



## NOTES ON THE GENUS *OENOTHERA*, SECTION *OENOTHERA*, SUBSECTION *OENOTHERA* IN ROMANIA

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**Abstract:** We present in this paper some results of our studies on the genus *Oenothera*, sect. *Oenothera*, subsect. *Oenothera* in Romania. Several species, including stabilized hybrids (*O. pycnocarpa*, *O. suaveolens*, *O. depressa*, *O. × fallax*, *O. × wienii*) are reported for the first time in the flora of the country. Other species are now confirmed in the flora, by herbarium material. We also give an identification key for the species of the subsect. *Oenothera* currently known in the spontaneous flora of Romania.

**Key words:** alien plants, identification key, new records, vascular flora

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### Introduction

Within the family Oenotheraceae (Onagraceae), *Oenothera* is the second genus as number of species (more than 120), after *Epilobium*, but taxonomically it is the most complex (Raven *et al.* 1979, Wagner *et al.* 2007).

The centre of diversity of the genus *Oenothera* is the south-western North America, from where it irradiated all over the North and South America (Raven *et al.* 1979, Dietrich *et al.* 1997, Wagner *et al.* 2007). Numerous representatives of the genus were introduced into Europe, deliberately or accidentally, and some of them became here naturalized or invasive (Mihulka & Pyšek 2011), but some taxa, unknown in North America, seems to have emerged in Europe, most probably through hybridization between taxa introduced here in historic time (Dietrich *et al.* 1997).

According to Wagner *et al.* (2007), the genus *Oenothera* includes 18 sections. Among these, the section *Oenothera* is divided into 6 subsections, one of which (subsect. *Oenothera*) is the best represented in the flora of Europe. This subsection, the most complex group of species in the Oenotheraceae (Dietrich *et al.* 1997), includes annual or biennial plants (even short-lived perennials), with ± erect stems; hypanthium (*i.e.* the tubular extension of the receptacle) of 10-50 (-160) mm long; petals yellow; capsule ± cylindrical, narrowed to apex, of 5-8 mm wide at the base, seeds prismatic, obviously angled (Dietrich *et al.* 1997, Rostański & Karlsson 2008), with mesotesta nearly crushed (Tobe *et al.* 1987).

There is no general consensus within the literature concerning the species of the subsection *Oenothera*. Taxonomic difficulties are mainly due to some unusual

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cytogenetic and breeding peculiarities, such as the specific interactions between genome and plastome (*i.e.* plastid DNA), the transmission of plastome through pollen, the permanent translocation heterozygosity (PTH), and the hybrid fertility (see Raven *et al.* (1979), Dietrich *et al.* (1997), Greiner *et al.* (2008) and other references listed there, for detailed explanations and discussions.

A narrow species concept in *Oenothera* was developed in Europe especially by O. Renner and K. Rostański, according to which populations characterized by particular chromosome complements (Renner complexes) and distinctive and constant morphological features should be placed in distinct species (Rostański 1982, 1985, Jehlík & Rostański 1995, Rostański *et al.* 1994, 2004, Rostański & Karlsson 2008, Rostański & Verloove 2015). Following this concept, a large number of species and permanent hybrids have been described in this subsection (*e.g.* Renner 1942, 1950, 1956, Hudziok 1968, Linder & Jean 1969, Rostański 1977, 1985, 2007, Soldano 1983, 1993, Jehlík & Rostański 1995, Rostański *et al.* 2004, Deschâtres *et al.* 2013, etc.) and many other species previously described based on morphological characters (*e.g.* Persoon 1805, Greene 1891, Steele 1911, Bartlett 1913, Klebahn 1913, Gates 1936, etc.) were recognized as good species. All these species from the subsect. *Oenothera* are grouped into five series (Rostański 1985), three of which (*Oenothera*, *Devriesia* Rostański and *Rugglesia* Rostański) are represented in the neophyte flora of Europe.

In contrast, a much broader species concept was applied by Dietrich *et al.* (1997) especially in North America. These authors considered the most of those true-breeding strains in the subsection *Oenothera*, described as “true species” by various botanists (especially the PTH taxa), as representing only phenotypic races (or microspecies) of a more limited number of species. Hence, they combined all those taxonomic entities that share the same fundamental genome (all various Renner complexes were grouped in only three fundamental genomes, designated A, B and C), the same type of plastome and certain related morphological traits into 13 extremely polymorphic species, 6 of which being known in Europe.

As Rostański & Verloove (2015) pointed out, the choice between these two concepts is not straightforward. The narrow species concept is perhaps not applicable in North America, where the number of different phenotypes found in most of the species is considerably greater than that observed in European populations (Dietrich *et al.* 1997). However, in Europe the broad species concept seems to be much too broad because it imposes to bring together, in the same species, a large number of morphologically well-delimited entities (Rostański *et al.* 2004, Rostański & Verloove 2015) which, in addition, most often exhibit clearly distinct ecological preferences, distribution patterns and invasive behaviours (Mihulka & Pyšek 2001, Mihulka *et al.* 2006, Tokhtar & Wittig 2008, 2009, Tokhtar *et al.* 2011, Tokhtar & Groshenko 2014). This is why in this study we follow the narrow species concept, using the plant name according to Rostański *et al.* (2010). However, for each species we also give, between square brackets, the alternative name, according to Dietrich *et al.* (1997).

All species of subsect. *Oenothera* occur in primarily or secondarily open habitats, including old fields, roadsides, stream sides, sand dunes etc., both in the native area (Dietrich *et al.* 1997) and in Europe (Mihulka & Pyšek 2011).

Only two species of this subsection (*O. biennis* L. and *O. glazioviana* Micheli in Martius) have been certainly documented so far in the flora of Romania, based on

herbarium material. Other three species (*O. rubricaulis* Klebahn., *O. parviflora* L. and *O. oakesiana* (A. Gray) Robbins ex Wats. & Coult.) have also been reported by various authors, but their presence has not been proven certainly so far. In this paper, we report 5 taxa from the subsect. *Oenothera* (3 species and 2 hybrids) for the first time in Romania, and confirm the presence of other two species previously mentioned in the country.

#### Material and methods

The present study is referred to some taxa of *Oenothera* sect. *Oenothera* subsect. *Oenothera* and reflects our field works particularly in the last three years (2015-2017) in Romania. The geographic coordinates were recorded on the field using an eTrex Legend HCx GPS system. Specimens collected on the field were deposited in the Herbarium of the University of Agricultural Sciences and Veterinary Medicine Iași (IASI). Herbarium data were collected from the following main herbaria of Romania (abbreviations according to Holmgren *et al.* 1990): BUC, BUCA, BUCM, CL, I, IAGB, and IASI. All species were identified using various keys published by Linder (1957), Raven (1968), Rostański & Ellis (1979), Jehlík & Rostański (1979), Rostański (1982), Rostański & Forstner (1982), Kerguélen (1985), Jehlík (1988), Soldano (1993), Rostański *et al.* (1994, 2010), Fischer *et al.* (2008), Rostański & Karlsson (2008), Király (2009), Rostański & Verloove (2015).

The nomenclature of the plant taxa follows Rostański (2000), Rostański *et al.* (2004, 2010).

#### Results and discussion

As a result of our recent field works, we have identified a number of 5 taxa (3 species and 2 hybrids) within the subsection *Oenothera*, which have not been previously known into the flora of Romania, namely: *O. pycnocarpa* Atkinson & Bartlett in Bartlett, *O. suaveolens* Person, *O. depressa* E. Greene, *O. × fallax* Renner and *O. × wienii* Renner ex Rostański.

Other 5 species (*O. biennis* L., *O. glazioviana* Micheli in Mart., *O. rubricaulis* Klebahn, *O. parviflora* L. and *O. oakesiana* (A. Gray) Robbins ex Wats. & Coult.) were previously reported in the botanical literature (see Sîrbu & Oprea 2011 and references given there), the first 4 being also identified by us in our recent field works.

Therefore, according to the current data, the subsection *Oenothera* is currently represented into the flora of Romania by 10 taxa (8 species and 2 hybrids). However, the presence of *O. oakesiana* in Romania (Jehlík & Rostański 1979, Rostański & Forstner 1982) still requires confirmation by herbarium material. In the Herbarium of the Cluj-Napoca Botanical Garden (CL) there is a specimen (No. 218148), collected (2.VII.1938) by Al. Borza *et al.*, originally identified as *O. biennis* L. and subsequently revised (15.II.1967) by K. Rostański as *O. syrticola* Bartl. (currently a synonym for *O. oakesiana*). However, this specimen was collected from the district Caliacra ("Dobrogea, distr. Caliacra. In arenosis litoris Ponti Euxini Marea Neagră ad pagum Ecrene"), which currently is outside the borders of Romania (in Bulgaria).

We present below only those taxa representing novelties for the flora of the country, or which have been ambiguously mentioned in the literature and now confirmed by herbarium specimens.

**a) Taxa registered for the first time in the flora of Romania**

***Oenothera pycnocarpa*** Atkinson & Bartlett in Bartlett, *Rhodora* 15: 83. 1913 (Syn.: *O. chicaginensis* de Vries ex Renner var. *minutiflora* Rostański et Jehlík, *Folia Geobot. Phytotax.* (Praha) 14: 401. 1979) [Treatment in Dietrich *et al.* (1997): phenotype of *O. biennis* L.].

**Origin and general distribution.** It is native in North America (Bartlett 1913, de Vries 1915, Renner & Cleland 1933) and introduced to Europe, where it has been first recorded in Austria (1917) (Mihulka & Pyšek 2001). According to the literature (Jehlík & Rostański 1979, 1995, Rostański *et al.* 2010, Tokhtar & Groshenko 2014, Rostański & Verloove 2015), it is currently relatively widespread on the continent (France, Belgium, Austria, Switzerland, Italy, Germany, Czech Republic, Slovakia, Poland, Ukraine), quite invasive in Central Europe (Mihulka & Pyšek 2001) and rather rare to the East (Ukraine) (Tokhtar & Groshenko 2014).

**Distribution in Romania.** We have identified it near the Răchiteni village, Iași county, N47°04'09.6", E26°54'49.4", 188 m a.s.l., leg. Sîrbu 28.08.2016; N47°03'56.61", E26°55'07.32", 188 m a.s.l., leg. Sîrbu 13.07.2017; N47°03'07.1", E26°55'37.7", 184 m a.s.l., leg. Sîrbu 26.08.2017).

**Ecology.** Similar to other species in the section, it prefers disturbed sites, such as ruderal places associated with roads and railways, industrial areas, river banks, sandy places (Jehlík & Rostański 1979, 1995), excavated grounds (Rostański & Verloove 2015) etc., most often in communities of *Dauco-Melilotion* (Jehlík & Rostański 1979). Near the village Răchiteni (Iași county, Romania), it grows on stable fluvial sands from the right bank of the Siret river, as a component of psammophilous pioneer vegetation or even into more stable plant communities dominated by *Elymus repens*, or in the poplar plantation near the river.

**Description of specimens identified on the field** (Fig. 1). Plants of ca. 150 cm height. Stem erect, basal branches decumbent at base then arcuate-ascending, green to purplish red in part, hirsute with arcuate-patent stiff hairs (up to 2-3 mm long) with high conical to cylindrical red papillae, and appressed pubescent with shorter crisped hairs. Cauline leaves up to 14 × 2-3 cm, short petiolate, elliptic-lanceolate, flat to slightly wavy, with straight apex, and distinct dentate margins, ± patent pubescent on both sides, dark (or greyish) green, with (purplish)-red midrib. Bracts sessile, ovate-lanceolate, concave, wavy, distinct dentate, tips upcurved, with (purplish)-red midrib, the lowermost ones longer than fruits, persistent, the uppermost of about half the length of open flowers or slightly longer, pubescence similar to the cauline leaves. Inflorescence erect, branched at the base, pyramidal, open flowers do not overtop the upper buds; rachis green (later could be reddened towards the base), hirsute with arcuate-patent stiff hairs with red papillae, and appressed pubescent with shorter crisped hairs (glandular hairs only in late summer, to the top). Flowers chasmogamous. Ovary (at anthesis) of ca. 12 × 3 mm, green, in the first part of the flowering period with dense long stiff hairs with red papillae, mixed with short crisped hairs, later (August-September) predominantly glandular, with fewer stiff hairs with red papillae. Hypanthium 36-46 × 2-3 mm (in late summer may be shorter), yellowish, patent hairy, with short glandular and long stiff hairs. Buds 15-20 × 4 mm, green (sometime, in late August, slightly red-striped), ± subcylindrical, tapered to the top, with glandular hairs and ± patent stiff hairs, free sepal tips of 3-4(-6) mm long, terminal, adherent at base in

bud, above  $\pm$  somewhat divergent. Petals yellow, obcordate, of 15-20  $\times$  15-20 mm (smaller in late summer). Anthers of 7-9 mm long. Stygma lobes 5-8 mm long, spreading between anthers or slightly exceeding them. Inflorescence rather dense (ca. 0.8-1.5 fruits per cm of rhachis). Capsules 28-32 mm long (usually longer than internodes of the rhachis), 5 mm thick at base, tapered upwards, green (somehow greyish at ripening), without red stripes, with numerous appressed crisped hairs, and (semi-)patent stiff hairs with prominent red papillae (red coloration disappears at the ripe fruits); the fruits which appear in late summer have also glandular hairs; teeth truncate, ca. 1-1.5 mm length. Seeds prismatic, light reddish-brown, of 1.0 -1.5  $\times$  0.5-1.0 mm, with narrow-winged edges.

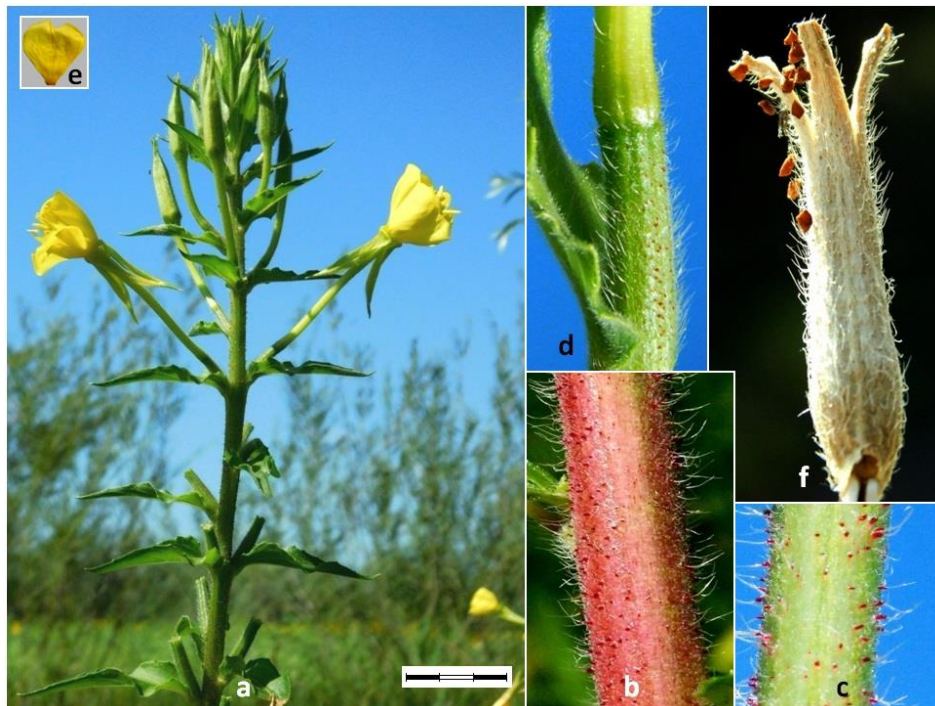


Fig. 1. *Oenothera pycnocarpa*: a-inflorescence; b, c-stem; d-ovary; e-petal; f-capsule. Scale bar: a-9 mm; b, c, d-1.5 mm; f-2 mm.

**Notes.** According to Jehlík & Rostański (1995), *O. pycnocarpa* is a very variable species. To a large extent the characters described for this species in the references (e.g. Jehlík & Rostański 1979, 1995, Rostański & Forstner 1982, Jehlík 1988, Rostański *et al.* 2004, 2010, Fischer *et al.* 2008, Rostański & Verloove 2015) correspond to those observed in specimens collected by us. Nevertheless, through the coarse hairiness of stem and inflorescence, with dense and long stiff hairs on often cylindrical (slightly curved) papillae, the plant resembles with *O. ersteinensis* Linder & Jean (see Linder & Jean 1969, Rostański & Verloove 2015), against which it differs, however, in many characters, such as: stem partially (not entirely) red, the rhachis of inflorescence always

green at top (not red), buds green (not red-striped), petals ca. as long as wide (no wider than long), hypanthium up to 45-46 mm long (not only 14-18 mm).

The taxonomic relationship between *O. pycnocarpa* Atkinson & Bartlett in Bartlett and *O. royfraseri* Gates (Syn. *O. turoviensis* Rostański) is still unclear in the literature. These two taxa are treated either as the same species (e.g. Jehlík & Rostański 1995, Fischer *et al.* 2008), or as distinct ones (e.g. Rostański *et al.* 2004, 2010, Rostański & Verloove 2015 etc.) differentiated especially by the size of flowers, i.e. petals of 12-18 × 14-20 mm and 5-12 × 5-12 mm, respectively; sepal tips of 4-7 mm and 2-3 mm, respectively, although according to Gates (1936), the typical *O. pycnocarpa* has, on the contrary, slightly smaller flowers (petals of 9-13 × 10-13 mm) than *O. royfraseri* (13-18 × 13-17 mm).

In Romania, *O. pycnocarpa* blooms later than the other species mentioned in this paper, starting with the second decade of July. The late blooming of this species (as *O. chicaginesis*) as against other related ones (e.g. *O. biennis*) was also indicated in Austria by Kappus (1960).

**Chromosomes:** 2n=14, with  $\Theta_{12+} 1_{II}$  (Renner & Cleland 1933; Gates 1958) in the meiotic metaphase I; the Renner complexes are rather uncertain: either *dependens* ♀ and *dentans* ♂ (as *O. pycnocarpa*) (Gates & Catcheside 1932, Gates 1958) or *excellens* ♀ and *punctulans* ♂ (as *O. chicaginesis*) (Renner & Cleland 1933; Gates 1958). According to Dietrich *et al.* (1997), it is a heterogamous PTH strain (i.e. one Renner complex of chromosomes ( $\alpha$ ) is transmitted through the egg, the other ( $\beta$ ) through the pollen), with the genome-plastome combination BA-III.

***Oenothera suaveolens*** Persoon, Syn. pl.: 1, 408. 1805 (Syn.: *O. suaveolens* Desfontaine *nomen nudum*, Tabl. Ecole Bot. 169. 1804; *O. biennis* L. subsp. *suaveolens* (Persoon) Rouy & Camus, Fl. France 7: 200. 1901) [Treatment in Dietrich *et al.* (1997): phenotype of *O. biennis* L.]

**Origin and general distribution.** The first report of this species in botanical literature is found at Desfontaines (1804) which listed *O. suaveolens* (as *nomen nudum*) among the species cultivated in the garden of the Museum of Natural History in Paris. A year later, the species was described under this name by Persoon (1805). From the descriptions published in the 19th century (Persoon 1805, Don 1832), one can understand that the species is native in America, while in Europe it did not occur in spontaneous state (at that time), but only cultivated in gardens, for its large flowers with a pleasant scent of orange. It seems, however, that *O. suaveolens* do not occur as a spontaneous plant in North America (Gates 1958, Rostański 1982, Rostański & Karlsson 2008), while in Europe it is frequent, especially in southern regions (Rostański & Forstner 1982). Hence, it should be either native in France (Gates 1958), or in southern Europe (Rostański & Forstner 1982) or of unknown origin (Rostański *et al.* 2010). However, since the entire subsect. *Oenothera*, which includes this taxon, is clearly of North American origin, as shown in the introduction, it is most likely that *O. suaveolens* has a hybridogenous origin in Europe from North American taxa introduced in historic time, having perhaps *O. argillicola* and *O. biennis* as parent species, as suggested by Gates (1958) and Dietrich *et al.* (1997).

As a wild plant, it was first reported from Hungary (1862) (Mihulka & Pyšek 2001), France (1912) (de Vries 1918) and Germany (1938) (Stubbe 1953). It is now quite widely naturalized in Europe (Jehlík & Rostański 1979, Rostański *et al.* 2010),

particularly in the southern regions (Rostański & Forstner 1982), including all countries neighbouring Romania: the Republic of Moldova (first record on the Prut river bank in Toceni, leg. C. Zahariadi, 1936, as *O. biennis*) (Rostański *et al.* 2004), Ukraine (very rare) (Rostański *et al.* 2004, 2010), Hungary (Király 2009) or Serbia (Rostański *et al.* 2010).

**Distribution in Romania.** We have identified it in several localities from eastern Romania, as follows: Galați county – near the Șendrenii Vechi village (N45°25'08.6", E27°53'08.5", 14 m a.s.l.; stable sands of the left bank of the Siret river, leg. Sîrbu & Oprea 09.09.2015, Sîrbu 02.08.2016), and near Bucești-Ivești (N45°37'45.02", E27°29'29.72", 18 m a.s.l.; stable sands of the left bank of the Siret river; leg. Sîrbu 01.08.2017); Iași county – near the Răchiteni village (between N47°04'20.54", E26°54'52.51", 188 m a.s.l., and N47°03'42.76", E26°55'41.66", 188 m a.s.l.; stable sands of the right bank of the Siret river; leg. Sîrbu 28.08.2016, 28.06.2017; N47°03'12.21", E26°55'33.02", 188 m a.s.l., leg. Sîrbu 26.08.2017, stable sands of the right bank of the Siret river; between N47°03'12.95", E26°55'44.32", 184 m a.s.l. and N47°03'06.67", E26°55'38.02", 188 m a.s.l., leg. Sîrbu 26.08.2017, stable sands of the right bank of the Siret river), and at Socola-Iași (N47°08'27.34", E27°36'36.56", 37 m a.s.l.; N47°08'24.78", E27°37'59.67", 36 m a.s.l.; ruderal places from the railway station and the surrounding areas; leg. Sîrbu 17.07.2016, 15.06.2017).

Surprisingly, this is not the first time when *O. suaveolens* was collected in Romania. In this respect we mention two specimens collected along the road Ungheni-Bosia (Iași county), on the Prut riverbank (the Herbarium of the Faculty of Biology from Iași, I-76706, I-76707, leg. C. Dobrescu, 15.07.1937, as *O. biennis* L.). However, since it has been identified under another name, *O. suaveolens* has remained unknown in the flora so far.

Given that in all mentioned localities, populations of *O. suaveolens* consist of a large number of individuals, both in anthropogenic and natural habitats, in places very distant from one another, we consider that it can be considered fully naturalized (even invasive) in Romania.

**Ecology.** According to Jehlík & Rostański (1979), *O. suaveolens* is a thermophilous species and grows well especially on sandy places, at forest edges or along communication routes, which is consistent with our field observations.

**Description of specimens identified on the field** (Fig. 2). Plants of 130-250 cm height. Stem simple or branched, green, slightly light brown towards the base, sometime slightly reddened above, pubescent with arcuate stiff hairs with green or translucent bulbous base and short appressed crisped hairs (sometimes, on the reddened splotches, with slightly reddened papillae). Cauline leaves short petiolate, usually ovate-lanceolate, flat, with straight apex, slightly denticulate along margins, green to grayish green, with white midrib, ± dense patent to sub-appressed pubescent, the lowermost up to 16 × 4 cm, the upper ones gradually smaller. The inflorescence simple or branched at the base, erect. Rhachis green to grayish-green, with long arcuate stiff hairs with green or translucent bulbous base and short appressed crisped hairs. Glandular hairs only on the uppermost part, in the late flowering phase. Bracts lanceolate, subsessile, V-shaped (concave), green to grayish-green, with pubescence as in the cauline leaves, the lowermost ones longer than fruits, the uppermost ones reaching or exceeding the top of the buds (before anthesis) or the top of the hypanthium (at anthesis). Flowers

chasmogamous, with orange flavour. Ovary of ca.  $9-12 \times 2-3$  mm (at anthesis), in the first flowering phase grayish-green (with numerous short appressed crisped hairs and long arcuate stiff hairs, without glandular hairs), in the late flowering phase green (with fewer appressed crisped hairs and arcuate stiff hairs, also with patent glandular hairs). Hypanthium  $28-35 \times 2-3$  mm, in the first flowering phase grayish green, without glandular hairs, densely pubescent with short crisped hairs mixed with longer  $\pm$  patent stiff hairs, in the late flowering phase green to yellowish, predominantly glandular hairy, with few  $\pm$  patent stiff hairs. Buds  $18-20 \times 4-6,5$  mm, green to yellowish,  $\pm$  cylindrical, tapered to the top, free sepal tips of 3-4 mm long, terminal, adherent at base in bud, above  $\pm$  parallel, in the first flowering phase grayish green (pubescence as at hypanthium), later yellowish-green also with glandular hairs. Petals yellow, obovate, of  $(22-25-35 \times (19-25-35(-40))$  mm, somewhat smaller in the late flowering phase (plants with petals much larger than long belong probably to the var. *latipetala* Soldano). Anthers of 8.5-10 mm long. Stygma lobes 3-5 mm long, spreading between anthers. Infructescence rather dense (ca. 0.7-1.2 fruits per cm of rhachis). Capsules  $\pm$  cylindrical, slightly tapered upwards,  $25-30 \times 5-6$  mm (usually longer than internodes of the rhachis), light brown,  $\pm$  greyish hairy, with numerous appressed crisped hairs and semi-patent stiff hairs (without red punctuation), glandular hairs only on the uppermost (youngest) capsules, with truncate teeth, ca. 1 mm length. Seeds prismatic, dull brown, of  $1.5-2 \times 1-1.2$  mm, with edges without wings.



Fig. 2. *Oenothera suaveolens*: a-inflorescence, b-stem, c-leaf, d-ovary, e-petals, f-capsule. Scale bar: a-6.5 mm; b, d, f-2 mm; c-8 mm; e-10 mm.



**Chromosomes:**  $2n=14$ , with  $\text{O}12+1_{\text{II}}$  in the meiotic metaphase I; the Renner complexes: *albicans* ♀ and *flavens* ♂(♀) (Linder 1957; Gates 1958). According to Dietrich *et al.* (1997), it is a heterogamous PTH strain, with the genome-plastome combination AB-II.

***Oenothera depressa*** E. Greene, Pittonia: 2, 216. 1891 (Syn.: *O. salicifolia* Desfontaines, Tabl. Ecole Bot., ed. 2: 271. 1815, *nomen nudum*, ex G. Don, Gen. Syst. 2: 685. 1832; *O. hungarica* (Borbás) Borbás, Magyar Bot. Lapok 2: 246. 1903; *O. bauri* Boedijn, Zeitschr. Abst. Vererb., 32: 360. 1924; *O. strigosa* (Rydberg) Mackenzie & Bush var. *depressa* (Greene) Gates, Tax. Genet. *Oenothera*, 34. 1958; *Onagra salicifolia* (Desfontaines ex G. Don) Spach, Hist. Veg. (Phan.), 4: 361. 1835; *On. depressa* (Greene) Small, Bull. Torr. Bot. Club, 23: 170. 1896; *On. hungarica* Borbás, Kert 1902: 204. 1902) [Treatment in Dietrich *et al.* (1997): *Oenothera villosa* Thunberg, subsp. *villosa* Dietrich & Raven, *Ann. Missouri Bot. Gard.*, 63: 382-383. 1976]

**Origin and general distribution.** It is native to the Great Plains region of North America (Dietrich *et al.* 1997), now established throughout much of North America and naturalized in South America, Asia, South Africa (Dietrich *et al.* 1997) as well as in Europe (Jehlík & Rostański 1979, Dietrich *et al.* 1997, Rostański *et al.* 2010).

It has occurred in Europe since the first half of the 19th century (Rostański & Ellis 1979, Rostański 1982), and now it is naturalized in large part of the continent, less in the southern and south-western regions (Rostański *et al.* 2010, Rostański & Verloove 2015). Among the countries neighboring Romania, it is reported from Hungary – as a wild plant since 1836 (Jehlík & Rostański 1979), Serbia – relatively frequent, first record as a spontaneous plant in 1967 (Zlatković *et al.* 1998) and Ukraine – frequent (Rostański *et al.* 2004).

**Distribution in Romania.** We found it on the sandy banks of the Siret river, from the Galați county at Șendrenii Vechi (N45°25'07.12", E27°53'05.26", 14 m a.s.l.; leg. Sîrbu 02.08.2016), Bucești-Ivești (N45°37'43.46", E27°29'29.66", 17 m a.s.l.; leg. Sîrbu 01.08.2017), and Movileni (N45°46'12.09", E27°21'14.93", 33 m a.s.l.; leg. Sîrbu 11.08.2017). In the mentioned localities we have identified hundreds of specimens of this species, both in vegetative (rosette) and flowering-fruiting phases. This is a proof that the species successfully reproduces itself, without human help, so we consider it as a naturalized (even invasive) alien species in eastern Romania. We also have found that a specimen of *O. depressa* had been previously collected in Romania from a ruderal place at the Miercurea Ciuc railway station (Harghita county). This specimen (leg. G. Negrean, 06.08.2001, as "*O. ? biennis* L.") is deposited in the Herbarium of the Botanical Garden of Bucharest (BUC - *Flora Romaniaae Herbarium G. Negrean* no. 1824).

**Ecology.** In America de Nord, where it is native, *O. depressa* grows in a variety of habitats, such as prairies, banks of rivers or lakes, open woodlands, old fields, and other disturbed sites (Dietrich *et al.* 1997). Similarly, in Europe it most often colonizes dried riverbeds, sandy riverbanks, dry grasslands, railways, railway stations and other ruderal fields, fallow grounds (Jehlík & Rostański 1979, Rostański 1982, Király 2009, Rostański *et al.* 2004, Rostański & Verloove 2015). In Ukraine, according to Rostański *et al.* (2004), it tolerates well saline conditions on sea dunes and shores.

**Description of specimens identified on the field** (Fig. 3). Stem of ca. 150 cm high, with arched-erect branches, reddish-peach tinted, dense pubescent with appressed

or semi-appressed stiff hairs with low red conical base and short appressed hairs. Cauline leaves  $9 \times 1.8$  cm, sub-sessile or short petiolate, ovate-lanceolate, sinuous wavy, with twisted apex, denticulate, grey green with midrib white or turned red at base later, dense appressed pubescent. Inflorescence simple, erect, with rhachis red-peach tinted, pubescence as on the stem but denser towards the top, without glandular hairs. Bracts sinuous wavy,  $\pm$  V-shaped, with twisted apex, the lowermost ovate-lanceolate, much longer than fruits, the upper ones narrow-lanceolate, sub-sessile or sessile, shorter than the open flowers. Flowers cleistogamous or/and chasmogamous. Ovary of  $10 \times 2$  mm (at anthesis), whitish or grayish, densely covered with short and long  $\pm$  straight appressed stiff hairs (strigose), the latter with or without red papillae, and without glandular hairs.



Fig. 3. *Oenothera depressa*: a-inflorescence, b-stem, c-leaf, d-flower and bracts, e-ovary, f-bud, g-petal, h-capsule. Scale bar: a-4.5 mm; b, g-2 mm; c-8 mm; d-4 mm; e-1.5 mm; f-2.5 mm.

Hypanthium up to 25-30 mm long, abundant appressed-hairy (also with some sub-appressed longer hairs), without glandular hairs, yellowish or slightly tinted red-peach. Buds  $\pm$  cylindrical, gradually tapered,  $16-18 \times 3-4$  mm, abundant white appressed hairy (as at hypanthium), without glandular hairs, usually red striped or diffuse stained red, with free sepal tips of ca. 3 mm long, terminal, adherent at base in bud, above  $\pm$  parallel. Petals yellow, obcordate, of  $14-20 \times 14-20$  mm. Anthers of 7 mm long. Stygma lobes spreading between anthers, ca. 5 mm long. Infructescence rather dense (ca. 0.6-0.7 fruits per cm of rhachis). Capsules  $\pm$  cylindrical, slightly tapered upwards, greyish appressed hairy, without glandular hairs, of  $25-32 \times 5-6$  mm (obvious

longer than internodes of the rhachis), red punctuated when young, with emarginated teeth of ca. 1 mm length or shorter. Seeds of  $1.5 \times 1$  mm, prismatic, with narrow winged edges or wingless, light brown.

**Note.** In the North American literature (Dietrich *et al.* 1997), the name *O. depressa* is treated as a synonym of *O. villosa* subsp. *villosa*, a North American taxon widely naturalized outside his native area (Europe, Asia, South America, and South Africa). According to the same references, this subspecies differs from *O. villosa* subsp. *strigosa* (which is indicated only from its native area, *i.e.* the Rocky Mountain region and Pacific Northwest), *inter alia*, by sepals green to yellowish green (in contrast, subsp. *strigosa* should have sepals usually yellow flushed with red, or red). However, according to European literature (Rostański 1982, Rostański *et al.* 2004, 2010, Király 2009 etc.), the plants designated as *O. depressa* have sepals red or red striped, just like our specimens.

**Chromosomes:**  $2n=14$ , with  $\Theta 14$  (Linder 1957, Dietrich *et al.* 1997) or  $\Theta 12+1_{II}$  (Dietrich *et al.* 1997) in the meiotic metaphase I; the Renner complexes: *laxans* ♀ and *undans* ♂ (Linder 1957, Gates 1958); it is a heterogamous PTH taxon with the genome-plastome combination: AA-I (Dietrich *et al.* 1997).

***Oenothera* × *fallax*** Renner, Zeitschr. Indukt. Abstammungs-Vererbungsl., 18: 176. 1917, *em.* Rostański, Fragm. Flor. Geobot. 11: 507. 1965 (= *O. glazioviana* × *O. biennis*) [Treatment in Dietrich *et al.* (1997): *O. biennis* × *O. glazioviana*]

This is a taxon native in Europe as a stable hybrid between two North-American species, *O. glazioviana* and *O. biennis* (Rostański 1982, Rostański & Forstner 1982, Rostański *et al.* 2010, Rostański & Verloove 2015). The oldest known specimen was collected in the United Kingdom (Rostański 1982, Mihulka & Pyšek 2001). This hybridogenous taxon has become well established (locally abundant) especially in places where the parent species are sympatric (but it occasionally may be found by itself), often in botanical gardens, ruderal places or sand-dunes (Jehlík & Rostański 1979, Rostański & Forstner 1982, Dietrich *et al.* 1997, Rostański *et al.* 2010), in large part of Europe, including countries neighbouring Romania, such as Ukraine (very rare), Hungary and Serbia (Rostański *et al.* 2004, 2010).

According to the available data, in Romania it is very rare. We have identified it, as a sub-spontaneous plant, on a grassland from the taxonomic sector of the Botanical Garden of Iași (leg. Oprea & Sîrbu 20.07.2016) (Fig. 4 a-c).

*O.* × *fallax* inherits the axis of inflorescence and ovary distinctly red-punctuated, sepals red-striped and capsule teeth somewhat emarginated, from *O. glazioviana*, and the cauline leaves ± plane (only the lower ones crinkled), flowers smaller and stigma lobes spreading between anthers, from *O. biennis* (Rostański 1982, Rostański *et al.* 2010, Rostański & Verloove 2015). From both parental species it inherits the abundance of glandular hairs in inflorescence (the entire rhachis, ovaries and all capsules).

**Chromosomes:**  $2n=14$ , with  $\Theta 12+1_{II}$  in the meiotic metaphase I (like *Oe. glazioviana*); the Renner complexes: *velans* ♀ (A genome from *O. glazioviana*) and *rubens* ♂ (B genome from *O. biennis*) (Dietrich *et al.* 1997).



Fig. 4. *Oenothera* × *fallax* (a-inflorescence, b-flower, c-capsule) and *Oenothera* × *wienii* (d- inflorescence, e- capsule). Scale bar: a-6 mm; b-6.5 mm, c-2.5 mm, d-5.5 mm; e-3 mm.

*Oenothera* × *wienii* Renner, Flora 131: 198 (1937), *nomen nudum*, ex Rostański, Fragm. Florist. Geobot. 23: 289. 1977 (= *O. rubricaulis* × *O. depressa*) [Treatment in Dietrich *et al.* (1997): *O. biennis* × *O. villosa* subsp. *villosa*]

This is another stable hybrid which arose in Europe having, as genitors, two North-American species, *O. rubricaulis* × *O. depressa* (Rostański *et al.* 2010). It was originally known from Dantzig / Gdańsk (in Northern Poland) (Gates 1958, Rostański & Forstner 1982), but nowadays it is spread from Central Europe (Rostański & Forstner 1982, Jehlík & Rostański 1995, Rostański *et al.* 2010) to the North (Scandinavia) (Rostański & Karlsson 2008, Rostański *et al.* 2010) and East (Ukraine) (Rostański *et al.* 2004, 2010). It grows mainly in the places of common occurrence of the parental species (Rostański *et al.* 2004).

In Romania we collected it in ruderal places associated with railways from the Sibiu train station (leg. Sîrbu & Oprea, 19.08.2011) (Fig. 4 d-e).

*O. × wienii* is more similar to *O. depressa* (according to Gates 1958, it looks rather as a variety of *O. depressa*), by grayish pubescence of leaves and stem, ovary whitish appressed hairy, capsule teeth emarginate (Gates 1958, Jehlík & Rostański 1995, Rostański & Karlsson 2008), but differs from this by some features from *O. rubricaulis*, such as: flat or only slightly wavy leaves, slightly higher conical red papillae, denser inflorescence, flowers always chasmogamous, shorter hypanthium, flower buds always green, glandular hypanthium, sepals and ovary (Jehlík & Rostański 1995, Rostański & Karlsson 2008).

**Chromosomes:**  $2n=14$ ; the Renner complexes: *tingens* ♀ (A genome) and *undans* ♂ (A genome) (Gates 1958, Dietrich *et al.* 1997, Rostański *et al.* 2004).

**b) Taxa confirmed in the flora by herbarium material**

*Oenothera rubricaulis* Klebahn, Jahrb. Hamburg. Wiss. Anst. 31, Beih. 3: 23. 1913 (Syn.: *O. muricata* L. Syst. Nat., ed. 12, 263. 1767. *nomen confusum*) [Treatment in Dietrich *et al.* (1997): phenotype of *O. biennis* L.]

**Origin and general distribution.** According to Rostański & Ellis (1979) and Rostański (1982), *O. rubricaulis* Klebahn is the same as *O. muricata* L. However, since the name *O. muricata* has most often been misapplied to other species (*e.g.* *O. ammophila* Focke, *O. parviflora* L. or *O. oakesiana* (A. Gray) Robbins ex Wats. & Coult.), it must be rejected as a *nomen confusum*. Like few other taxa from the subsection *Oenothera*, *O. rubricaulis* do not occur in the wild in North America (Rostański 1982, Dietrich *et al.* 1997). Consequently, it is considered native in Europe (Rostański 1982, Rostański & Forstner 1982, Rostański & Karlsson 2008, Rostański *et al.* 2010), originating perhaps via hybridization, from North-American taxa introduced in Europe long time ago (Dietrich *et al.* 1997, Rostański & Karlsson 2008). The species, originally described from culture, has been recorded in the wild in Europe since the middle of the 19th century, *e.g.* in 1841, Scandinavia (Rostański & Karlsson 2008), or in 1846, Austria (Rostański & Forstner 1982, Mihulka & Pyšek 2001). It is currently widespread in most of Europe, except for southern regions (Spain, Italy, and the Balkan Peninsula) (Rostański *et al.* 2010). Likewise, according to Jehlík & Rostański (1979) and Rostański (1982), it has been reported from Asia. In the neighbourhood of Romania, the species has been reported from Hungary (Rostański & Forstner 1982, Király 2009) and Ukraine (Rostański *et al.* 2004). In Eastern Europe, it is considered (alongside with *O. biennis* and *O. depressa*) the most frequent species of *Oenothera* with the highest invasion rate (Rostański *et al.* 2004, Tokhtar & Groshenko 2014, Rostański & Verloove 2015).

**Distribution in Romania.** Sîrbu & Oprea (2011) assumed the presence of this species in the flora of Romania (as *O. muricata* L., syn. *O. rubricaulis* Klebahn) based on the reporting of the name "*O. muricata* L." in the botanical literature (*e.g.* Schur 1866).

We however have found that the plant designated in the Flora R.P. România, vol. V, pp. 514-519 (Morariu, in Săvulescu 1957), under the name *O. muricata* L. (*Onagra muricata* Mch.), according to the description (*e.g.* the tip of the inflorescence nodding during flowering time; hypanthium of 4-5.5 cm long etc.), cannot be *O. rubricaulis* Klebahn, but rather *O. parviflora* L. or another species from the same series (*e.g.* *O. oakesiana* (A. Gray) Robbins ex Wats. & Coult.). In addition, in the herbaria from Romania studied by us no specimen previously collected by various authors could be without doubts assigned to this species.

Nevertheless, we can confirm now the presence of *O. rubricaulis* in Romania. It grows on stable fluvial sands on the right bank of the Siret river, near the Răchiteni village, Iași county (N47°04'07.44", E26°54'49.54", 188 m a.s.l.; leg. Sîrbu 28.08.2016).

**Ecology.** Like other related species, *O. rubricaulis* prefers disturbed habitats on sandy soils, such as banks of rivers or lakes, forests edges, railway stations, roads, ruderal places etc. (Jehlík & Rostański 1979, Rostański 1982, Rostański *et al.* 2004). According to Tokhtar & Groshenko (2014) this species shows a higher ecological plasticity compared to its relatives.

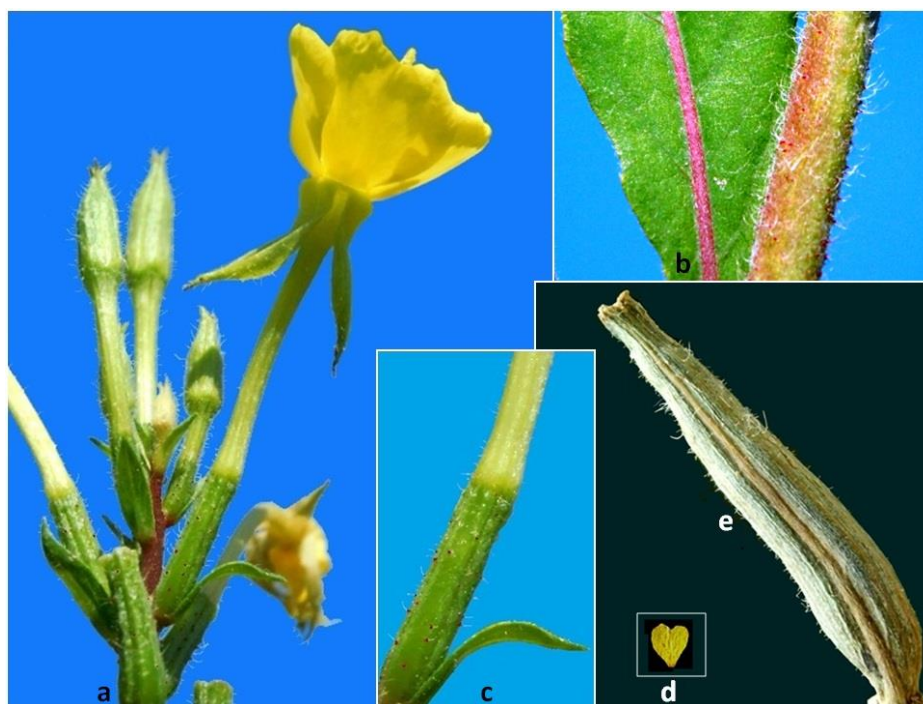


Fig. 5. *Oenothera rubricaulis*: a-inflorescence, b-stem and leaf, c-ovary, d-petal, e-capsule.  
Scale bar: a, b-3 mm; c-1.3 mm, d-10 mm; e-1.5 mm.

**Description of specimens identified on the field** (Fig. 5). Plants of 80 cm height. Stem simple, reddened in the middle third, pubescent with arcuate stiff hairs with coniform red base and short appressed crisped hairs. Cauline leaves up to  $8.5 \times 1.7$  cm, short petiolate, elliptic-lanceolate,  $\pm$  flat, slightly denticulate,  $\pm$  patent pubescent, green with red midrib. Bracts similar to cauline leaves but gradually decreasing in size, the lowermost longer than fruits, the uppermost ones glandular, ca. by the length of the ovary (at anthesis). Inflorescence erect, branched at the base. The rhachis reddish towards the base and to the tip, with pubescence similar to the stem but in addition with numerous glandular hairs. Flowers chasmogamous. Ovary (at anthesis) of ca.  $9 \times 1$  mm, green, with glandular hairs mixed with  $\pm$  patent stiff hairs with red papillae, and few short appressed crisped hairs. Hypanthium  $24 \times 1-1.5$  mm, yellowish, sparse glandular hairy, also with few  $\pm$  patent stiff hairs (occasionally with red papillae). Buds  $10 \times 3$  mm, green,  $\pm$  cylindrical, abruptly narrowed to the top, sparse patent hairy with glandular hairs, and  $\pm$  patent stiff hairs, occasionally with red papillae; free sepal tips of 2 mm long, terminal, adherent at base in bud, above  $\pm$  divergent. Petals yellow, obcordate, of  $9-12 \times 8-12$  mm. Anthers of 4-5 mm long. Stygma lobes 3-4 mm long, spreading between anthers. Infructescence dense (ca. 1-1.4 fruits per cm of rhachis). Capsules  $\pm$  cylindrical, tapered upwards, of ca.  $25 \times 5-6$  mm (longer than internodes of the rhachis), greenish-brown, with glandular and stiff hairs (with red papillae when young), also with few short crisped hairs, with truncate teeth, of ca. 1 mm length.

**Chromosomes:**  $2n=14$ , with  $\text{O}14$  (Linder 1957) or  $\text{O}6+\text{O}8$  (Gates 1958) in the meiotic metaphase I; the Renner complexes: *tingens* ♀ and *rubens* ♂ (Linder 1957, Gates 1958); it is heterogamous, with the genome-plastome combination: AB-II (Dietrich *et al.* 1997).

***Oenothera parviflora* L.**, *Syst. nat.*, ed. 10. 998. 1759 (Syn.: *O. muricata* auct. non L.; *O. biennis* L. var. *parviflora* (L.) Torrey & A. Gray, *Fl. N. Amer.*, 1: 492. 1840) [Treatment in Dietrich *et al.* (1997): *O. parviflora* L.]

**Origin and general distribution.** It is native to North America, nowadays naturalized in Europe, China, Japan, S Africa, and New Zealand (Dietrich *et al.* 1997, Jiarui *et al.* 2007, Rostański *et al.* 2010). It has been recorded in Europe (in the wild) since 1871 (Austria) (Rostański & Forstner 1982, Mihulka & Pyšek 2001) or even 1612, according to some assumptions (Gates 1958), however yet not very common. According to Rostański *et al.* (2010), it is rather rare (casual) in Eastern and Central Europe, Great Britain and Scandinavia (Jehlík & Rostański 1979, Rostański 1982, Rostański *et al.* 2010). Near Romania, it is known only from Ukraine (very rare – only 3 localities yet known) (Rostański *et al.* 2004).

**Distribution in Romania.** It seems that various botanical works indicated the occurrence of this species in Romania since the second half of the 19th century. Kanitz (1879-1881) and Brândză (1898) reported “*Oenothera biennis* L. var. *parviflora* Koch non L.”, from Dobrogea. Prodan (1939a, b) and Borza (1947) took over this nomenclatural combination as a synonym for *O. muricata* Murray (non L.), with two varieties, *i.e.* *muricata* and *parviflora* (L.) Levi. Indeed, the plant described by Murray (1776), under the name of “*O. muricata* L.”, has rather distinguishing features of *O. parviflora* L., *e.g.*: the tip of stem / inflorescence nodding (“*caulis erectus, apice incurvus*”), sepal tips on flower buds divergent (“*calyx*” ... “*denticulis subulatis longioribus divergentibus*”), etc. (the same also applies in the case of the description given by Vail (1907) for “*O. muricata* L.”, or by Moench (1794) for “*Onagra muricata*”). In the *Flora of P.R. România*, 5, pp. 516-519, Morariu, in Săvulescu (1957) replaced the name “*O. muricata* Murray”, previously reported by Prodan and Borza, with that of “*O. muricata* L.”. However, the plant described there could be interpreted (as shown above) either as *O. parviflora* L. or as another species from the same series, but not as “*O. muricata* L.” – in its actual meaning. In the botanical works of the last decades, the species is reported in Romania as *O. parviflora* L., with synonyms either *O. muricata* L. (Beldie 1977, Ciocârlan 1994), or *O. muricata* auct. non L. (Ciocârlan 2000, 2009, Sîrbu & Oprea 2011, Sîrbu *et al.* 2013). Some authors (Jehlík & Rostański 1979, Rostański *et al.* 2010), taking perhaps into consideration the rarity of the species *O. parviflora* in Europe, compared to the more common *O. oakesiana*, indicate only the latter species from Romania. However, without reliable herbarium specimens, we cannot assert whether previous data could be assigned certainty to one of these two species.

As a result of our field research, we can confirm now the presence of *O. parviflora* in the flora of Romania, based on herbarium specimens collected on a ruderal place from Mediaş, Sibiu county (leg. Oprea 13.08.2016).



Fig. 6. *Oenothera parviflora*: a-inflorescence, b-stem, c-leaf, d-bud, e-petal, f-capsule.  
Scale bar: a-2.5 mm, b-1.5 mm; c-7.5 mm, d-2 mm; e-10 mm, f-2.3 mm.

**Ecology.** In the natural area from North America, *O. parviflora* occurs usually in open or disturbed, sandy or gravelly sites (*e.g.* roadsides, fallows, clearings, river banks, etc.) (Dietrich *et al.* 1997). In Europe it usually grows on open sandy habitats near settlements (Rostański *et al.* 2004).

**Description of specimens identified on the field** (Fig. 6). Plants of ca. 130 cm height. Stem branched, green, reddened in part, with arcuate stiff hairs with green or translucent, sometime pinkish coniform base and short appressed crisped hairs. Cauline leaves up to  $10 \times 2$  cm, short petiolate, narrow elliptic-lanceolate, short denticulate, flat with straight apex, spars (sub-)appressed pubescent, green, midrib white or reddened toward the base. Bracts sessile or short petiolate, narrow lanceolate, flat, green or grayish green, the lowermost longer than fruits, the uppermost  $\pm$  glandular-pubescent on the underside, as long as the ovary or shorter (at anthesis). The tip of the inflorescence rather erect (advanced stage of flowering). The rachis reddish towards the base, green above with glandular hairs (more abundant to the top) and stiff hairs semi-appressed or erecto-patent, with conical green (or pink) papillae. Flowers chasmogamous. Ovary of ca.  $10-12 \times 1$  mm (at anthesis), green, with glandular hairs mixed with  $\pm$  semi-appressed stiff hairs with translucent papillae, and few short appressed crisped hairs. Hypanthium yellowish green, of  $33-40 \times 1$  mm, with sparse patent glandular and stiff hairs. Buds  $10 \times 3$  mm, green,  $\pm$  cylindrical, abruptly narrowed to the top, sparse pubescent (as in hypanthium), with free sepal tips of 1-2 mm



long, clearly subterminal, separated at base in U-shape). Petals yellow, obcordate, of 10-12 × 9-10 mm. Anthers of ca. 4-5 mm long. Stygma lobes 3-4 mm long, spreading between anthers. Infructescence rather dense (ca. 0.7-1 fruits per cm of rhachis). Capsules ± cylindrical, slightly tapered upwards, of ca. 28-37 × 4-6 mm (usually longer than internodes of the rhachis), greenish-brown, with numerous ± appressed stiff hairs (without red papillae), few short crisped hairs, the younger ones also with glandular hairs; teeth truncate to slightly emarginate, of ca. 1-1/5 mm length. Seeds prismatic, brown, of 1.5-1.8 × 0.8-1 mm, edges narrow winged or without wings.

**Chromosomes:** 2n=14, with ♂14 (Dietrich *et al.* 1997) in the meiotic metaphase I; the Renner complexes: *augens* ♀ and *subcurvans* ♂ (Linder 1959); it is heterogamous, with the genome-plastome combination: BC-IV (Dietrich *et al.* 1997).

### c) Identification key.

We give below an identification key for the species referred in this paper, including *O. oakesiana*. Some important diagnostic characteristics, *e.g.* the red pigmentation, the colour of sepals, the size and shape of petals, the shape of the sinus between sepal tips in bud etc., become less obvious in herbarium and should preferably be assessed on fresh material.

- 1a.** Inflorescence erect (*e.g.* Fig. 1a, 2a). Free sepal tips apical, adherent at base in bud, above parallel or divergent (*e.g.* Fig. 3f) ..... **2**
- 1b.** Inflorescence nodding at anthesis (sometimes becoming erect, with time). Free sepal tips subapical, obviously separated from each-other, with space between sepal apices U or V shaped (Fig. 6a,d) (**ser. *Rugglesia*** Rostański) ..... **9**
- 2a.** Ovary and young capsules whitish or grayish, densely covered with short crisped and long ± straight appressed stiff hairs (strigose) (Fig. 3a,e; Fig. 9d), usually without glandular hairs. Papillae of the stiff hairs on stem and rhachis low-conical (Fig. 3b, 9d). Leaves with dense, ± appressed hairs, velvety to the touch, usually grayish-green. Capsule teeth emarginate (Fig. 3h) (**ser. *Devriesia*** Rostański) ..... **3**
- 2b.** Ovary and young capsules with short crisped and long arcuate erecto-patent stiff hairs. Glandular hairs on ovaries and young capsules either dominant (ovary and young capsules green, *e.g.* Fig. 7c,e) or few to absent (ovary and young capsules grayish-green, due to the abundance of crisped and stiff hairs, *e.g.* Fig. 2d,f). Papillae of the stiff hairs on stem and rhachis high-conical (Fig. 9b,r,p) to almost cylindrical (Fig. 9p). Leaves ± patent hairy, usually green. Capsule teeth truncate or obtuse (*e.g.* Fig. 1f; Fig. 2f), rarely slightly emarginate (**ser. *Oenothera***) ..... **4**
- 3a.** Cauline leaves and bracts with wavy margins and curved tips. Red papillae very low. Infructescence loose. Flowers often cleistogamous (Fig. 3a). Buds reddish (peach) or red striped. Hypanthium of 25-35 mm long. Plant usually without glandular hairs (Fig. 3) ..... ***O. depressa***
- 3b.** Cauline leaves and bracts flat or slightly wavy. Red papillae higher. Infructescence rather dense. Flowers always chasmogamous. Buds always green. Hypanthium of 15-25 mm long. Glandular hairs present at late flowers on hypanthium, buds ovary and capsules (Fig. 4d,e) ..... ***O. × wienii***



Fig. 7. *Oenothera biennis*: a-inflorescence, b-leaf, c-ovary and rhachis, d-petal, e-capsule.  
Scale bar: a-6.5 mm; b-8 mm; c-1.2 mm; d-7 mm; e-1.3 mm.

- 4a.** The bulbous base of stiff hairs green or translucent (stem, inflorescence axis and ovary without red papillae) (e.g. Fig. 2a,b; Fig. 7c; Fig. 9b,s). Inflorescence axis green in the upper part. Sepals in buds green ..... **5**
- 4b.** The bulbous base of stiff hairs red (stem, inflorescence axis and ovary with red papillae) (e.g. Fig. 1b,c; Fig. 5c; Fig. 8b; Fig. 9p,r). Sepals in buds green or red striped ..... **6**
- 5a.** Inflorescence axis (from the bottom to the top), ovary and all capsules, always with numerous glandular hairs and fewer stiff and crisped hairs (inflorescence and young capsules predominantly green). Flowers weak fragrant. Cauline leaves elliptic to elliptic-lanceolate, with red midrib (rarely white, at shade-grown plants). Bracts usually do not exceed 1/3-1/2 of the hypanthium length (at anthesis). Petals always wider than long, 15-30 × 18-35 mm (Fig. 7) ..... *O. biennis*
- 5b.** Inflorescence axis, ovary, hypanthium and capsules with numerous crisped and stiff hairs, without glandular hairs in the first half of the flowering phase (the inflorescence and young capsules are predominantly grayish-green). Glandular hairs present only in the late flowering phase, toward the tip of the inflorescence, even then usually fewer than the stiff and crisped hairs. Flowers with a distinctive orange scent. Cauline leaves lanceolate or oblanceolate, always with white midrib. Bracts often reach or exceed the hypanthium length (at anthesis). Petals (22-)25-35 × (19-)25-35(-40) mm, as long as wide or slightly longer, or (var. *latipetala*) larger than long (Fig. 2) ..... *O. suaveolens*



Fig. 8. *Oenothera glazioviana*: a-inflorescence, b-ovaries and rhachis, c-petal, d- capsule.  
Scale bar: a-8 mm; b-2 mm; c-7 mm; d-1.1 mm.

- 6a.** Stigma lobes considerably exceeding anthers. Sepals red-striped. Petals of 30-50 × 30-58 mm (Fig. 8) ..... *O. glazioviana*
- 6b.** Stigma lobes spreading between anthers. Sepals red-striped or green. Petals much smaller ..... **7**
- 7a.** Sepals red-striped. Petals wider than long, usually more than 20 mm. Capsule teeth truncate to slightly emarginated (Fig. 4a-c) ..... *O. × fallax*
- 7b.** Sepals always green. Petals as long as wide or slightly longer, less than 20 mm. Capsule teeth truncate to obtuse ..... **8**
- 8a.** Bracts flat. Rhachis red at tip, entirely glandular. Hypanthium of 15-25 mm long. All ovaries and capsules predominant glandular (Fig. 5) ..... *O. rubricaulis*
- 8b.** Bracts wavy. Rhachis green at tip, first eglandular later glandular on the upper part only. Hypanthium of 30-46 mm long. Ovaries and capsules with numerous appressed crisped hairs, and (semi-)patent stiff hairs with prominent red papillae (as in the previous species, red coloration disappears at the ripe fruits); only the late ovaries and capsules with glandular hairs (Fig. 1) ..... *O. pycnocarpa*

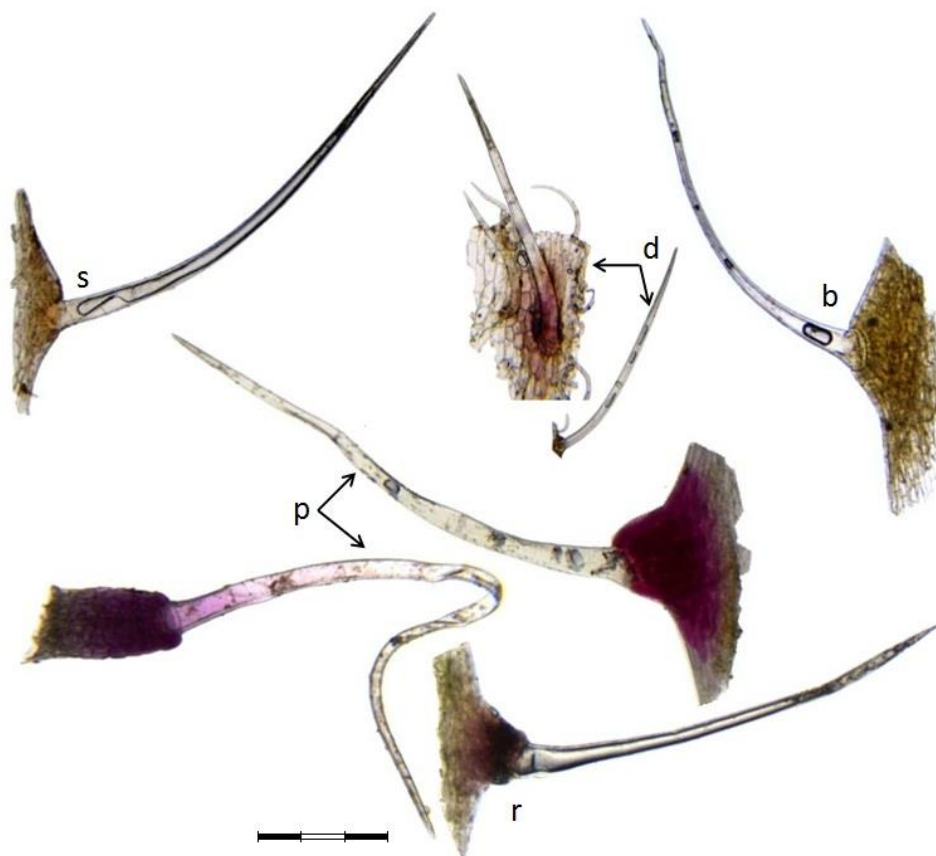


Fig. 9. Stiff hairs in *Oenothera* subsect. *Oenothera*: b-*O. biennis*, d-*O. depressa*, p-*O. pycnocarpa*, r-*O. rubricaulis*, s-*O. suaveolens*.  
Scale bar: 0.2 mm.

- 9a.** Stem predominantly erecto-patent hairy. Leaves light green. Space between sepal apices U-shaped. Petals of 6-12 mm long. Capsules dark green when dry. Capsule teeth truncate to slightly emarginate (Fig. 6) ..... *O. parviflora*
- 9b.** Stem predominantly appressed hairy. Leaves grayish-green or dark green. Space between sepal apices V-shaped. Petals of 12-16 mm long. Capsules usually rusty brown when dry. Capsule teeth obtuse to truncate ..... *O. oakesiana*.

### Conclusions

In this paper, we report for the first time in Romania 5 taxa of *Oenothera*, sect. *Oenothera*, subsect. *Oenothera* (3 species and 2 hybrids), namely: *O. pycnocarpa*, *O. suaveolens*, *O. depressa*, *O. × fallax* and *O. × wienii*. We also confirm in the flora two other species (*O. rubricaulis* and *O. parviflora*), by herbarium material. Finally, we give an identification key for the species discussed in the paper (including *O. oakesiana*).

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