen is dispersed by wind and insects. The development and functioning of stigmas in the same flower is observed in the next 2 days (fig. 2 e, f). It was observed, that during the flowering, *B. corolliflora* is visited by the beetles *Oxythyrea cinctella* Schaum and *Cantharis melaspis* Chevrolat. Fruiting is observed in August, after which the shoots dry. The fruit is single-seeded, with a dry and hard pericarp, revealing a dropable lid.

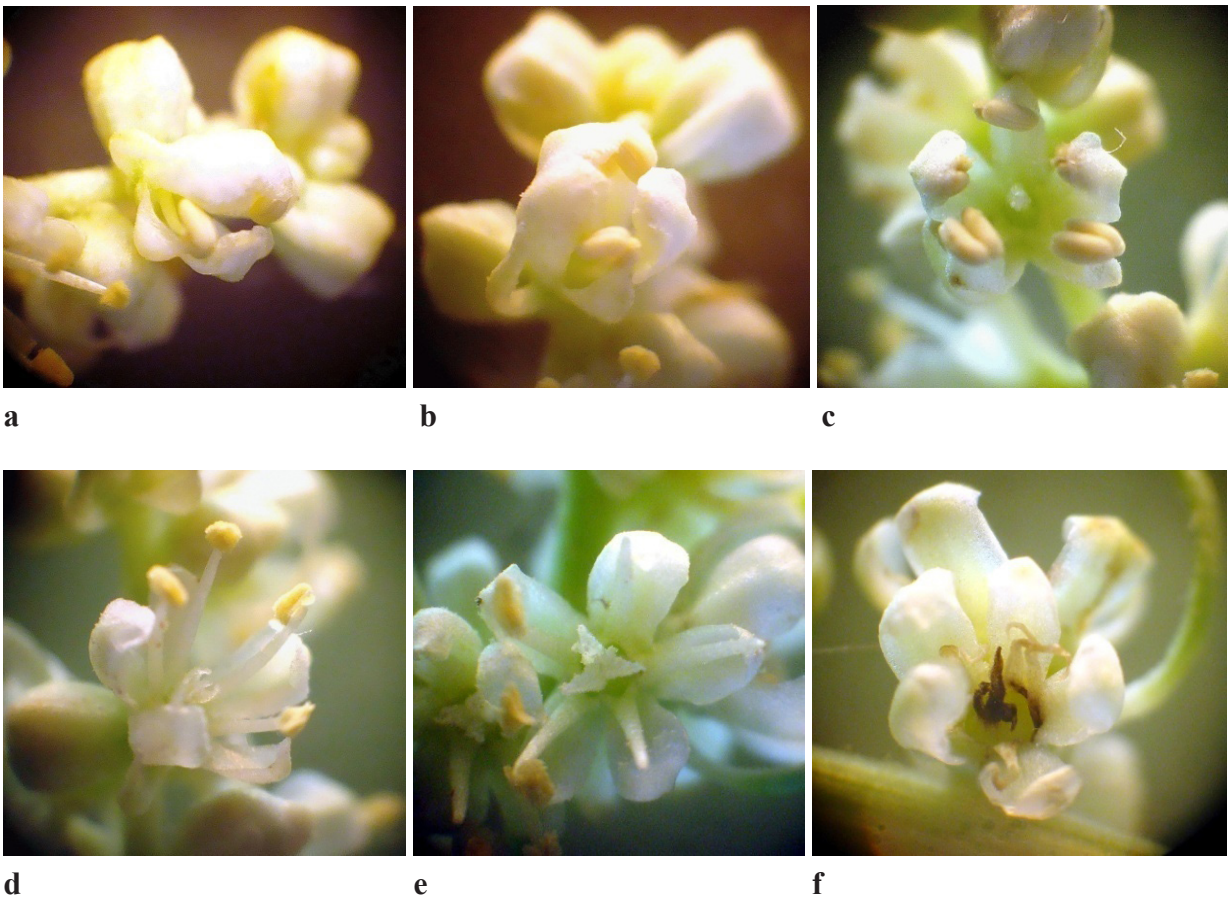

Fig. 2. Stages of *Beta corolliflora* protandric flower opening (× 10)

a, b, c – staminate phase; d - completion of the staminate and the beginning of the pistillate phase; e - the phase of functioning of the stigma; f - the phase of completion of the functioning (drying out) of the stigma

Hablitzia tamnoides is a perennial herbaceous vine with thin, deeply cordate leaves, granular-furrowed, glabrous or slightly hairy shoots and a fleshy persistent root. The shoots that form the above-ground structure of the plant are annual, fertile, up to 100-200 cm long, monopodially growing, incapable of prolonged orthotropic growth, and therefore need support. The vine is attached to the other stems of the same plant or neighboring stems of other plants by its long slender petioles. A small part of the shoots is shorter, up to 10-30 cm long, they are also fertile, but usually with vestigial flower buds.

The flowering of *H. tamnoides* in natural habitats is observed from mid-May to July and in the conditions of the Yerevan Botanical Garden in early May-June. The inflorescence is compound with indeterminate main axis and many closed lateral units (fig. 3a). The flowers are arranged in lax thyrses, arising from axils of leaf-like bracts. The order of flowers opening along the inflorescence lateral branches is acropetal. The flowers are usually perfect, green or greenish-yellow, with 1-3 bracts. At the end of inflorescence there are observed functionally female flowers with vestigial stamens. Flowers are often arranged by 3. The middle flower of the 3-flowered loose cluster is sessile and laterals are on slender pedicles, which are equal to or longer than the perianth. The middle flower opens a few days earlier than the lateral ones. Before the beginning of the lateral flowers blooming, in the middle flower the fruit setting already occurs. In terminal cymes, the lateral flowers are present only as vestigial buds below the terminal flower (Kadereit et al., 2006; personal observations) (fig. 3b).

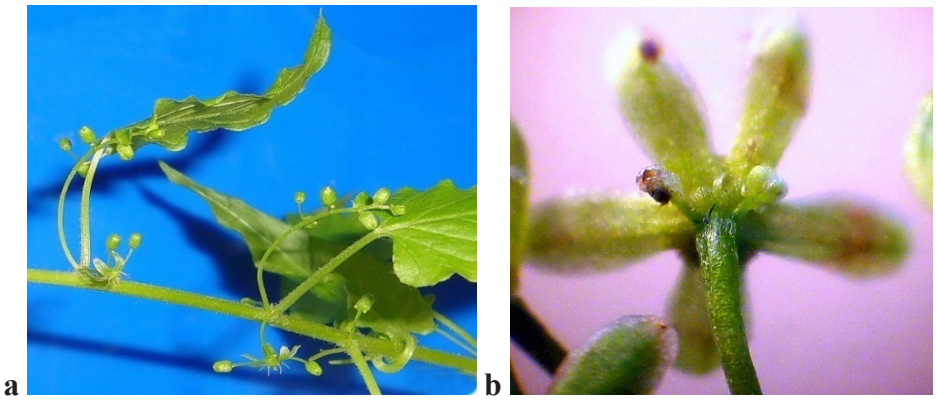

Fig. 3. *Hablitzia tamnoides* inflorescence fragment (a); lateral flower buds at the base of middle flower in the three-flowered clusters of *H. tamnoides* (×10) (b)

Perianth of *H. tamnoides* is herbaceous, 5-merous, at first bell-shaped (fig. 4a), later in blooming five-pointed star-shaped (fig. 4 b, c), 6.5-7 mm in diam., with (2.5) 3.5×1 mm, oblong-linear, at the top obtuse-rounded, 3-veined tepals. Stamens are 5, opposite the tepals, connected at the base into membranous ring. Anthers are 0.8-1 mm long, filaments 1.5 mm long, stigmas 2-3, short, on a short column. The gynoecium is fused with the bases of the stamens, the ovary is epigynous. Fruiting perianth is membranous.

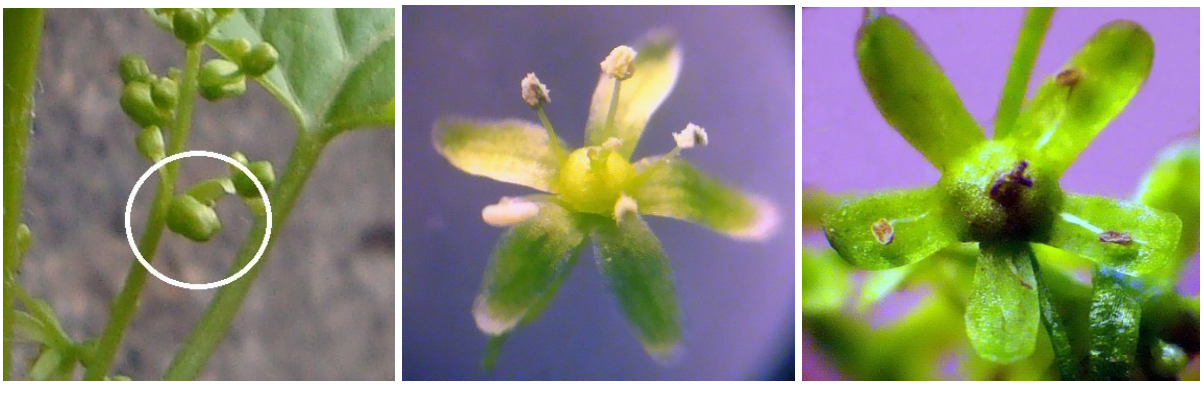

Fig. 4. Stages of *Hablitzia tamnoides* protandric flower opening: a - the beginning of the flower opening (× 4), b – staminate stage (×12), c - the stage of completion of the functioning (drying out) of the stigma (×12)

Dichogamy in the flower of *H. tamnoides* is expressed in the form of protandry. The flower staminate stage duration is about five hours. Opening of the flower begins in the morning (at about 8.00 - 8.30) with the asynchronous spreading of tepals, one of them usually moves earlier than the rest (fig. 4a). Till about 11.00 am the flower has bell shape, the stamens are oriented vertically. The tepals move and diverge occurs simultaneously with stamens. Tepals partly cover the anthers with their bent tops, but then bend lower and in the interval between 12 – 1 pm the flower opens completely and takes a star shape (fig. 4b). The stamens being vertical in the flower bud, deviate during flowering from the vertical axis of the flower at an angle of about 45°. The anther thecae are fused at the center by a short connective, which is 1/4 of the anther length. The basal and upper parts of the anther thecae remain free. In the connective tissue of the ma-

ture anthers there are air cavities (Kamelina, 2001). The attachment of the stamen filament to the connective is mobile and the anthers shake under the wind, so promoting the pollen dispersal. Due to the mobility of the anthers, pollen eruption is oblique-introrse and latrorse. The length of empty anthers is reduced by about half compared to the original. According to our observations, *H. tamnoides* is a cross-pollinated anemophilous plant. Fruit subtended by the persistent perianth lobes, opening by a circumscissile lid.

Thus, as a result of the study, some features of flowering biology were identified as similar in *Beta corolliflora* and *Hablitzia tamnoides*: sequence of the flowers opening in the clusters starting from the middle flower, asynchrony in the opening of flower tepals, the same mechanism for the simultaneous movement of tepals and stamens when opening the flower, clearly pronounced dichogamy in the form of protandry, anthers movable on their filaments, anemophily as an important pollination way. The revealed features of flower biology bring these representatives of the subfamily *Betoideae* closer.

REFERENCES

Akopian J. A. 2012. On the biomorphology of *Hablitzia tamnoides* (Chenopodiaceae) // Caryophyllales: New Insights into the Phylogeny, Systematics and Morphological Evolution of the Order. Proceedings of the Symposium. Moscow. M. V. Lomonosov State University: 37–40.

Kadereit G., Hohmann S. & Kadereit, J. W. 2006. A synopsis of Chenopodiaceae subfam. Betoideae and notes on the taxonomy of Beta // Willdenowia 36: 9–19.

Kamelina O. P. 2001. Development of embryonic structures in the genus Hablitzia (Chenopodiaceae) // Bot. Zhurn., 86, 10: 1–9 (in Russ.) (Камелина О. П. 2001. Развитие эмбриональных структур в роде *Hablitzia* (Chenopodiaceae) // Бот. журн., 86, 10: 1–9).

Tabenitsky A. A. 1968. Anatomy and morphology of sugar beet // I. F Buzanov (eds.). Biology and breeding of sugar beet. Moscow: Kolos: 69–135 (in Russ.) (Табеницкий А. А. 1968. Анатомия и морфология сахарной свеклы // И. Ф. Бузанов (ред.). Биология и селекция сахарной свеклы. Москва: Колос: 69–135).

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