

FIRST RECORD OF *AMARANTHUS VIRIDIS* AFTER OVER 25 YEARS

CAMEN-COMĂNESCU Petronela^{1*}

Abstract: We report the presence of *Amaranthus viridis* after over 25 years from the last mention. The species is native to South America and in Europe is naturalized or casual. The way of introduction in Romania is unknown. We provide information about its morphological features, distribution, biology, ecology and invasiveness.

Keywords: *Amaranthus*, alien plant, amaranth

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Introduction

The genus *Amaranthus* L. comprises about 70 species, many of them native to Americas and the rest to Australia, Africa, Asia and Europe (Costea et al. 2001, Costea & DeMason 2001). Among these, just two species are native from Europe (Akeroyd 1993). According to DAISIE (2009) a number of 39 alien species of *Amaranthus* L. have been reported in various countries of Europe. From Romania, 26 taxa (species and hybrids) are mentioned (Sirbu & Oprea 2011), but 10 of them are not reported in the last 20th years (*A. bouchonii* Thell., *A. quitensis* Kunth, *A. rudis* J.D.Sauer, *A. spinosus* L., *A. tamariscinus* Nutt., *A. viridis* L., *A. × budensis* Priszter, *A. × ozanonii* Thell., *A. × soproniensis* Priszter et Karpati, *A. × theveneauii* Deg. et Thell.).

The genus *Amaranthus* comprises some of the world's worst weeds (CABI 2022) and are economically important, many species being cultivated as cereals, some for their edible leaves and other are ornamental (Costea & Tardif 2003).

In the present paper we report the first record in Romania of *Amaranthus viridis*, after 25 years from the last record.

Material and methods

The species was recorded during our field works on alien plants, in Bucharest (Romania). Plant material was photographed, collected and herborized in autumn of 2021. The morphological characters of the species were compared with data from the literature (Costea 1998a,b, Sârbu et al. 2013, Petrova 2018, PROTA4U 2021, Verloove 2022, WFO 2022). The geographic coordinates were recorded using GPS Essential tool for Android. Herbarium specimens were deposited in the Herbarium of the Botanical Garden "D. Brandza", University of Bucharest (BUC 409509, 409510). The taxonomy and nomenclature of species follow GBIF database.

Results and discussion

Amaranthus viridis belongs to Amaranthaceae family, subgenus *Albersia* (Kunth.) Gren. & Godr., section *Blitopsis* Dumort who include also *A. blitum* L., *A. deflexus* L., *A. emarginatus* Salzm. ex Uline & Bray, *A. albus* L., *A. blitoides* S.Watson, *A. graecizans* L., all present in the Romanian flora Europe (Akeroyd 1993, Sârbu et al. 2013).

¹ University of Bucharest, Botanic Garden "D. Brandza", Șos. Cotroceni 32, 060114-București, România.

* Correspondence: petronela.camen-comanescu@unibuc.ro

Nomenclature:

Amaranthus viridis L. Sp. Pl. ed. 2 1405 (1763) – Slender amaranth, tropical green amaranth, green amaranth, african spinach.

Euxolus viridis Moq. in DC. Prodr. 13 (2): 274. 1849.

Chenopodium caudatum Jacq. Coll. 2: 325. 1788.

Euxolus caudatus Moq. in DC. Prodr. 13 (2): 274. 1849.

Amaranthus gracilis Desf. Tabl. Bot. 43. 1804; Thellung Mem. Soc. Sci. Math. Cherbourg 38: 216. 1912 (Fl. Adv. Montpellier 216); Standl. N. Am. Fl. 21: 117. 1917.

Albersia gracilis Webb & Berth. Phyt. Canar. 3: 287. 1836.

Type: lectotype LINN (HERB. LINN. 1117.15).

Voucher specimen: BUC409509, BUC409510 (Fig. 1):

Description (Fig. 2): Annual plant, with stem ascending to erect, up to 80 cm tall, glabrous to sparsely pubescent in the upper part. Leaves long petiolate with blade rhombic-oblong or ovate, base cuneate to subrounded, margins entire, plane, apex obtuse, rounded or slightly emarginated. Inflorescence long, flexuous, consisting of agglomerated cymes arranged in slender, axillary or mostly terminal spikes, frequently paniculate. Flowers unisexual, subsessile, green, male and female intermixed but female ones more numerous. Bracteoles acute, ovate to lanceolate, membranous, shorter than tepals. Perianth with 3 segments, oblong to obovate. Stamens 3; stigmas 2–3, short. Fruit an indehiscent utricle, ellipsoidal to globose, 1.2-1.5 mm, not or slightly exceeding the perianth, strongly rugose, 1-seeded. Seed subglobose, slightly compressed, margin acute, glossy, black or dark brown, verrucose or with inconspicuous sculpture. (Akeroyd 1993, Costea et al. 2001).

In Europe, the closer relative, with whom it has sometimes been confused, is *A. blitum*, which has smooth or slightly wrinkled fruit and ascending stems branched from the base; while *A. viridis* is characterized by its few, small perianth segments and broad, rugose fruit and erect, somewhat branched stems (Sîrbu & Oprea 2011, Petrova 2018, CABI 2022).

In Romania, the nomenclature of the taxon created a lot of confusion and *A. viridis* was often confused with *A. retroflexus* (Sîrbu and Oprea 2011) or some authors considered *A. viridis* as synonymous of *Amaranthus blitum* L. var. *blitum* (Covas 1941, Morariu 1952 fide Costea 1998a). Thus, the species is first mentioned by Baumgarten (1816) from Transylvania, the morphological characters given being more suitable for *A. retroflexus* (erect stems with terminal spiciform inflorescences and female flowers with 5 tepals). Schur (1866) comments in “*Enumeratio Plantarum Transsilvaniae*” that Baumgarten's indication “fere ubique” actually refers to *A. retroflexus*, and Brandza (1883) puts *A. viridis* quoted by Baumgarten in 1816 as synonymous with *A. retroflexus*. Moreover, in 1866 Fuss also considered “*A. viridis* Bgt. (not L.)” as a synonym for *A. retroflexus*.

However, Grecescu, in 1898, cites from Romania three species of *Amaranthus*: *A. retroflexus*, *A. blitum* and *A. viridis*. About the later, he appreciated that it is a very common species in Bucharest. In 1909, he also quotes it from Fundeni-Mărcuța.

Origin and general distribution: Species native to South America but according to some authors “possibly of Asian origin” (Townsend 1988 fide Costea et al. 2001). Introduced and naturalized in countries from Asia, Africa, Australia, North America and

Europe (Holm et al. 1997, Uva et al. 1997, Waselkov and Olsen 2014 fide Khan 2021), being one of the most widespread weeds in the tropics, subtropics and warm temperate regions (CABI 2022). The species is naturalized or casual species in countries from all over the Europe, being cited as casual even in the northern countries as Denmark, Finland, Norway and Sweden (Iamonico 2015). In the neighbouring countries of Romania, it has been recorded until now from Bulgaria – casual (Petrova 2018), Hungary – casual (Iamonico 2015) and Ukraine (Moysiienko & Mosyakin 2008).

In the last 50 years, the taxon was collected in 1974 from Turnu Măgurele by Negrean (Costea 1998a,b) and in 1994 and 1995 from Constanța by Costea (Costea 1998a,b), from the harbour and from its vicinity.

After over 25 years, the species was found in October 2021, in the centre of Bucharest, in University Square (N 44.434271°, E 26.101259°). 14 individuals were identified, with a height ranging from 20 to 80 cm, all in a fruiting state, 5 of the highly branched specimens, with a large number of inflorescences.

Biology and ecology: *Amaranthus viridis* flowers from July to October, fruiting in September-November (December). It has very high self-fertility and every individual produces 7000 seeds (Holm et al. 1997, Schweizer and Zimdahl 1984 fide Khan 2021). The seeds loss viability in the high temperature conditions (Purwanto & Poerba 1990 fide Khan 2021). Seed dispersal mainly occurs by rainwater, wind, manure, birds, movement of farm machinery, as contaminated seed crop seeds (Mohler et al. 1999). The germination of the seeds may be inhibited under high moisture stress (Khan 2021).

A. viridis is a thermophilic, xerophilous, mesophilic, nitrophilous species (Costea 1998a). It is adapted to a wide range of pH level, soil types, and textures (CABI 2022, Kigel 1994, Weaver & McWilliams 1980 fide Khan 2021) but prefers sandy soils or those rich in humus and with no standing water (Setyawati et al. 2015).

The species is found in many disturbed habitats like cultivated and waste ground, gardens and plantations, roadsides, disturbed ground near dwellings, sea-shore (POWO 2022). It is an economic weed and is widely distributed in 80 countries of the world (Holm et al. 1991). In Belgium, it is usually seen on unloading quays, dumps or along road verges (Verloove 2022). In Bulgaria, the species grows in a small sector of a green area in the center of the city, near a cathedral church. Preferred habitat in Malta are wasteground road sides and pathways, valleys and fallow fields (Mifsud 2021). In Korea the habitats of *A. viridis* were roadside, bare ground, farm area, and pasture (Lee et al. 2016).

The specimens found in Bucharest were collected from the surface layer of soil deposited between the asphalt tiles and a wall of a building. It was accompanied by other ruderal species such as: *Ailanthus altissima* (seedlings), *Setaria viridis*, *Lactuca serriola* and *Erigeron canadensis*.

Amaranthus viridis is an economic weed being present in many types of cultures. In several Asian countries is a troublesome weed of rice crop (Moody 1989) and of cotton in Australia (Manalil et al. 2017 fide Khan 2021).

Way of introduction: Slender amaranth is a medicinal plant and used like fodder for cattle and green manure. It is also part of local diet in Africa, India, Mexico and other countries of Central America. In Europe, it is among the greens used in Greece where is called *vłita* (Gordon 2017). Sometimes it was observed in plant containers with olive trees from southern Europe (Hoste et al. 2009 fide Verloove 2022).

The place where the species was found is close to the historic centre of Bucharest and is transited by many tourists. There are also restaurants and terraces in the area. We suppose that *A. viridis* was accidentally introduced, probably by tourists or in plant containers.

Conclusions

Amaranthus viridis is a problematic weed in a wide range of geographic and climatic conditions and has multiple negative impacts on the agriculture. The studies have suggested that the species demonstrate productive biology, as they can evolve at a quick pace thereby making them very invasive. Taking into consideration this, its further distribution in Romania is predicted to extend in the near future.

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References

- Akeroyd J. R. (1993) Amaranthaceae, In T.G. Tutin et al (Eds.), *Flora Europaea* (ed. 2), Vol.1, pp. 130-132. Cambridge: Cambridge Univ. Press
- Amaranthus viridis* L. in GBIF Secretariat (2021). GBIF Backbone Taxonomy. Checklist dataset <https://doi.org/10.15468/39omei> accessed via GBIF.org on 2022-01-31.
- Amaranthus viridis* L. in PROTA4U (2021). Retrieved January 22, 2022, from: <https://www.prota4u.org/database/protav8.asp?g=pe&p=Amaranthus+viridis+L.>
- Baumgarten, J. (1816). *Enumeratio stirpium Magno-Transsilvaniae Principatus prae-primis indigenarum*. Vindobonae.
- Brandza, D. (1883). *Prodromul florei Române sau enumerațiunea plantelor până astă-dă cunoscute în Moldova și Valachia*. București: Tip. Academiei Romane.
- CABI, (2022). *Amaranthus viridis*. In: Invasive Species Compendium. Wallingford, UK: CAB International. Retrieved January 22, 2022, from: www.cabi.org/isc.
- Costea, M. & DeMason, D.A. (2001). Stem Morphology and Anatomy in *Amaranthus* L. (Amaranthaceae), Taxonomic Significance. *The Journal of the Torrey Botanical Society*, 128(3), 254-281.
- Costea, M. (1998a). Cercetări monografice asupra genului *Amaranthus* L. din România. Unpublished doctoral dissertation, Universitatea din București.
- Costea, M. (1998b). *Amaranthus* L., subgenus *Albersia* (Kunth) Gren. & Godr. in Romania. *Rev. Roumaine Biol., sér. Biol. Vég.* 43(2), 95-112.
- Costea, M. & Tardif, F. J. (2003). Conspectus and notes on the genus *Amaranthus* in Canada. *Rhodora*, 105(923), 260-281.
- Costea, M., Sanders, A. & Waines, G. (2001). Notes on some little known *Amaranthus* taxa (Amaranthaceae) in the United States. *SIDA, Contributions to Botany*, 19(4), 975-992.
- DAISIE (2009). *Handbook of Alien Species in Europe*. Springer Science + Business Media B.V.

- Flora of North America @ eFloras 2008. Retrieved January 22, 2022, from: http://www.efloras.org/florataxon.aspx?flora_id=1&taxon_id=200006991
- Fuss, M. (1866). *Flora Transsilvaniae Excursoria*. Cibinii: Typis Haeredum Georgii de Closius.
- Gordon, A. (2017). Case study: FSQS in solving market access prohibition for a vegetable product—callaloo (*Amaranthus* sp.). In Gordon A. (Ed.). *Food Safety and Quality Systems in Developing Countries* (pp. 217-244). Academic Press.
- Grecescu, D. (1898). *Conspectul Florei României. Plantele vasculare indigene și cele naturalizate ce se găsesc pe teritoriul României, considerate sub punctul de vedere sistematic și geografic*. București: Tipografia Dreptatea.
- Holm, L.G., Pancho, J.V., Herberger, J.P. & Plucknett, D.L. (1991). *A geographical atlas of world weeds*. Krieger Publisher Company, Malabar, Florida, USA.
- Iamónico, D. (2015) Amaranthaceae, In *Euro+Med Plantbase – the information resource for Euro-mediterranean plant diversity*. Retrieved on January 22, 2022, from: <http://www.emplantbase.org/home.html>.
- Khan, A. (2021). Biology of *Amaranthus retroflexus* and *Amaranthus viridis*. Published doctoral dissertation. Retrieved 03 February 2022, from <https://espace.library.uq.edu.au>
- Lee, Y.H., Hong, S.H., Na, C.S., Sohn, S.I., Kim, M.H., Kim, C.S. & Oh, Y.J. (2016). Predicting the suitable habitat of *Amaranthus viridis* based on climate change scenarios by MaxEnt. *Korean Journal of Environmental Biology*, 34(4), 240-245.
- Mifsud, S. (2021). *Amaranthus viridis*. Retrieved on 02 February 2022 from https://maltawildplants.com/AMAR/Amaranthus_viridis.php
- Moody, K. (1989). *Weeds Reported in Rice in South and Southeast Asia*. Los Banos, Laguna, Philippines: International Rice Research Institute.
- Moysiyenko, I.I. & Mosyakin, S.L. (2008) *Amaranthus viridis* L. (Amaranthaceae) – a new alien species for Ukraine. *Chornomors'k. bot. z.*, 4(1), 123-127.
- Petrova, A.S. (2018). *Amaranthus viridis* and *Euphorbia serpens*, new alien species records for the flora of Bulgaria. *Comptes rendus de l'Académie bulgare des Sciences*, 71(1), 46-52.
- POWO 2022. Plants of the World Online. Retrieved February 02, 2022, from: <http://www.plantsoftheworldonline.org/>.
- Sârbu, I., Ștefan, N. & Oprea, A. (2013). *Plante vasculare din România. Determinator ilustrat de teren*. București: Edit. Victor B Victor.
- Schur, F. (1866). *Enumeratio plantarum Transilvaniae*. Apud Guilielmum Braumuller. Vindobonae.
- Setyawati, T., Narulita, S., Bahri, I.P. & Raharjo, G.T. (2015). *A Guide Book to Invasive Plant Species in Indonesia*, Bogor: Research Development and Innovation Agency.
- Sîrbu, C. & Oprea, A. (2011). *Plante adventive în flora României*. Iași: Edit. Ion Ionescu de la Brad.
- Verloove, F. (2022) [*Amaranthus viridis*]. On: Manual of the Alien Plants of Belgium. Botanic Garden Meise, Belgium. Retrieved 31 January 2022 from alienplantsbelgium.be
- WFO (2022). *World Flora Online*. Version [2021].[01]. Retrieved 31 January 2022 from <http://www.worldfloraonline.org>.



Fig. 1. Voucher specimens (BUC 409509, BUC409510)



Fig. 2. *Amaranthus viridis* – habitus

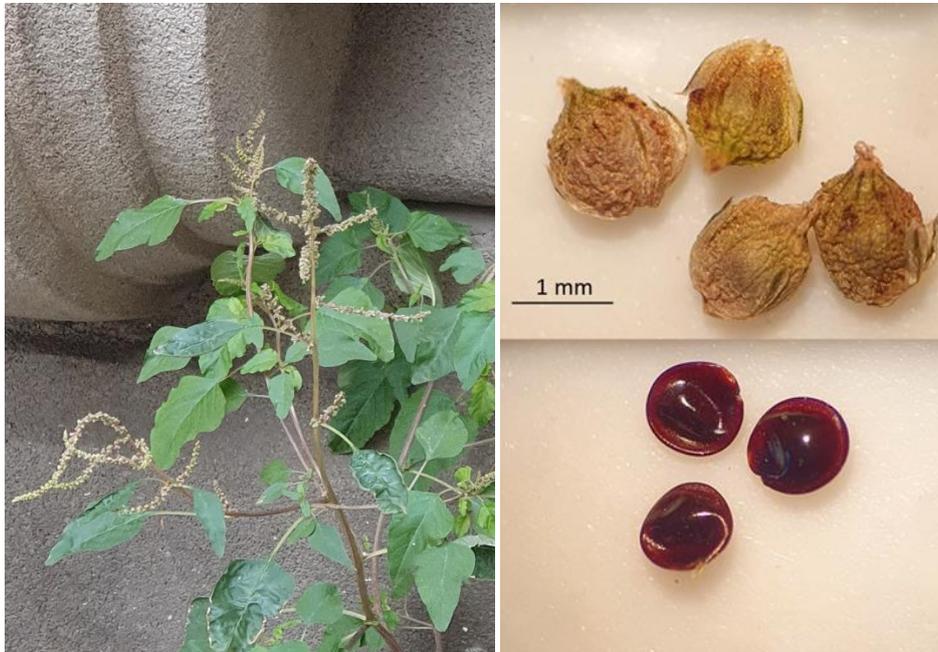


Fig. 3. a – inflorescence, b – fruits and seeds