

*Botany*

## ***Grindelia squarrosa* (Pursh) Dunal - a New Alien Genus and Species for Flora of Georgia**

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**ABSTRACT.** Biological invasion is considered as one of the main threats to biodiversity, food security, human health and global economics. Appearance of a new alien species beyond its natural range is always noteworthy because of its possible invasive behavior in a new region. The present paper describes the first occurrence of curlycup gumweed - *Grindelia squarrosa* (Pursh) Dunal in Georgia. The species is native to North and Central America. The population is represented by perennials occupying an area of about 100 m<sup>2</sup> near the village of Karsani (41° 49. 938'N, 44° 42.715'E, elev. 650 m). Its dense, pure stand demonstrates the ability of sustainable reproduction. Notable signs of the species are conspicuously gummy involucre with phyllaries deflected downward. The acuminate phyllaries are covered with numerous sessile glandular trichomes located in pits. The leaf surfaces are abundantly dotted with sessile multicellular glandular trichomes. The mean length of the awn is 4 ± 0.5 mm; the width in the middle part is ca.108 and ca.65 µm near the tip. Awns are spinulose with the setae of 50 µm length in the middle part and 10 µm near the tip. Polar diameter of the spheroidal pollen grain is 27 - 31 µm. Pollen grains are trisulcate - porate with spinulose exine. Detailed illustrations of the key diagnostic characters and the list of the surrounding plant species are provided. The voucher specimen of *G. squarrosa* is deposited in the Herbarium of the Tbilisi Institute of Botany (TBI). © 2014 Bull. Georg. Natl. Acad. Sci.

**Key words:** *Grindelia squarrosa* (Pursh) Dunal, alien plant, flora of Georgia.

During the field expedition carried out near Tbilisi in summer 2013 we found a new alien genus for flora of Georgia from family *Asteraceae*. The morphology of plant and the examined diagnostic characters indicate that it is the most distinct genus of *Asteraceae* – *Grindelia* (Willd.). The species was identified as curlycup gumweed - *Grindelia squarrosa* (Pursh) Dunal, following the taxonomic key given in the last revision of North American species of *Grindelia* [1].

*Grindelia* is a New World genus of *Asteraceae*, tribe *Astereae*, subtribe *Solidagininae*, which is native to North, Central and South America. The genus was named in honor of the pharmacologist and botanist, Professor David Hieronymus Grindel (1776 - 1836) of Dorpat [2]. The specific epithet translates from Latin “squarrosus” as scaly or roughened in reference to involucre bracts splayed out below the capitulum. The purpose of the present work is to



A



B

Fig. 1. Population of *G. squarrosa* in Karsani. A – general view, B – fertile habit



Fig. 2. Capitulum with 6 series of downwardly – deflexed phyllaries

document the first occurrence of *G. squarrosa* in Georgia and to describe the habitat and surrounding plant community.

## Materials and Methods

Macromorphological features of involucre, achenes and leaves were examined under Carl Zeiss stereomicroscope. Cross sections ( $15\mu\text{m}$ ) of fresh leaf tissue were made with a freezing microtome and the preparations were examined under the light microscope Axio Lab. A 15 (Carl Zeiss, Germany) equipped with a digital photocamera AxioCam Erc 5s.

## Results and Discussion

*Grindelia squarrosa* (Pursh) Dunal, 1819, Mem. Mus. Hist. Nat. (Paris), 5: 50. - *Donia squarrosa* Pursh, 1813 Fl. Amer. Sept. 2: 559.

Plants inhabit open rocky area near Karsani village ( $41^{\circ}49'938\text{N}$ ,  $44^{\circ}42'715\text{E}$ , elev. 650 m.) (Fig. 1A, B). The capitula are extremely resinous with strongly

graduated phyllaries arranged in 6 series (Fig. 2). The stems of the plants are ramified, glabrous and stramineous. Also, we observed two-colored stems with big light spots of irregular shape around the sessile, auriculate cauline leaves (Fig. 3). The leaves are characterized by subcoriaceous texture, dove-green color and the teeth ending in a group of glandular trichomes. The margins of the blade are highly variable in shape ranging from entire to pinnatifid (Fig. 4A, B). The leaf surface is abundantly dotted with the resin drops. On the transversal section of the leaf blade a sessile multicellular glandular trichomes are observed in pits on both surfaces (Fig. 5). The pits are formed by epidermis depression. Maximum diameter and depth of pits measured on median sections are 130 and 160  $\mu\text{m}$ , respectively. The capitula are grouped in corymbiform synflorescences (Fig. 6 A) as well as in solitary terminal floral branches. We also observed the unusual development of the single-headed floral branchlets



Fig. 3. Spotty stem with the sessile, auriculate cauline leaves.

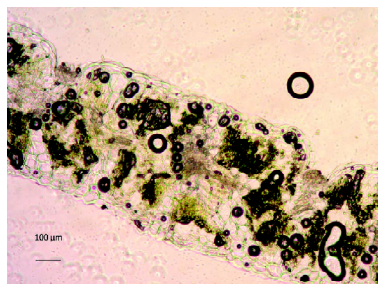


A



B

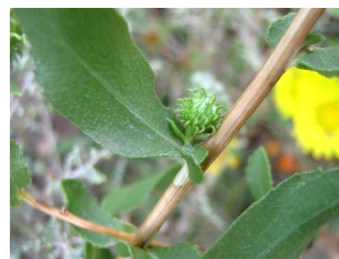
Fig. 4. Leaf margine variability



**Fig. 5.** Transversal section of the leaf blade with sessile glandular trichomes in pits



**A**



**B**

**Fig. 6.** A - corymbiform synflorescence and B – single-headed floral branchlet in the axile of cauline leaf

in the axils of cauline leaves (Fig. 6B). Ray and disk achenes differ in shape, size and color: those of the first one are longer (3.5 - 4.5 mm), more or less flattened and brownish, while those of the second one are shorter (2 - 2.7 mm), quadrate-oblong and pale yellow. There are 3 - 6 deciduous awns developed around the apex of achene (Fig. 7). The mean length of awn is  $4 \pm 0.5$  mm, the width in the middle part is ca. 108 and ca. 65  $\mu\text{m}$  near the tip. At high magnification the awns are spinulose with the setae of mean length of 50  $\mu\text{m}$  in the middle part and 10  $\mu\text{m}$  near the tip (Fig. 8A, B). The setae arrangement is alternate. The proximal part of the bright yellow ray florets are profusely covered with resinous substance secreted by the stipitate glandular trichomes (Fig. 9). Sweeping papillose trichomes are developed on the style branches (Fig. 10). Pollen grains are spheroidal and trisulcate-porate with spinulose exine with polar diameter of 27 - 31  $\mu\text{m}$  (Fig. 11). Discs are usually flat, but sometimes the receptacles have a convex surface (Fig. 12). The plants have a massive tap root up to 60 cm long with numerous lateral roots (Fig. 13).



**Fig. 7.** Ray (left) and disc (right) achenes

The surrounding plant community consists of *Ambrosia artemisifolia*, *Astrodaucus orientalis*, *Bromus japonicus*, *Callicephalus nitens*, *Centaurea solstitialis*, *C. ovina*, *C. reflexa*, *Cerasus incana*, *Cynodon dactylon*, *Dactylis glomerata*, *Echinops spaeocephalus*, *Echium vulgare*, *Ficus carica*, *Fraxinus exelsior*, *Fumana procumbens*, *Heliotropium ellipticum*, *Jasminum fruticans*, *Paliurus spina-christi*, *Rhamnus pallasii*, *Rhus coriaria*, *Rosa canina*, *Spyraea hypericifolia*, *Stachys atherocalyx*, *Teucrium polium*, *Tragus racemosus*, *Xeranthemum squarrosus*. The species nomenclature follows Gagnidze [3]. Remarkably, the listed plants do not penetrate deeply into the dense, pure stand of *G. squarrosa*.

The alien flora of Georgia comprises 460 taxa. Among them 80 species are cultivated without dispersal into wildlands. The other 380 aliens have become subsontaneous (23.3%), adventive (18.5%), naturalized (35%) and invasive (4.2%). The species of North American origin make up 17%, 19 species are recorded from *Asteraceae* [4]. The number of al-



**A**



**B**

**Fig. 8.** A, B - awn setae on high magnification



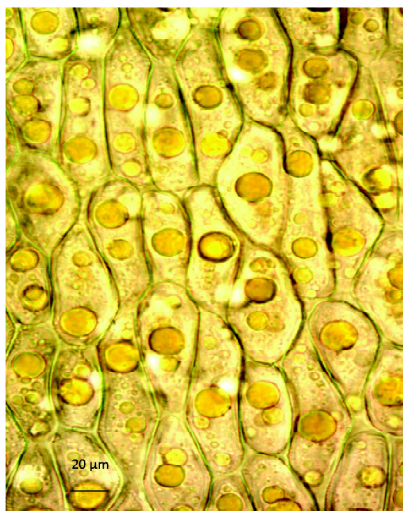


Fig. 9. Gum drops on the ray ligule

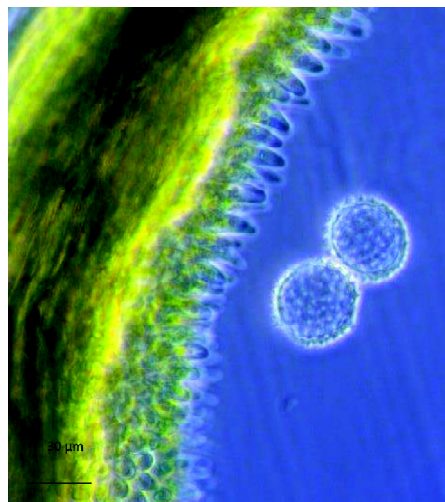


Fig. 10. Papillose trichomes at the proximal end of the style

ien plants might increase considering various ways of introduction and general tendency [5].

*G. squarrosa* is the only one out of 41 species of the genus expanding its range in the Eurasian region. In its native distribution area the species exhibits a remarkable capacity to live in a wide altitudinal range and various types of habitat from extremely xeric to humid. An ability to combine mutually opposite habitat behavior is also characteristic of this plant. It is noteworthy that, it belongs to the pioneer species established in the eroded habitats. To quote J. A. Steyermark [2], *Grindelia* "...will always be the first, or among the first plant forms to invade open places..."

## Conclusion

Given the increasing number of degraded habitats, the appearance of *G. squarrosa* might increase especially in sites disturbed by human activity, because of the strong link between the concomitant habitat degradation and the introduction of alien species [6]. Considering the adaptation plasticity of the species and tolerance to poor growing conditions we can conclude the following: the Karsani population of *G. squarrosa* recorded in Georgia for the first time reveals an ability of sustainable reproduction with the potential threat to the native plant community.

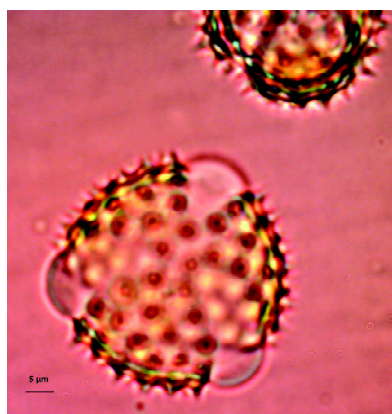


Fig. 11. Pollen grains

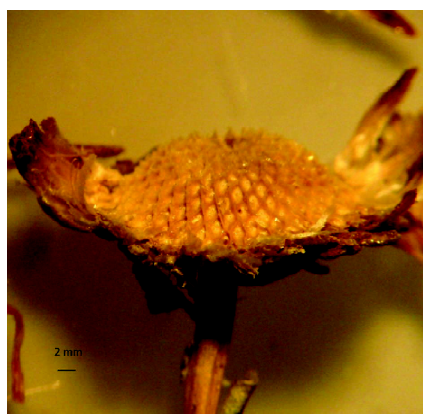


Fig. 12. Convex receptacle



Fig. 13. Perennial premature plant with rosette leaves and massive tap root.



## ბოტანიკა

## *Grindelia squarrosa* (Pursh) Dunal – ახალი გვარი და სახეობა საქართველოს არაადგილობრივი ფლორისთვის

ლ. ჯინჯოლია, ნ. შაქარიშვილი

ილიას სახელმწიფო უნივერსიტეტის ბოტანიკის ინსტიტუტი

(წარმოადგინა აკადემიის წევრმა გიორგი ნახუცრიშვილმა)

ბიოლოგიური ინვაზია წარმოადგენს ერთ-ერთ მთავარ საფრთხეს ბიომრავალფეროვნების, უსაფრთხო საკვების, ადამიანის ჯანმრთელობისა და გლობალური ეკონომიკისათვის. სახეობის გაერცელება ბუნებრივი არეალის გარეთ, ყოველთვის საყურადღებოა, მისი შესაძლო ინვაზიური ქცევის გამო ახალ რეგიონში. ნაშრომში აღწერილია 2013 წელს პირველად საქართველოში ავტორების მიერ ნაპოვნი გრინდელია - *Grindelia squarrosa* (Pursh) Dunal (*Asteraceae*), რომელიც ბუნებრივად გაერცელებულია ჩრდილოეთსა და ცენტრალურ ამერიკაში. კარსანთან ( $41^{\circ} 49.938' N$ ,  $44^{\circ} 42.715' E$ , 650 ზ. დ.) აღმოჩენილი პოპულაცია მოიცავს 100 კვ.მ ფართობს და წარმოდგენილია მჭიდროდ მოზარდი მრავალწლიანი ინდივიდებით. აღსანიშნავია მცენარეების მდგრადი გამრავლება. სახეობისთვის დამახასიათებელია განსაკუთრებულად წებოვანი, ქვევით გადაზრილი საბურველის ფოთოლაკები, რომლებიც დაფარულია მრავალრიცხოვანი ჯირკვლოვანი ტრიქომებით. ფოთლის ფირფიტის ორივე ზედაპირზე ვითარდება მრავალუჯრედიანი ჯირკვლოვანი მჯდომარე ტრიქომები. ქოჩრის ჯაგრულის საშუალო სიგრძე  $4 \pm 0.5$  მმ-ია, სიგანე – 108 მკმ. (შუა ნაწილში), 65 მკმ. წვერისკენ. ჯაგრულები ეკლიან-ქიცვებიანია, ქიცვის სიგრძე 50-დან (შუა ნაწილში) 10 მკმ-მდეა (წვერისკენ). სფეროიდული მტკერის მარცვლის პოლარული დიამეტრი 27-31 მკმ. მტკერის მარცვალი სამღარიან-ფორიანია, ეგზინა ეკლიანია. საკვანძო სადიაგნოზო ნიშნები დეტალურად არის ილუსტრირებული. მოყვანილია საპერბარიუმო მასალის (TBI) ეტიკეტი. მითითებულია თანმხლები სახეობები.

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