

Botany

Reproductive Biology and *ex situ* Conservation of *Lilium caucasicum* (Misch.ex Grossh.) Grossh. (*L. martagon* L. Subsp. *caucasicum* Misch.ex Grossh.) (VUC2a (i)) Included in the Red List of Caucasus Plants

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(Presented by Academy Member Gia Nakhutsrishvili)

The biological characteristics and processes of seed formation have been studied in the vulnerable species – *Lilium caucasicum* (Misch. Ex Grossh.) Grossh (*L. martagon* L. subsp. *caucasicum* (Misch.ex Grossh.) VUC2a (i), included in the Red List of Caucasus Plants. Based on the obtained data we carried out works targeted at *ex situ* conservation of the species. The seeds, which were produced through artificial cross-breeding were used for the reproduction of the species in culture. Part of the seed is deposited for long-term storage in the National Seed Bank at the National Botanical Garden of Georgia (NBGG). In case of need the material being at our disposal is available for the reintroduction of the species in the places of primary distribution. © 2022 Bull. Georg. Natl. Acad. Sci.

Lilium caucasicum (Misch. Ex Grossh.) Grossh. (*L. martagon* L. subsp. *caucasicum* (Misch.ex Grossh.), seed production processes, *ex situ* conservation, pollen, anther

Nowadays as a result of the impact of global and anthropogenic factors on the plant kingdom, many species are not only reduced, but they are under the threat of extinction. In spite of the intensive work targeted at definition of their distribution range, age, and species number, the danger of extinction for many of them still exist. *Lilium caucasicum* (Misch. Ex Grossh.) Grossh. (*L. martagon* L. subsp. *caucasicum* (Misch.ex Grossh.) – the endemic, relict species of the Caucasus is among these plants. It has

been included in the Red Book of Georgia since 1982 [1]. The plants, which are represented only by small populations, are in danger of extinction. They are preserved only as small populations among natural vegetation and crop fields due to intensive land use for agriculture. One of the conservation measures was considered to establish a managed reserve in Abkhazia that is a natural habitat for the plants. Though, the initiative was not realized.

According to the recent data *L. caucasicum* has been categorized as a vulnerable species (VUC2a (i)) [2]. As the Georgian jurisdiction over the territory of Abkhazia has not been extended for the last decades, the modern state of the species actually remains unspecified.

At present, in Eastern Georgia *L. caucasicum* is preserved under conditions of cultivation in the Bakuriani Alpine Botanical Garden (single specimens) and some samples, grown from the bulbs, introduced from Psirtskha (Gudauta, Abkhazia) to the plot of the Plant Conservation Department of the National Botanical Garden in 40ies of the 20th century.

The Caucasus is considered to be one of the places of origin of the genus *Lilium* L. [3]. Thus, we are particularly responsible for the protection and conservation of the genus *Lilium* L.

L. caucasicum is a preglacial bulbous plant of Colchic flora. Its stem is 80-100 cm high, with leaves whorled into 1-3 levels. Inflorescence is a raceme consisting with 5 (7) flowers. Its flowers open acropetally at 2-2 day intervals. Flowers are bent, curved backwards, lilac-pink, with dark

speckled petals of corolla. The anthers are dark purple; the pollen is brick-red. The fruit is a hexahedral capsule (Figs. 1-4).

The species grows in lower and middle belt forests, in forest edges and glades. It is a precious ornamental, melliferous plant. Bulbs are used for food as well as for making paint.

L. caucasicum starts vegetative growth at the end of March or early in April. Buds are observed to appear on plants at the end of April. This phase lasts rather long, quite a month. Flowering begins in the second decade of May and appears on the specimens with more than one tier of leaves. The flowering phase lasts for 2 weeks, during which the shape and arrangement of its individual parts vary. The corolla petals of the newly opened flower are horizontally oriented. The pistil and stamens are all arranged in one plane. At this time the stamens are not yet open. They tightly enring the style. The presence of secretions on the stigma is not observed yet. Soon after the flower opens, an hour later the petals of the corolla bend aside and begin to gradually rolling up. The anthers dehiscing introrsely



Fig. 1. The flower of *Lilium caucasicum*.



Fig. 2. A ripe capsule of *Lilium caucasicum*.



Fig. 3. Germinated seed of *Lilium caucasicum*.



Fig. 4. Sprouts of *Lilium caucasicum*.

– longitudinally, gaining orientation perpendicular to the filaments and become rotating. One of the filaments touches the stigma and gets abundantly covered with pollen, but there is no presence of autogamy. On the second day of flowering, the petals of corolla are maximally rolled up. At the same time, the receptacle gets crooked, giving the flower a bent down position that cover the stamens like an umbrella, protecting them from damage. At the same time, the style leans over and the stamens bend aside. Such location of the stigma increases the chance for pollen to get on it.

On the 3rd, 4th day of flowering, the stamens wither and fall down. Only the style with its stigma is preserved, which is noticeable even on 7th or 9th days.

Thus, the longevity of female and male generative phases of the investigated species varies a great deal. The male generative phase is short and lasts 2-3 days while the female generative phase lasts for 5-6 days.

The generative organs of the target species are fertile. The pollen is binucleate, its fertility reaches 70%. The pollen grains differ in size. Conventionally they can be grouped into three categories: relatively small, medium and large pollen grains. From 79 to 129 ovules are formed in the ovary. Their size gradually reduces from the central part of the ovary towards its tip and the base. The embryo sac, as described in the representatives of genus *Lilium*, is formed according to the *Fritillaria* type [4].

L. caucasicum is an entomophilous plant. It is mostly pollinated by non-specialized insects, small size *Coleoptera*. The flowers are frequently visited by beetles, ants, rarely butterflies, and pollination can also be performed by the air flow. The fertilization process takes 54-58 hours [4]. In the beginning of September, the fruit (capsule) begins to open from the tip. The ovules of different size that are developed in the ovary have the potential for fertilization. However, the number of seeds obtained from either natural or artificial pollination is unpredictable. As a rule, their numbers are very

small compared to the number of ovules, often represented by a small amount or pollination does not occur at all. As a result of artificial cross-fertilization the number of seeds significantly increases and is even half the number of ovules.

From the limiting factors of pollination, the following should be pointed out: coincidence of the adverse environmental conditions (rainy, windy weather, low air temperatures), lack of pollinator insects; winning the insect pollinators over by other plants flowering during this period, little amount of pollen fallen on the stigma; lack of pollen in terminal flowers as they open acropetally.

The seeds of the target species vary in size (0.5-0.9 cm); They are brown, transparent with easily noticeable germ.

In the ripening phase, the capsules return to their vertical position, and when shaking, the seeds fall out. Due to the fringe around the seeds and its lightness (weight of 1000 seed is 8.4 mg) they can be easily spread.

Lilium caucasicum is vegetatively static. Its propagation is mainly carried out by seed. And the bulb determines the stability of the plant in time and space. Propagation of the species can also be achieved with bulb scales. Although the developed plants enter the flowering phase two years earlier, the parent bulb experiences some kind of stress and develops flowers only in the third or fourth year.

L. caucasicum lacks self-seeding ability. Therefore, periodically it is necessary to promote renewal of the plant by seed.

Seeds were sown in October. It has capacity for rapid germination (2-3 weeks) and high emergence (70%). In order to get strong sprouts the seeds were sown on Petri dishes, on an agar substrate. Then they were transplanted into the soil and pots.

L. caucasicum is characterized by high plasticity. It is well adapted to the conditions of cultivation. Thus, the seed stock, obtained from artificially grown seed material enables not only *ex situ* conservation but it can be used for *in situ* reintroduction in case of need.

ბოტანიკა

კავკასიის წითელი ნუსხის მცენარის *Lilium caucasicum* (Miscz.ex Grossh.) Grossh. (*L. martagon* L. subsp. *caucasicum* Miscz.ex Grossh. (VUC2a (i)) რეპროდუქციის ბიოლოგია და *ex situ* კონსერვაცია

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(წარმოდგენილია აკადემიის წევრის გ. ნახუცრიშვილის მიერ)

შესწავლილია კავკასიის წითელი ნუსხის მოწყვლადი სახეობის (VUC2a(i) *Lilium caucasicum* (Miscz. ex Grossh.) Grossh. (*L. martagon* L. subsp. *caucasicum* (Miscz.ex Grossh.) – კავკასიის მთის შროშანი – ბიოლოგიური თავისებურებები და თესლწარმოქმნის პროცესები. მიღებული მონაცემების საფუძველზე განხორციელებულია სახეობის *ex situ* კონსერვაცია. ხელოვნური შეჯვარების გზით მიღებული თესლი გამოყენებულია კულტურაში სახეობის აღდგენის მიზნით. თესლის ნაწილი მოთავსებულია კავკასიის რეგიონულ თესლის ბანკში გრძელვადიანი შენახვისათვის. საჭიროების შემთხვევაში ჩვენს ხელთ არსებული მასალა შესაძლებელია გამოყენებულ იქნეს რეინტროდუქციისთვის სახეობის პირველადი გავრცელების ადგილებში.

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