

ACALYPHA RHOMBOIDEA IN THE VASCULAR FLORA OF ROMANIA

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Abstract: In this paper, *Acalypha rhomboidea* (Euphorbiaceae) is reported for the first time, as a neophyte, in the vascular flora of Romania. We have identified small populations of this species native to North America, in the central area of the Iași city (north-eastern Romania), as a weed in a garden of ornamental plants, near the Palace of Culture. Most likely it has been introduced here accidentally, by importing contaminated growing medium for gardens. It produces viable seeds and seems to survive here for more than 10 years despite regular weed control. The morphology of this species is described based on field and herbarium specimens, and checked on literature data. The paper also includes some data on general distribution and favourite habitats of this species, as well as two identification keys.

Keywords: Acalyphoideae, alien plants, Euphorbiaceae, identification keys, neophytes

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Introduction

The genus *Acalypha* L. (Sp. Pl. 2: 1003. 1753) belongs to the family Euphorbiaceae Juss., subfam. *Acalyphoideae* Asch., tribe *Acalypheae* Dumort., subtribe *Acalyphinae* Griseb. (Webster 1975, 1994). With ca. 500 species, *Acalypha* is the third largest genus of Euphorbiaceae, after *Euphorbia* L. and *Croton* L. (Cardiel & Rodriguez 2015; Cardiel *et al.* 2022; Montero-Muñoz *et al.* 2021).

The species of *Acalypha* are distributed in the tropical and subtropical regions worldwide, with New World as home to around two thirds of them, but some species are found in temperate regions (Mohlenbrock 1931; Webster 1994; Gordillo *et al.* 2002; Cardiel & Rodriguez 2015; Levin 2016; Cardiel *et al.* 2022).

According to Webster (1994) the combination of characters by which *Acalypha* differs from other Euphorbiaceae is as follows: latex absent; leaves alternate, unlobed, stipulate; inflorescences usually spicate, bisexual or unisexual (when bisexual, pistillate flowers proximal and staminate distal, rarely vice versa); foliaceous bracts subtending the pistillate flowers usually enlarged in fruit; staminate flowers with 4 distinct tepals and 4-8 distinct stamens, with anther sacs pendulous and vermiform and pollen grains porate, rugulose; pistillate flowers with 3 (-5) distinct tepals, ovary (2-) 3 - locular, with 1 ovule per locule, styles distinct or connate basally, multifid or laciniate (rarely entire); fruit capsular; seeds ± carunculate. In addition to normal pistillate flowers, some species produce allomorphic flowers, usually long-pedicelate, ebracteate, with fewer carpels (usually 1), and the axis of the ovary turned almost 180° so that the style is sub-basal (Radcliffe-Smith 1973).

Six species of *Acalypha* have been reported as alien plants in Europe so far, all of them being monoecious annual herbs, namely:

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- *Acalypha australis* L. – native to eastern Asia (Hauxing & Gilbert 2008; Levin 2016): Caucasus (naturalised) (Poyarkova 1974), Ukraine (naturalised) (Poyarkova 1974; Shevera & Kish 2018), Italy (naturalised) (Conti *et al.* 2005; Celesti-Grapow *et al.* 2009, 2010; Galasso *et al.* 2018a,b), Switzerland (naturalised?) (Mangili *et al.* 2016), Bulgaria (naturalised; formerly mistakenly reported as *A. virginica*) (Petrova 2017), and Austria (Pilsel 2022); the species has been also reported from Turkey (Duman & Terzioğlu 2009; Uludağ *et al.* 2017);

- *Acalypha indica* L. – native to tropical Asia and Africa (Hauxing & Gilbert 2008; Radcliffe-Smith 2011): ?Caucasus (according to Poyarkova 1974, records from this area are probably incorrect since all the examined specimens determined as *A. indica* should be referred to *A. australis*); Belgium (casual) (Verloove 2006);

- *Acalypha mexicana* Müll. Arg. – native from central Mexico to Guatemala (Steinmann & Felger 1997; Levin 2016): France (naturalized) (Thellung 1912); however, not mentioned in the *Flora Europaea* (Tutin 1968);

- *Acalypha ostryifolia* Riddell – native to North America (Levin 2016): Italy (casual) (Celesti-Grapow *et al.* 2009, 2010; Galasso *et al.* 2018b);

- *Acalypha rhomboidea* Raf., native to North America (Levin 2016): Portugal (naturalized) (Almeida & Matos 2006) and Italy (naturalized) (Di Pietro *et al.* 2021);

- *Acalypha virginica* L. – native to North America (Levin 2016): France (naturalized) (Thellung 1912), Italy (naturalized to invasive) (Tutin 1968; Conti *et al.* 2005; Celesti-Grapow *et al.* 2009, 2010; Galasso *et al.* 2018b), Switzerland (naturalized) (Tutin 1968; Wittenberg 2005), Austria (naturalized) (Tutin 1968; Essl & Rabitsch 2002; Fischer 2018); however, according to Euro+Med (2006+) this species is present only in Madeira archipelago, as casual.

Based on data from the literature (Mohlenbrock 1931; Correll & Johnston 1970; Poyarkova 1974; Steinmann & Felger 1997; Rhoads & Block 2007; Hauxing & Gilbert 2008; Radcliffe-Smith 2011; Levin 2016), these six species can be distinguished as follows:

- 1a.** Blade base cordate; inflorescences unisexual *A. ostryifolia*
1b. Blade base cuneate to obtuse; inflorescences bisexual **2**
2a. Pistillate bracts margins shallowly incised (crenate or repand-dentate) **3**
2b. Pistillate bracts margins deeply incised, at least 1/3 of the bract length (lobed) **5**
3a. Pistillate bracts usually 1 or 2, (10-) 14-25 mm long, ovate-cordate; allomorphic pistillate flower usually absent (if present, 2-carpellate); capsule ca. 4 mm in diam.; seeds smooth *A. australis*
3b. Pistillate bracts 3-9, 5-10 mm long, ovate-cordate or suborbicular; allomorphic pistillate flowers present, 1 - carpellate, at the inflorescence apex; capsule ca. 2 mm in diam.; seeds minutely punctulate **4**
4a. Pistillate bracts ca. 5 mm, margins repand-dentate (teeth not rounded at the apex) *A. indica*
4b. Pistillate bracts ca. 10 mm, crenate (teeth rounded at the apex) *A. mexicana*
5a. Stems hirsute with spreading hairs. Leaves narrowly rhombic to broadly lanceolate. Pistillate bract abaxial surfaces hirsute, and sometimes stipitate-glandular, with (9-) 10-14 (-16) lobes triangular, 1/4 - 1/2 of bract length; allomorphic pistillate flowers absent *A. virginica*
5b. Stems glabrous or with incurved hairs. Leaves ovate to broadly rhombic. Pistillate bract abaxial surfaces sparsely pubescent, stipitate-glandular, with (5-) 7-9 (-11)

lobes lanceolate to triangular, 1/3 - 3/4 of bract length; allomorphic pistillate flowers rare, solitary in axils near base of stem *A. rhomboidea*

None of the *Acalypha* species has been reported from Romania so far (see Prodan 1953; Oprea 2005; Ciocârlan 2009; Sârbu *et al.* 2013). In this paper we report *A. rhomboidea* as a new record in the vascular flora of the country.

Material and methods

Species has been identified as a result of our field works (2021 - 2022), in north-eastern Romania. The geographic coordinates were recorded on the field using the OsmAnd application, available at <https://osmand.net/>. Species has been identified based on descriptions and identification keys published, for North America, by Mohlenbrock (1931), Correll & Johnston (1970), Levin (1999, 2016) and Rhoads & Block (2007). We also checked it in many other references concerning the genus *Acalypha*, from other world regions, as indicated below: Africa (Cardiel & Montero-Muñoz 2018); Asia (Poyarkova 1974; Hauxing & Gilbert 2008; Sagun *et al.* 2010; Radcliffe-Smith 2011; Welzen & Chayamarit 2020); Australia (Forster 1994); Europe (Tutin 1968; Poyarkova 1974); South America (Cardiel Sanz 1994; Cardiel & Rodriguez 2015; Cardiel *et al.* 2022; Cordeiro de Sousa *et al.* 2016); Western Indian Ocean Region (Montero-Muñoz *et al.* 2018, 2020, 2021). Voucher specimens were deposited in the Herbarium of the University of Life Science “Ion Ionescu de la Brad” of Iași (IASI) (abbreviation according to Holmgren *et al.* 1990). The nomenclature of the plant taxa follows Levin (1999, 2016), for *Acalypha*, and Sârbu *et al.* (2013), for accompanying species.

Results and discussion

Acalypha rhomboidea Raf., New Fl. 1: 45. 1836 (*Acalypha virginica* L. var. *rhomboidea* (Raf.) Cooperr. in Michigan Bot. 23: 165. 1984) – rhombic three-seeded mercury (*Fig. 1*).

Botanical description (based on the specimens collected on the field): annual herb, 15-40 cm tall; stem erect, branched, pubescent with upward curved hairs; leaves alternate; stipules present, very small, triangular-lanceolate; petiole at least 1/3 as long as the blade, pubescence like on the stem; blade up to 4.5 × 2.2 cm, 3 - nerved at base, rhombic-ovate, base subcuneate, margins crenate-serrate, apex subacute, glabrous or covered with sparse stiff, ± adpressed hairs; inflorescences axillary, spiciform, bisexual, up to 10 mm long, the pistillate flowers proximal, staminate crowded distal; bracts subtending pistillate flowers 1 - 3 (each with 1 - 3 flowers), crowded, wider than long (10 - 12 × 5 - 6.5 mm), enlarging in fruit, abaxial surface sparsely pubescent and stipitate-glandular, cut about 1/3 to 1/2 of their length into 5 - 9 (-11) lobes oblong-lanceolate; pistillate flowers with 3 distinct tepals and 3 united carpels, styles multifid; the axis below the staminate flowers with ± adpressed hairs; staminate flowers with 4 distinct tepals and 8 stamens, pollen sacs distinct, vermiform and pendulous; capsule 3 - seeded, pubescent with stiff hairs (the apical ones with purple bulbous base) and few glandular hairs towards the top; seeds yellowish brown, with small brown spots (from the underlying layer?), minutely pitted, ovoid, 1.5 mm long, with a small caruncle.

The above features fit very well with descriptions of *A. rhomboidea* published by Mohlenbrock (1931), Correll & Johnston (1970), Levin (2016) and Rhoads & Block (2007).



Fig. 1. *Acalypha rhomboidea*, Iași (north-eastern Romania). Pistillate bracts deeply incised (5-9 lobed) with the abaxial surface stipitate-glandular are seen (Photo: C. Sîrbu)

As shown by Levin (2016), allomorphic pistillate flowers and fruits may be present in *A. rhomboidea*, but no such flowers and fruits were observed on our specimens.

Origin, general distribution and habitats. *A. rhomboidea* is a native to North America (south-eastern USA), where it grows in a wide range of habitats, both natural (woods, moist depressions, swampy areas, bluffs, riverbanks, moist to dry sandy sites) and anthropogenic (roadsides, agricultural fields, waste ground) (Mohlenbrock 1931; Correll & Johnston 1970; Rhoads & Block 2007; Levin 2016).

As it was already shown, the first report of this species in Europe was made by Almeida & Matos (2006). According to the cited authors, *A. rhomboidea* was introduced by culture in the Botanical Garden of Coimbra (Portugal), from where it has been escaping, becoming a naturalized alien weed in ruderal communities of gardens and roadsides. More recently, the species has been reported by Di Pietro *et al.* (2021) in Italy (Lazio), as a naturalized weed, introduced accidentally, inside and outside of a nursery garden, where it survived for at least 4 years despite various attempts of complete eradication.

Distribution and habitats in Romania. We first observed this species in August 2021, in the central area of the Iași city (north-eastern Romania), as a weed in the garden of ornamental shrubs and trees, from the park of a shopping center, near the Palace of Culture (N 47.15661, E 27.58802), but we managed to identify it barely a year later (2022) (examined specimens: Herb. IASI, no. 18047, 18048, *legit. et det.* C. Sîrbu, 20.08.2022; 02.10.2022). This is the first record of the genus *Acalypha* for Romania.

Among the accompanying weeds in the mentioned place, we registered the following ones: *Convolvulus arvensis*, *Digitaria sanguinalis*, *Euphorbia peplus*, *Eragrostis minor*, *Portulaca oleracea*, *Setaria viridis*, *Stellaria media* (native), *Erigeron canadensis*, *Euphorbia prostrata*, *E. serpens*, *Eclipta prostrata*, *Oxalis corniculata* (alien plants, some of which have been already reported from the same garden, by Sîrbu & Şuşnia 2018, and Oprea *et al.* 2021).

Possible introduction way and current status in Romania. Since *A. rhomboidea* has not been cultivated in Romania until now, we suppose that it was accidentally introduced in the garden near the Palace of Culture of Iași by growing medium imported (2010-2012) from Italy (together with various ornamental plants), which possibly has been contaminated with weed seeds. A similar introduction in the same place was assumed for *Euphorbia serpens* by Sîrbu & Şuşnia (2018), but could also be considered for other neophytes recently recorded here (e.g. *Euphorbia prostrata*, *E. serpens*, *Eclipta prostrata*).

In the mentioned place, *A. rhomboidea* grows in small populations (up to 17 individuals each) and produce viable seeds which germinate in several stages during the second part of summer and early fall, which enables it to survive (possibly for over 10 years?) despite regular weed control. Thus, it seems to be somehow naturalized in Romania, but further investigations are necessary to a better assessment of its status.

Useful resources for the species identification. Characters often used to separate *A. rhomboidea* from other congeneric similar species from North America (*i.e.* *A. deamii* (Weath.) H.E. Ahles; *A. gracilens* A. Gray; *A. monococca* (Engelm. ex A. Gray) Lill. W. Mill. & Gandhi; *A. virginica* L., all these being designated as the “*Acalypha virginica* group”), were summarised and commented by Levin (1999, 2016).

Identification keys which include *A. rhomboidea* were published by Mohlenbrock (1931), Correll & Johnston (1970), Rhoads & Block (2007) and Levin (1999, 2016).

Valuable iconography for *A. rhomboidea* is provided by Mohlenbrock (1931), Rhoads & Block (2007) and Alonge, in Levin (2016).

Comprehensive information on the taxonomy and biogeography of *Acalypha* is provided by the website “*Acalypha* Taxonomic Information System” developed by Cardiel *et al.* (<http://www.acalypha.es/>).

***Acalypha* among other Euphorbiaceae in Romania.** Three genera of Euphorbiaceae have been known in the vascular flora of Romania so far, namely (Prodan 1953; Ciocârlan 2009; Sîrbu *et al.* 2013): *Euphorbia* L., *Ricinus* L. and *Mercurialis* L. *Acalypha* differs from these genera as follows (key mainly based on the data of Webster 1994):

- 1a.** Plants with latex; inflorescence a pleiochasium of cyathia; each cyathium consists in a cup shaped involucre (more or less deeply lobed, with 4-5 glands to the top, outside) which encloses a single, central, pistillate flower (3-carpellate, with gynophore), and several staminate flowers (of a single stamen); perianth absent
..... *Euphorbia*

- 1b.** Plants without latex; inflorescences spiciform or paniculate; the staminate flowers with at least 4 stamens, the pistillate ones with 2-3 carpels; perianth present **2**
- 2a.** Leaves palmate lobed; stipules connate into a sheath, deciduous; inflorescence terminal, paniculate, with cymules of staminate flowers proximal, and pistillate flowers distal; stamens many, filaments connate into branching fascicles; capsules large, 13-15 mm; seeds carunculate **Ricinus**
- 2b.** Leaves not lobed; stipules free, persistent; inflorescences axillary, unisexual or bisexual, spiciform; stamens not connate into fascicles; capsules much smaller; seeds carunculate or not **3**
- 3a.** Plants dioecious; leaves opposite; staminate flowers with 3 tepals and 8-12 stamens; pistillate flowers 2-carpellate, with 3 tepals, and 2 subulate nectaries, not-subtending by foliaceous bracts enlarging in fruit; anther-sacs not vermiform; pollen colpore; seeds carunculate **Mercurialis**
- 3b.** Plants monoecious (as in *A. rhomboidea*) or dioecious; leaves alternate; staminate flowers with 4 tepals and 4-8 stamens; pistillate flowers (1-2-)3-carpellate, with 3 tepals (nectaries absent), subtending by foliaceous bracts enlarging in fruit; anther-sacs vermiform and pendulous; pollen porate; caruncle minute or absent **Acalypha**

Conclusions

Acalypha rhomboidea, native to North America, is reported here for the first time in the spontaneous flora of Romania, based on field and herbarium specimens.

It has been identified in the central area of the Iași city (north-eastern Romania), as a weed in a garden of ornamental plants, near the Palace of Culture.

We suppose that this neophyte was accidentally introduced in north-eastern Romania through growing medium for ornamental plants from import, contaminated with weed seeds.

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