Acalypha rhomboidea Raf. (Euphorbiaceae) – a new alien species in the flora of Croatia

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Abstract

In the autumn of 2022 an unknown species from the Euphorbiaceae family was observed at two localities in Croatia. In Karlovac it grows as a weed on arable land and in Hrvatsko zagorje (Kostel) on a gravelled parking lot next to the local cemetery. Based on the studied morphological traits and relevant literature, we identified the species as *Acalypha rhomboidea* Raf. (syn. *Acalypha virginica* var. *rhomboidea* (Raf.) Cooperr.) which is native to North America, but its appearance has also been recorded in Europe. Given that it is a new species in the Croatian flora, it should be added into the Flora Croatica database and its possible further appearance and spread, as well as the impact on the native flora and vegetation, should be monitored.

Keywords: *Acalypha rhomboidea*, alien species, Croatia, Hrvatsko zagorje, Karlovac

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Sažetak

U jesen 2022. godine na dva lokaliteta u Hrvatskoj uočena je nepoznata vrsta iz porodice Euphorbiaceae. U Karlovcu kao korovna vrsta raste na oranici, a u Hrvatskom zagorju (Kostel) na pošljunčanom parkiralištu uz mjesno groblje. Na temelju proučenih morfoloških obilježja i relevantne literature ustanovljeno je da se radi o vrsti *Acalypha rhomboidea* Raf. (syn. *Acalypha virginica* var. *rhomboidea* (Raf.) Cooperr.) koja je autohtona u Sjevernoj Americi, no zabilježeno je njeno pojavljivanje i u Europi. S obzirom da se radi o novoj vrsti u hrvatskoj flori, valja je uvrstiti u bazu Flora Croatica te pratiti njeno moguće daljnje pojavljivanje i širenje, kao i utjecaj na autohtonu floru i vegetaciju.

Ključne riječi: *Acalypha rhomboidea*, strana vrsta, Hrvatska, Hrvatsko zagorje, Karlovac

Acalypha is the fourth largest genus of the Euphorbiaceae family with 443 accepted species (POWO 2023). The genus includes annuals or perennial herbs, shrubs, and small trees. Most are monoecious and some are dioecious. There are several types of inflorescence, terminal or axillary, frequently both, unisexual or androgynous. Male inflorescences are spicate, densely flowered, with several flowers at each node subtended by a minute bract. Female inflorescences are generally spicate, sometimes racemose or panicle-shaped, with 1–3(–5) flowers at each node, usually subtended by a large bract, generally dentate or lobed. Androgynous inflorescences usually with female flowers at proximal nodes and male flowers at distal nodes. Flowers are unisexual, apetalous. Male flowers are very small, shortly pedicellate, calyx parted into 4 small valvate sepals, stamens 4–8(–16). Female flowers generally sessile or subsessile, pedicellate in a few species; calyx of 3– (4–5) small sepals, ovary of (1–2) 3 carpels, surface often muricate, pubescent or papillose. Fruits are capsular, small, usually 3-lobed, soon dehiscing septicidally into 3 bivalved cocci, generally surrounded by the accrescent bract (Duman & Terzioglu 2009, Levin 2021).

The genus is native to all continents except Europe and Antarctica. Most species occur in the tropical and subtropical regions of America (about 60%) and Africa (about 30%) (Atha 2008), but 11 species have been introduced to Europe – some intentionally, as ornamental plants, and more often accidentally, by transporting goods and people (Tab. 1). Some of them have naturalized as well. The largest number of introduced *Acalypha* spp. have been recorded in the Netherlands, which is not surprising because Rotterdam is the biggest European port and the plants are favored by the mild oceanic climate. Also, available data indicate that *A. australis* L., which is native to China, Korea, Vietnam, Laos, and Japan, is spreading notably in Eastern Europe, around the Black Sea, and in Siberia and less intensively in Northern and Southern Europe (Almeida & Matos 2006, Gestim & Vilar 2021, GBIF 2023, POWO 2023, iNaturalist 2023, Pl@ntNet 2023, Nikolić 2005-onwards). *Acalypha rhomboidea* was first recorded in Europe in Portugal in 2006 (Almeida & Matos 2006). Since then it has spread to Italy (Di Pietro et al. 2021), Belgium, Austria, Spain, France, Switzerland and Turkey (Tab.1).

So far, only a single species has been officially recorded in the Croatian flora – *Acalypha virginica* L. (Ruščić 2003). The plants were observed in Split on the southern slopes of the hill Marjan in gardens and homesteads. In the Flora Croatica Database (Nikolić 2005-onwards) there is a photo of the same species from Sveta Klara taken by J. Topić with the comment that the seeds probably came with garden soil. But in the iNaturalist database (iNaturalist 2023) there are two photos taken by S. Ćato from Dubrava near Šibenik which undoubtedly show the species *Acalypha australis* L.

At the beginning of October 2022 a field observation of flora was made in the area of the castle of Kostel (Hrvatsko zagorje). A dozen or so individuals of an unknown plant species from the Euphorbiaceae family were spotted on the gravelled ground next to the local cemetery (WGS84 coordinates: N = 46.187446°, E = 15.742702°; Fig. 1). The plants were thoroughly photographed and other species were also recorded. In the same period, identical plants were also found on arable land in Karlovac (WGS84 coordinates: N = 45.507874°, E = 15.531491°; Fig. 1). Using the literature (Nikolić 2019, Nikolić 2020), it was determined that the species belongs to the genus *Acalypha*, but that according to some morphological traits it does not correspond to the only species of that genus that has been recorded so far in the Croatian national flora, *Acalypha virginica* L. Using dichotomous keys (Haines 2011, Levin 2021) it was identified as *A. rhomboidea* Raf.

Table 1 *Acalypha* spp. introduced into Europe (information based on web databases/services*)

	INTRODUCED INTO EUROPE (COUNTRY)		
SPECIES	**GBIF**	**Plants of the World Online**	**iNaturalist, Pl@ntNet, FCD**
***Acalypha rhomboidea* Raf.**	Belgium, Austria, Italy	Italy	Italy, Portugal, Spain, France, Switzerland, Turkey
Acalypha australis L.	Italy, Ukraine, Russian F., Belarus, Switzerland, Netherlands, Finland, Sweden, Turkey	Bulgaria, Italy, Turkey, Ukraine	Italy, **Croatia**, Slovakia, Ukraine, Belarus Russian F., Turkey
Acalypha virginica L.	Italy, Slovenia, Switzerland, France Netherlands	Italy	**Croatia**, Italy, UK
Acalypha brachystachya Hornem.	Netherlands, Sweden, Norway	-	-
Acalypha hispida Burm.f.	Netherlands, Finland, Sweden	-	UK, Belgium, Denmark
Acalypha wilkesiana Müll.Arg.	Netherlands, Spain	-	France, UK, Denmark
Acalypha alopecuroidea Jacq.	Netherlands	-	-
Acalypha phleoides Cav.	Spain	-	-
Acalypha persimilis Müll.Arg.	Spain	Italy	-
Acalypha integrifolia Willd.	France	-	-
Acalypha claoxyloides Hutch.	France	-	-

**Given that amateurs also enter data into some databases, which were used in this work, those should be taken with caution. One should also take into account that all European countries are not engaged in inventarization of flora to the same degree, so the completeness of the data may vary accordingly. In general, databases should be taken with caution because sometimes they do not give a true picture of the distribution of individual taxa. However, in the absence of published works, they are a valuable source of data related to invasive species that should be paid attention to.*

Based on the careful observation of morphological details on the plants *in situ* and in macrophotographs, as well as the study of the relevant literature (Heines 2011, Levin 2021, Anonymous 2023a, Anonymous 2023b) we can give the following description of *Acalypha rhomboidea* Raf.:

Root – The root system consists of a central taproot and lateral roots.

Stem – Ascending to erect, up to 60 cm, branched (Fig. 2), glabrous or moderately to densely pubescent (sometimes in vertical lines) with short, strongly curved hairs, sometimes with a few longer, straight hairs.

Leaves – Alternate, long-petiolate. Petiole longer than the inflorescence bracts. Leaf blades 1-10 cm long, broadly lanceolate to ovate or rhombic, angled to broadly angled at the base, tapered to a sharply pointed tip, the margins with several (mostly 8-12 on each side) often relatively closely spaced, usually blunt teeth, the surfaces sparsely pubescent with relatively straight, more or less appressed hairs (Fig. 3).

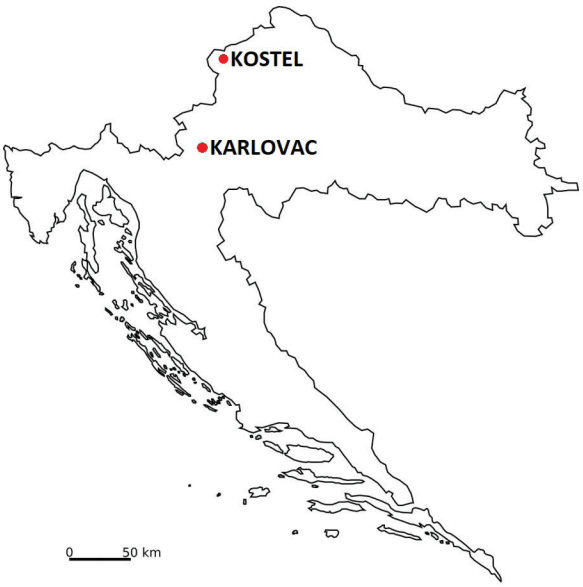

Figure 1. Distribution map of the species *Acalypha rhomboidea* Raf. in Croatia

Figure 2. Habitus (branched stem), a plant at Kostel (Photo: Lj. Borovečki-Voska, 13 October 2022).

Inflorescences – Entirely axillary spikes, 1-3 per node, each with 1-3 basal pistillate flowers below several nodes of staminate flower clusters, the tip of the spike not or only slightly extending beyond the bract (Fig. 4). Bracts 4.5-25 mm long, appearing more or less folded longitudinally around the inflorescence, with usually 5-9 narrowly lanceolate to oblong-lanceolate lobes, the surface glabrous or sparsely with stipitate glands (Fig. 4 and 5).

Flowers – Male flowers in capitate clusters terminating the peduncle. Sepals 4, golden-green, antrorsely bent, 0.3 mm long, acute to blunt. Stamens numerous. Female flowers apetalous, the sepals minute and green. Ovary 3-locular, pubescent. Styles 3, laciniate.

Fruits – Capsules 1.5-2.3 mm long, 3-locular, 3-seeded, the surface moderately to densely hairy, lacking tubercles or slender projections at maturity. Seeds 1.3-2 mm long.

Habitat: Literature states that *A. rhomboidea* is native to the United States and the eastern part of Canada (Almeida & Matos 2006, Gestim & Vilar 2021, POWO 2023). It prefers moist disturbed areas: disturbed areas of moist prairies, limestone glades, openings or lightly shaded areas of floodplain forests, thickets, seeps, stream banks, ditches, fields, fence rows, roadsides, areas along railroads, vacant lots, poorly maintained lawns and gardens, and waste areas

Figure 3. Leaves (petiole 36% as long as the leaf blade) (Photo: Z. Cunjak, 10 October 2022).

(Anonymous 2023a, Anonymous 2023b). The habitat in Karlovac, where numerous individuals grow as weeds on wet arable land (Fig. 6), corresponds to the literature, but the habitat in Kostel is a gravelled parking lot and is quite dry. This might explain why the plants in Karlovac are numerous and robust, while those in Kostel are stunted. Also, the abundance at the former locality might indicate that the plants have been present there for a longer time. In Kostel the seeds probably came with garden soil and in Karlovac perhaps with seeds of agricultural crops that are sown on arable land.

Raunkiær's life-form: *A. rhomboidea* is an annual plant, therophyte.

In North America, where *A. rhomboidea* is native, but also elsewhere, confusion is possible with similar species of the same genus – *A. virginica*, *A. deamii* (Weath.) H.E. Ahles and *A. gracilens* A. Gray. That is why we provide a dichotomous key (Haines 2011), supplemented by us with 1a. – 2b.

1a. Pistillate bracts entire, heart-shaped, shallowly toothed (roughly 1/20th of the bract length) .... *A. australis*

1b. Pistillate bracts deeply toothed or split into lobes **2**

2a. Ovaries/fruits bilocular ..... *A. deamii*

2b. Ovaries/fruits trilocular **3**

3a. Leaf blades linear to narrow-oblong; petioles 2–14 mm long, 9–25 (–30)% as long as the leaf blade; pistillate bracts sparsely to densely beset with sessile glands, toothed with triangular to ovate teeth 8–28% as long as the bract ..... *A. gracilens*

Figure 4. Inflorescences (Photo: Lj. Borovečki-Voska, 13 October 2022).

Figure 5. Bracts (Photo: Lj. Borovečki-Voska, 13 October 2022)

Figure 6. Population in Karlovac (Photo: Z. Cunjak, 10 October 2022).

3b. Leaf blades broad-lanceolate to ovate; petioles 7–70 mm long, (23–) 33–89% as long as the leaf blade; pistillate bracts lacking sessile glands (though usually with stipitate glands), toothed with linear to lanceolate teeth 21–75% as long as the bract **4**

4a. Pistillate bracts with 5–9 lobes (Fig. 5), stipitate-glandular, without long, eglandular hairs (Fig. 4); stems usually without long, eglandular hairs; petioles 34–89% as long as the leaf blades (Fig. 3), the petioles of the larger leaves commonly more than ½ as long as the blades .... *A. rhomboidea*

4b. Pistillate bracts with 9–15 lobes, hirsute with long, eglandular hairs, short stipitate glands may also be present; stems usually hirsute with long, eglandular hairs; petioles 23–66% as long as the leaf blades ..... *A. virginica*

It is advisable to monitor a possible further appearance and spreading of the species *A. rhomboidea* in Croatia as well as its impact on the autochthonous flora and vegetation, because in North America, where it is native, it has become a serious weed that can cause substantial crop losses in cereal, corn and soybean fields (Anonymous 2023c).

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