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Two New Species for the Alien Flora of the Caucasus and Georgia: *Solanum viarum* Dunal and *Solanum elaeagnifolium* Cav. (Solanaceae)

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During the 2023-2024 period floristic expeditions in Ajara and Samegrelo-Zemo Svaneti (West Georgia), *Solanum viarum* Dunal, known as tropical soda apple, was recorded for the first time in Kobuleti. This species had not been previously documented in the Caucasus. Additionally, *Solanum elaeagnifolium* Cav., or silverleaf nightshade, was identified in Kartli, specifically in the urban area of Tbilisi, marking its first recorded occurrence in Georgia. Both species belong to the Solanaceae family and are recognized as serious invasive weeds in many parts of the world. The introduction and spread of these *Solanum* species in new regions are strongly influenced by global factors. In the context of the Caucasus and Georgia, these findings highlight the growing concern of weed invasion in response to climate change, increased human activity and international trade. The morphology of key systematic characters of both species are examined and illustrated. The voucher specimens of *S. viarum* and *S. elaeagnifolium* are deposited at the Herbarium department of the N. Ketskhoveli Institute of Botany (TBI). © *2024 Bull. Georg. Natl. Acad. Sci.*

Solanum viarum – first record in the Caucasus, *Solanum elaeagnifolium* – first record in Georgia, invasiveness

According to the latest data, the genus *Solanum* (Solanaceae) comprises over 1400 species, making it one of the largest genera of flowering plants [1]. About 140 species of *Solanum* are considered to be weeds [2]. During recent floristic expeditions in Ajara and Samegrelo-Zemo Svaneti, *Solanum viarum* Dunal was recorded for the first time in the Caucasus. This species, known for its highly invasive nature, had not been previously documented in the region. Additionally, *Solanum elaeagnifolium* Cav. was discovered in Kartli, in the urban area of Tbilisi, marking its first recorded occurrence in Georgia. The aim of the present work is to report these findings, list the surrounding species, and illustrate the key morphological traits of *S. viarum* and *S. elaeagnifolium.*

Materials and Methods

The field surveys were initially conducted in Kobuleti (41°49'28"N 41°46'41"E, elev. 5.1 m), Ajara floristic region and later in Samegrelo, near the villages of Lia and Chkaduashi. *S.*

elaeagnifolium was found in Tbilisi, near Lisi Lake (41°44'45"N 44°44'18"E, elev. 634 m a.s.l.). The scale of occurrence, spread patterns, flowering, and fruiting time of *S. viarum* and *S. elaeagnifolium* were assessed and surrounding plant species were documented**.** Macromorphological traits of both species were examined under a stereomicroscope (Carl Zeiss DV 4). Micromorphology of the trichomes was analysed under the light microscope (Axio Lab. A, Carl Zeiss, Germany), equipped with a digital camera (AxioCam Erc 5s) and mounted fluorescent module. Autofluorescence of unstained trichomes was viewed at λ_{ex} 350 nm. The names of plant species are provided in accordance with their presence in the Global Biodiversity Information Facility (GBIF) database [3].

Results

Solanum viarum Dunal, 1852, A. DC. Prodr. 13(1): 240.

Type: Sao Paulo. Brazil, Lund 799 (GDC. holo. IDC microf. 2080: 1.1)

Solanum viarum is the perennial herbaceous shrub naturally distributed in Argentina, Bolivia, southern Brazil, Colombia, Paraguay, Peru and Uruguay [4, 5]. Initially, we found the plant in Kobuleti. Surrounding species included *Commelina communis, Eleusine indica, Sporobolus fertilis, Cyperum esqulentus, Arthraxon hispidus, Kyllinga gracillima, Solidago canadensis, Verbena brasiliensis, Symphyotrichum squamatum, Carpesium abrotanoides,* and others. The occurrence of *S. viarum* was frequent along roadsides, in relatively moist and weedy locations (Fig. 1). Later, in 2024 the plant was detected also in the Samegrelo floristic region, near the villages of Lia and Chkaduashi.

According to our observations, all parts of the plant are pubescent. Stems, petioles, and leaves have spines especially noticeable along the midrib of the leaf on both sides. We observed 2 main types of trichomes: simple unicellular and multicellular stellate ones. Flowers are white with recurved petals. Flowering begins in June. The fruit measures 3-6 cm in diameter, is globose, smooth, mottled green when immature, and becomes yellow when ripe in October (Fig. 2). Fruiting is abundant; the number of seeds per fruit ranges from 150 to 350.

Solanum elaeagnifolium Cav. 1795, Icon. Descr. Pl. 3: 22, tab. 243.

Type: Mexico, Nuevo León, near Monterrey, 1804, G. de la Luz 123 (P, holo. IDC microf. 2045: 2.3).

Solanum elaeagnifolium is a perennial herb native to North and South America [6]. We observed a scattered population in Tbilisi, specifically in ruderal vegetation near Lisi Lake. Surrounding

Fig. 1. Habitat.

Fig. 2. Pale green immature fruits with dark green stripes and ripe yellow berry.

Fig. 3. Fragment of the scattered population of *S. elaeagnifolium*; plants with light-purple flowers and wavy marginated leaves.

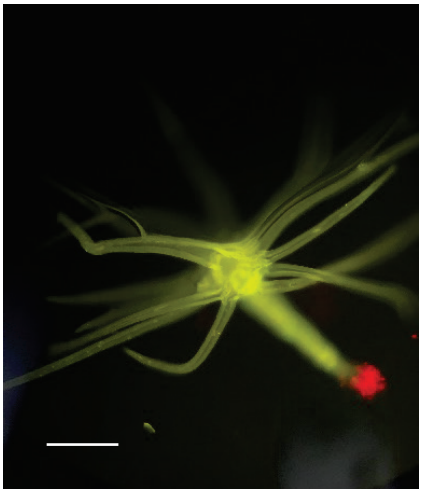

Fig. 4. Green autofluorescence of stalked multiangulate trichome with numerous rays arranged in more than one plane. NB! Red fluorescence of the stalk base; bar: 400 µm.

species included *Cynodon dactylon, Setaria glauca, Botriochloa ischaemum, Medicago coerulea, Salvia nemorosa, Lactuca seriola, Falcaria vulgaris, Eryngium campestre, Chenopodium album, Centaurea diffusa, Plantago lanceolata*, and others. The root system of *S. elaeagnifolium* consists of a deep taproot. The species often spreads through rhizomatous underground stems, producing new stems after cutting. Besides the well-branched underground organs, the aboveground stems also exhibit a strong ability for vegetative regeneration. We observed vegetative reproduction several times during one growing season, with shoots constantly straightened out from the buds despite ongoing mowing, developing flowers and fruits. We suggest that rapid compensatory growth after cutting reflects a plant life history strategy focused on reproductive urgency. The leaves of *S. Elaeagnifolium* are simple (5-15 cm in length), lanceolate or oblong, with slightly wavy margins (Fig. 3), and exhibit intrapopulation polymorphism based on age and solar exposure.

The pubescence consists of trichomes and prickles. Trichomes are silvery – grayish, giving the plant its characteristic sheen. We observed 2 types of stellate trichomes: porrect, with straight unicellular rays arranged horizontally in a single plane and stalked multiangulate trichomes with numerous rays arranged in more than one plane scattered on the both leaf surfaces. The proximal part of the stalk is likely embedded in the mesophyll tissue. We observed red fluorescence in the basal part of the stalk, in contact with the leaf parenchyma (Fig. 4). Prickles are minute and scattered on petioles and both surfaces of the leaf. Flowers are 5-merous, varying in colour from light to dark purple. The flowering period extends from late April to October. The immature fruits are small, up to 7 mm in diameter, with characteristic dark green lines, turning yellow when ripe. Seeds (up to 100 per berry) are yellow-brown and coated in a mucilaginous substance.

Discussion

Our observations indicate that both species are well adapted to local habitat conditions. We suggest that in the humid riparian areas in western Georgia the above-ground parts of *S. viarum* may not always die off during a warm winter. The species' abundant fruiting and high seed production reflect its competitive reproductive strategy and potential to spread, which may suppress the development of native flora. For *S.*

elaeagnifolium, rapid stem regeneration after cutting demonstrates an adaptive reproductive strategy. Additionally, the red fluorescence observed in the basal part of trichomes may be related to water conservation in xeric environments [7].

Outside its native range, the species grows as a noxious weed in cultivated landscapes, disturbed agricultural lands, pastures, and natural areas [8]. Thus, *S. viarum* has been spreading rapidly in the USA since it was discovered in Florida in 1988; by 2002, the infested area was estimated at over 404,694 hectares of pasture lands, hammocks, ditch banks, citrus groves, vegetable fields, sugarcane fields, and roadsides [9]. The introduction range of *S. viarum* covers Africa (Cameron, Congo, Eswatini, South Africa), North America (11 States), Central America, Caribbeans (Honduras, Puerto Rico), Asia (Bhutan, China, India, Iran, Myanmar, Nepal, Taiwan, Vietnam), and Oceania (Australia) [4]. The nearest location to the Caucasus where *S. viarum* has been recorded is the Qadikola in Mazandaran province (north of Iran), where the species was documented for the first time in 2020 [10]. The nearest recorded location of *S. elaeagnifolium* to Georgia is in Azerbaijan, Baku – Ganja highway near Sangachal oil terminal (40°11'315"N 49°29'738"E, elev. 22 m a.s.l), where it was first documented in 2006 as a new species for the Caucasus [11].

Given the invasive behaviour beyond native ranges, *S. viarum* and *S. elaeagnifolium* pose a threat to native biodiversity in the Caucasus, necessitating ongoing monitoring and management strategies, especially as Georgia is a member of the European and Mediterranean Plant Protection Organization (EPPO).

Conclusion

The appearance of *S. viarum* in the Caucasus and *S. elaeagnifolium* in Georgia raises considerable concerns regarding weed invasion and potential effects on natural ecosystems and local agricultural phytocenoses. Based on our observations and existing data on the invasive nature of these species, we underline that our findings underscore the importance of tracking the spread of *S. viarum* and *S. elaeagnifolium*, especially given the impacts of climate change and increased global commerce, which contribute to the introduction of invasive species to new regions.

ბოტანიკა

კავკასიის და საქართველოს არაადგილობრივი ფლორის ორი ახალი სახეობა: *Solanum viarum* Dunal და *Solanum elaeagnifolium* Cav. (Solanaceae)

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(წარმოდგენილია აკადემიის წევრის გ. ნახუცრიშვილის მიერ)

საველე სამუშაოების დროს, 2023-2024 წელს აჭარისა და სამეგრელო – ზემო სვანეთის ფლორისტულ რეგიონში ჩვენ მიერ ნაპოვნია *Solanum viarum* Dunal, რომელიც კავკასიის არაადგილობრივი ფლორისთვის ახალ სახეობას წარმოადგენს. ამავე პერიოდში ნაპოვნია *Solanum elaeagnifolium* Cav. ქართლის ფლორისტულ რეგიონში, თბილისის ურბანულ ნაწილში. აღნიშნული მცენარე წარმოადგენს ახალ სახეობას საქართველოს არაადგილობრივი ფლორისთვის. ნაშრომში მოყვანილია *S. viarum*-ისა და *S. elaeagnifolium*-ის მორფოლოგიური ნიშნები, გეოგრაფიული გავრცელება და თანმხლები მცენარეების სია. საკვანძო მორფოლოგიური ნიშნები ილუსტრირებულია. მომზადებულია საჰერბარიუმო ნიმუშები, რომლებიც გადაეცა ნ. კეცხოველის ბოტანიკის ინსტიტუტის ჰერბარიუმის (TBI) განყოფილებას. ჩვენი დაკვირვებით, *Solanum viarum* და *Solanum elaeagnifolium* ავლენენ ინვაზიური მცენარის თვისებებს, ამიტომ საჭიროა მათი გავრცელებისა და რიცხობრივი დინამიკის შესწავლა, სასიცოცხლო ციკლისა და გამრავლების თავისებურებების ანალიზი, რათა დადგინდეს ამ სახეობების როლი სეგეტალური მცენარეების სპექტრში და პოტენციური გავლენა აგროფიტოცენოზებზე.

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