

Rough-fruit amaranth *Amaranthus tuberculatus* (*Amaranthaceae*): a new alien species in the flora of Bosnia and Herzegovina and the Balkans

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Abstract. The rough-fruit amaranth *Amaranthus tuberculatus* was discovered in September 2019 during fieldwork in the vicinity of Tuzla city (northeastern Bosnia). *A. tuberculatus* is native to North America but has been introduced in some areas beyond its natural range. This is the first record of this species for Bosnia and Herzegovina and the Balkans. The paper presents a short morphological description and photographs of the species based mainly on the collected specimens, as well as distribution of the taxon.

Key words: alien species, Amaranth, distribution, morphology, naturalization

Introduction

The genus *Amaranthus* L. (*Amaranthaceae*) is represented by 43 species in the European flora (Iamonico 2015a). In the flora of Bosnia and Herzegovina, ten species of the genus *Amaranthus* have been recorded so far: *A. albus* L., *A. blitoides* S. Watson, *A. blitum* L., *A. caudatus* L., *A. crispus* (Lesp. & Thévenau) J. M. Coult. & S. Watson, *A. cruentus* L., *A. deflexus* L., *A. graecizans* L., *A. hybridus* L., and *A. retroflexus* L. (Beck-Mannagetta 1906, Malý 1948, Slavnić 1960). *A. tuberculatus* was found in the course of fieldwork conducted in Northeast Bosnia in 2019. Apparently, this is the first find of this species in Bosnia and Herzegovina, as well as in the Balkans. So far, *A. tuberculatus* has been reported from Europe as introduced in Austria (Essl & Rabitsch 2002), Belgium (Verloove 2006), Czech Republic (Pyšek & al. 2002), Denmark (Karlsson 2001), Finland (Karlsson 2001), Germany (Buttler & al. 2018), Great Britain (Brenan 1961), Ita-

ly (Iamonico 2015b), Netherlands (Van der Meijden & al. 2003), Romania (Anastasiu & Negrean 2006), Russia (Czerepanov 1995), Spain (Sanchez Gullon & Verloove 2013), Sweden (Karlsson 2001), and Ukraine (Mosyakin & Fedoronchuk 1999).

Material and methods

Digital photographs and GPS coordinates were taken in the field. Identification of the specimens was done according to Pratt & Clark (2001), Iamonico (2015b), Mosyakin & Robertson (2003), and Verloove (2019). Nomenclature follows the Euro-Med Checklist (Iamonico 2015a). The invasive status of the species was given according to Richardson & al. (2000). The specimens were collected and stored in the Herbarium of the National Museum of Bosnia and Herzegovina (SARA, 51989, 51991).

Results and discussion

Amaranthus tuberculatus (Moq.) J. D. Sauer, in Madroño 13: 18. 1955. (synonyms: *Acnida tuberculata* Moq., *Amaranthus rudis* J. D. Sauer), also known as Rough-Fruit Amaranth, originates in North America, and is a very rare, locally naturalized alien in some parts of Europe (Iamónico 2015b). *A. tuberculatus* belongs to subgenus *Acnida*, which comprises 10 dioecious species (Mosyakin & Robertson 2003).

A. tuberculatus (Fig. 1) is an annual taproot therophyte. Stems of mature plants 20–200 cm tall,

erect or ascending, glabrous, often reddish, branched. Leaves alternate, estipulate, petiolate (petiole 0.5–5.0 cm long), lanceolate to ovate or elliptic, with entire margins, glabrous, 2–12 cm long and 1–3 cm wide; apex retuse or rounded, mucronulate. Male and female flowers occur on separate plants (dioecious). Inflorescence terminal, linear spikes to panicles, occasionally interrupted-moniliform, erect, usually reddish, the main inflorescence up to 50 cm long. Floral bract 1, green to reddish, lanceolate, 0.8–2.5 mm long, as long as or slightly longer than the perianth, occasionally carinate, apex acuminate, margin entire,



Fig. 1. *Amaranthus tuberculatus* in the vicinity of Gornji Srebrenik: **a** – naturalized habitat; **b, c** – inflorescence; **d** – female flowers (Photo Šemso Šarić).

glabrous. Male flowers with five unequal tepals, ovate to lanceolate, 2–3 mm long, apex obtuse or acute, awned. Female flowers without tepals or with only one reduced lanceolate to linear tepal (up to 1.5 mm long); style lacking; stigmas three, long and feathery, persistent on the fruit. Fruit a single-seeded utricle, about 1.5 mm long, dark-brown to reddish, ovate, papery, as long as or slightly shorter than the perianth. Seed lenticular, about 1.0 mm in diameter, black or reddish-brown. Flowering from September to October. Chromosome numbers, $2n = 32$ (Pratt & Clark 2001, Costea & al. 2005, Iamonico 2015b).

In September and October 2019, three *Amaranthus tuberculatus* plants (Fig. 1) were found in three different localities around Tuzla city (northeastern Bosnia) (Fig. 2). All plants were well-developed female specimens, about 150 cm high.

Chorological data:

1. Gornji Srebrenik, 44°42'06.35"N; 18°32'11.02"E, elevation 495 m, only a single specimen was recorded on September 20th 2019 at the edge of the road in the village centre.

2. Majevisa, Dokanj, 44°37'27.00"N; 18°40'43.19"E; elevation 640 m, only a single specimen was recorded on September 21th 2019 at the edge of the regional road R-459 Tuzla – Lovački dom – Čelić.

3. Živinice, 44°26'42.49"N; 18°38'56.23"E; elevation 215 m, only a single specimen was recorded on October 24th 2019 on the slopes of waste and soil piled near the train station. In that locality, *A. tuberculatus* was accompanied by *Amaranthus retroflexus* L., *Ambrosia artemisiifolia* L., *Chenopodium album* L., *Chenopodium ambrosioides* L., *Fallopia dumetorum* (L.) Holub, *Sambucus ebulus* L., *Sonchus asper* (L.) Hill. and *Solanum nigrum* L. subsp. *schultesii* (Opiz) Wessely.

It is yet unknown how and when this species has been introduced to Bosnia and Herzegovina. On the one hand, considering the fact that only three plant individuals were found after a thorough examination of the region, it could be presumed that the species has been recently introduced and no persistent seed bank has accumulated yet. According to Richardson & al. (2000), the observation period has been too short to understand and declare a state of naturalized species. Therefore, the current invasive status of *A. tuberculatus* on the territory of Bosnia and Herzegovina should be determined as a casual alien. On the other hand, the plants found in Bosnia were well-developed female individuals and one of them had ripening fruits. It is important to note that we have recorded one plant with ripening fruits, although only female plants were recorded in the field. Most likely that male plants were also present in the area, but we simply overlooked them. According to Costea & al. (2005), the male plants of *A. tuberculatus* were 1 m tall, and the pollen grains could travel 300–325 m with optimal wind velocity. On the other hand, *A. tuberculatus* is known to make hybrids with *A. hybridus*, which was found in the area. Hybrids look generally healthy and very similar in size and morphology to *A. tuberculatus* (Trucco & al. 2006).

A single female plant of *A. tuberculatus* normally produces between 35 000 and 1 200 000 seeds that could be easily transferred by water, road or rail traffic, by birds and animals, and to a lesser extent by wind (Costea & al. 2005). As a new alien species to Bosnia

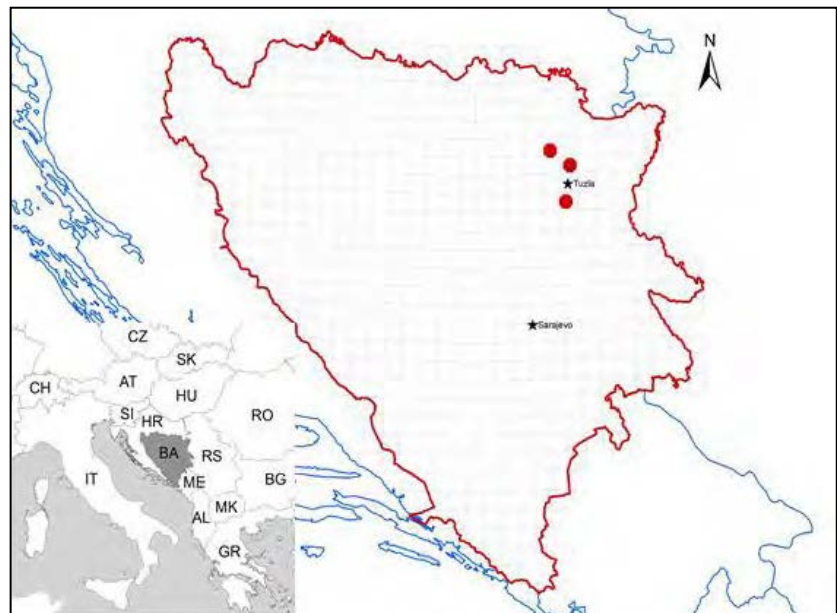


Fig. 2. Distribution of *Amaranthus tuberculatus* in Bosnia and Herzegovina.

and Herzegovina, *A. tuberculatus* should be monitored further, considering its invasive character and potential spread from the sites it has been found in.

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