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New records in the alien flora of Romania (*Artemisia argyi*, *A. lavandulaefolia*) and Europe (*A. lancea*)

Culiță SÎRBU[1], Adrian OPREA[2,*]

[1]University of Agricultural Sciences and Veterinary Medicine Iaşi, Faculty of Agriculture, 3, Mihail Sadoveanu Street, Iaşi - ROMANIA

[2]National Institute of Research and Development for Biological Sciences, Branch Institute of Biological Research, Iaşi, 47, Lascar Catargi Streeti - ROMANIA

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Abstract: *Artemisia lancea* Vaniot, *A. argyi* H.Lév. & Vaniot, and *A. lavandulaefolia* DC., all native from eastern Asia, are reported as new alien taxa from Romania. *A. lancea* has not been recorded so far in Europe, while *A. argyi* and *A. lavandulaefolia* are naturalised in the European part of the former USSR. All 3 species were collected in the Socola railway yard in northeastern Romania; the specimens were deposited in the IASI Herbarium, at the University of Agricultural Sciences and Veterinary Medicine Iaşi. Their introduction was accidental, through the rail transport from the former USSR. The 3 species are perennial herbs, with white, glandular punctate leaves. All of them spread clonally, by stoloniferous rhizomes; *A. argyi* and *A. lavandulaefolia* produce fertile seeds, but only barren seeds were found in *A. lancea*, perhaps due to fertilisation failure. They grow on disturbed ground associated with railways, together with other ruderal species, most of them characteristic to the class *Artemisietea vulgaris*. The description and distribution of the species, as well as some data related to their taxonomy, biology (including seed germination and chromosome numbers), ecology (habitats, plant communities), and general uses, are given in this paper. An identification key for these species and other 2 related taxa is provided.

Key words: Alien plants, *Artemisia*, chromosome numbers, identification key, Romania

Introduction

Many alien species native from eastern Asia have naturalised in eastern Europe, e.g. in the Caucasus, the Black Sea region (Terzioğlu & Karaer, 2009), Ukraine (Mosyakin, 1990; Mosyakin & Yavorska, 2002), European Russia (Tzvelev, 2002), and Romania (Ciocârlan, 2009). Among these alien species, some belong to the genus *Artemisia* L. (wormwood), which is one of the largest genera in the tribe *Anthemideae* Cass., family Asteraceae Dumort., widespread in temperate and subtropical regions of the northern hemisphere and less common in the southern hemisphere (Ling, 1994; Ling & Peng, 1998; Ling et al., 2006).

Many species of *Artemisia* have a high medicinal value, due to their content of monoterpenes, sesquiterpenes, flavonoids, and other compounds with medical use (Lao et al., 1984; Ling, 1992;

* E-mail: a_aoprea@yahoo.co.uk

Mucciarelli & Maffei, 2002). Some species are used for food (aromatic), for feeding livestock, or sand stabilisation in desert or semidesert areas (Ling et al., 2006; Hayat et al., 2009a).

Traditionally, the genus *Artemisia* was divided into several sections with heterogamous capitula (*Dracunculus* Besser, *Absinthium* (Tourn.) DC., *Abrotanum* (Tourn.) Besser, *Artemisia* Tourn.) and a section with homogamous capitula (*Seriphidium* Besser) (Besser, 1834; De Candolle, 1837; Poljakov, 1961; Nyárády, 1964). In recent classifications (Ling, 1982, 1994; Bremer & Humphries, 1993; Ling et al., 2006), *Seriphidium* is separated as a distinct genus, *Seriphidium* (Besser) Poljakov. However, this interpretation is not supported by some research of phylogeny, based on molecular analysis (Vallès & McArthur, 2001; Watson et al., 2002; Torrell et al., 2003; Vallès et al., 2003) or on the analysis of foliar trichomes and pollen grains (Hayat et al., 2009b, 2009c). Consequently, classification of *Artemisia* and relationships among its different taxa are still controversial, and many authors treat this genus in a broad sense traditionally (Nyárády, 1964; Tutin et al., 1976; Ciocârlan, 2009). The greatest concentration of the wormwood species seems to be in Asia, with 187 taxa in China (Ling et al., 2006) and 116 in the former USSR (Poljakov, 1961), except sect. *Seriphidium*. In Europe, Tutin et al. (1976) mentioned 57 species of *Artemisia*, of which 12 belong to sect. *Seriphidium*. According to DAISIE (2009), 28 alien species of *Artemisia* have been reported in Europe so far. Of these, 10 species are from outside of Europe, and 18 species are native in certain regions of the continent but became alien outside of their native range.

In Romania, 16 species of *Artemisia* were previously known, of which 13 species are indigenous, native to the Eurasian area, and 3 are alien (*A. dracunculus* L., *A. abrotanum* L., and *A. annua* L.) (Nyárády, 1964; Ciocârlan, 2009). In recent years, we identified 3 other alien species of *Artemisia*, 2 of them new for the flora of Romania and 1 new for the flora of Europe, which are reported in this paper.

Materials and methods

The species were recorded during our recent field work on alien plants (2008-2009), in the historical province of Moldavia (Romania). The geographic coordinates were recorded using the eTrex Legend HCx GPS system. Voucher specimens were deposited in the herbarium of the University of Agricultural Sciences and Veterinary Medicine Iaşi (IASI). The 3 species of *Artemisia* were identified using *Flora of China* (Ling et al., 2006), but they were also checked in other references (Pampanini, 1929; Poljakov, 1961; Ohwi, 1965; Mosyakin, 1990; Ling & Peng, 1998; Leonova, 2002) and compared to their original diagnoses (Besser, 1834; De Candolle, 1837; Vaniot, 1903; Léveillé, 1910; Diels, 1912; Kitamura, 1933). The taxonomy and nomenclature of the genus *Artemisia* follow those of Ling et al. (2006). Biological and ecological features of the species were noted in the field and phytosociological relevés were made according to the standard central European phytosociological method (Braun-Blanquet, 1964). Seed germination was tested in the laboratory at room temperature in petri dishes on wet filter paper, in light conditions. Germination was scored in terms of number of seeds with emerged radicles and expanded cotyledons. To evidence the mitotic chromosomes, seedling roots (*A. argyi* and *A. lavandulaefolia*) and adventitious roots (*A. lancea*) were processed. The root tips were pretreated with 0.004 M 8-hydroxyquinoline for 4 h in the dark, at room temperature. After its removal, the biological material was maintained for 24 h in an absolute ethanol and glacial acetic acid mixture (3:1). In order to obtain microscopic preparations, the roots were hydrolysed in 50% hydrochloric acid and stained with a modified carbol-fuchsin solution. Squash preparations were made in 45% acetic acid, and somatic metaphases with well-spread chromosomes were analysed using an Optica B-350 microscope.

Results and discussion

Artemisia lancea Vaniot, *A. argyi* H.Lév.& Vaniot, and *A. lavandulaefolia* DC., unknown in the flora of Romania, until now, were identified at the Socola railway yard, in the surroundings of the city of Iaşi (northeastern Romania)(Figure 1). The following descriptions of the 3 species were based on the specimens collected from the locality mentioned above.

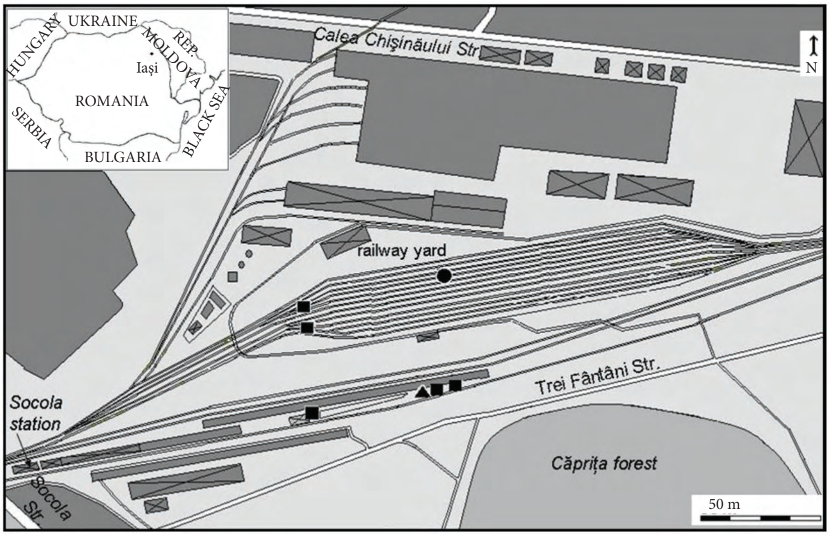

Figure 1. Distribution of *A. lancea* (●), *A. argyi* (▲), and *A. lavandulaefolia* (■) in northeastern Romania (Socola-Iași railway yard).

Artemisia lancea Vaniot, Bull. Acad. Int. Géogr. Bot. 12: 500. 1903. Syn.: *A. feddei* H.Lév. & Vaniot; *A. lavandulaefolia* DC. var. *lancea* (Vaniot) Pamp., *A. lavandulaefolia* DC. var. *feddei* (H.Lév. & Vaniot) Pamp. (Figures 2 and 3).

Perennial herbs, 150-180 cm tall, with woody, thick rhizomes. Stems are striate, initially pubescent, later glabrescent or glabrous, purple-tinted, here and there white glandular punctate. Leaves of young shoots and lowermost leaves of stems (dried at

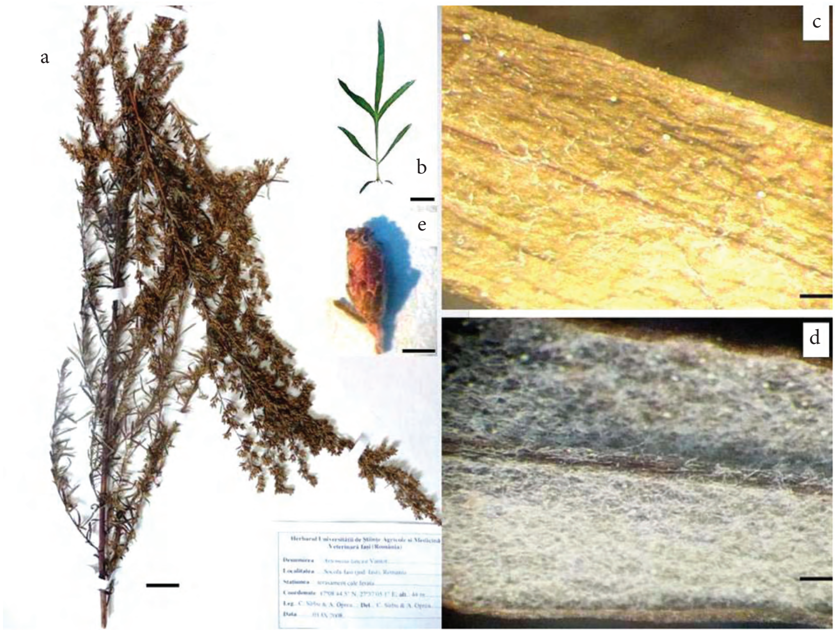

Figure 2. *Artemisia lancea*: a) herbarium specimen, b) middle cauline leaf, c) adaxial surface of leaf, d) abaxial surface of leaf, e) capitulum. Scale bar: a = 2 cm, b =1 cm, c and d = 0.25 mm, e = 1 mm.

Figure 3. *Artemisia lancea* Vaniot: habitus (photo by A. Oprea).

flowering time) long petiolated (3-5 cm); leaf blades ovate (4-6 × 3-4 cm), 2-pinnatisect, with 2-4 pairs of lobes, arachnoid-pubescent, obscure glandular punctate adaxially, and dense incanous tomentose abaxially; lobules lanceolate, or linear lanceolate, entire or 1-2 dentate, ± acuminate and mucronulate. Middle and upper cauline leaves crowded, shortly petiolate, white glandular punctate and glabrescent adaxially, densely incanous arachnoid-pubescent abaxially, entire, linear, 10-40 × (1-)2(-3) mm, or 1-pinnatisect, ovate, 25-50 × 20-40 mm, with 1-2 pairs of linear segments; margin of lobes revolute, apex obtusiuscule-acute, mucronulate. Pseudostipules 1-2 pairs, linear, or absent. Leafy bracts are entire and linear. Inflorescence paniculate, 40-50 × 10-15 cm, wider at the middle; primary branches oblique-erect, ± tomentose, the bottom up to 20 cm long, the secondary ones (racemules) 0.5-2(-4) cm long, with 2-10(-15) capitula (even short tertiary branches, sometimes). Capitula numerous, oblique-erect, ellipsoid-ovoid, 3 × 1-1.5 mm, subsessile or short pedunculate (0.5-1 mm); involucral bracts green, later purple-tinted, somehow lustrous, 4-5 seriated, the outer ones smaller (approximately 1/4-1/2 the length of the capitulum), ovate, sparsely pubescent, later glabrescent, the inner ones longer, elliptic-lanceolate, ± glabrous; receptacle glabrous. Florets approximately 2.5 mm long, with translucent, sessile glandules; peripheral florets pistillate, 4-6, with narrow tubular corolla, 2-toothed; disc florets 5-8, bisexual, with tubular corolla, 5-toothed, discreet purple; anthers whitish; style approximately as long as corolla, with divergent branches.

Artemisia argyi H.Lév. & Vaniot, Feddes Repert. Spec. Nov. Regni Veg. 8: 138. 1910. Syn.: *A. handel-mazzetii* Pamp.; *A. princeps* Pamp. var. *candicans* Pamp.; *A. vulgaris* L. var. *incana* Maxim.; *A. vulgaris* L. var. *incanescens* Franch. (Figures 4 and 5).

Perennial herbs, strongly aromatic, 80-100 cm tall, with stoloniferous rhizomes. Stems striate, incanous arachnoid-pubescent or tomentose. Lowermost leaves dried at flowering time. Middle cauline leaves long petiolated (2-4 cm), leaf blade broad (triangle-) ovate, 5-8 × 4-7 cm, 1 (or 2)-pinnatipartite, arachnoid pubescent, white glandular punctate adaxially, densely incanous arachnoid-tomentose abaxially; segments 2 or 3 pairs, broad ovate, pinnatipartite or serrate, attenuate basally, 2-3(-4) cm wide, with serrate lobules, apically obtuse, mucronulate; pseudostipules 1-2 pairs, linear. Upper cauline leaves similar to the median ones, but smaller, with shorter petioles (0.2-1 cm) and less divided. Leafy bracts elliptic-lanceolate, entire. Inflorescence is paniculate, of 30-40 × 10-15 cm; primary branches oblique-ascendant, tomentose, ± nutant apically, the bottom up to 20 cm long; secondary branches (racemules) nutant, 0.5-2 cm long, with 2-10(-15) capitula. Capitula ovoid-campanulate or ellipsoid, 3 × 2.5 mm, ± nutant, subsessile; involucral bracts ovate, ovate-lanceolate, incanous arachnoid-tomentose, 3-4 seriated; receptacle glabrous. Florets approximately 2.5 mm long, with translucent and sessile glandules; peripheral florets pistillate, 6-10, with narrow tubular corolla, 2-toothed; disc florets 8-12, bisexual, with tubular, 5-toothed, and discreet purple corolla; anthers whitish; style approximately as long as corolla, with divergent branches. Achenes ovoid-oblong.

Artemisia lavandulaefolia DC., Prodr. (DC.) 6: 110. 1837. Syn.: *A. araneosa* Kitam.; *A. codonocephala* Diels; *A. clemensiana* Pamp.; *A. grisea* Pamp.; *A. tristis* Pamp.; *A. lavandulaefolia* DC. var. *maximowiczii* Pamp.; *A. leucophylla* Kitag.; *A. selengensis* Turcz. ex Besser var. *umbrosa* Ledeb.; *A. umbrosa* (Besser) Turcz. ex DC.; *A. vulgaris* L. var. *umbrosa* Turcz. ex Besser; *A. vulgaris* L. var. *maximowiczii* Nakai (Figures 6 and 7).

Perennial herbs, strongly aromatic, with stoloniferous rhizomes. Stems striate, incanous arachnoid-pubescent or tomentose, 80-100 cm tall.

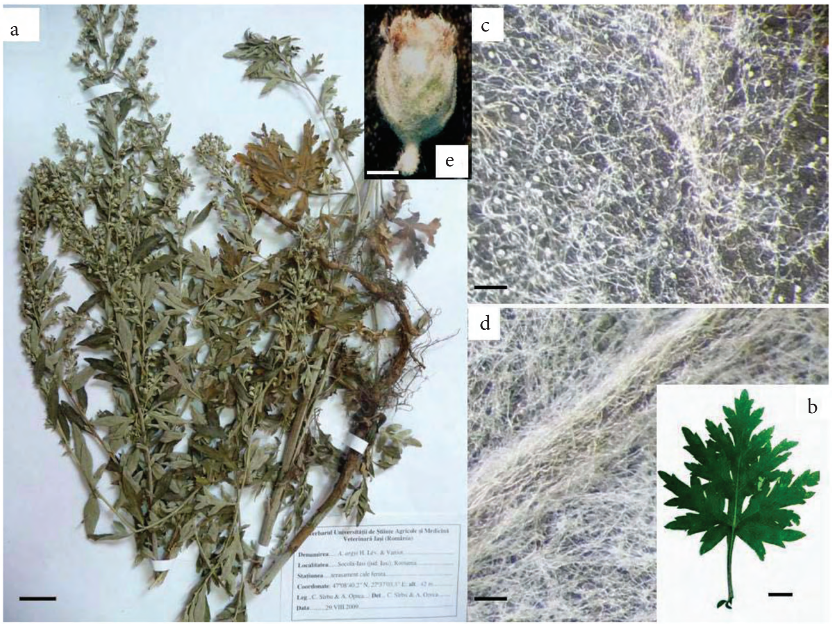

Figure 4. *Artemisia argyi*: a) herbarium specimen, b) middle cauline leaf, c) adaxial surface of leaf, d) abaxial surface of leaf, e) capitulum. Scale bar: a = 2 cm, b = 1 cm, c and d = 0.25 mm, e = 1 mm.

Figure 5. Ruderal phytocoenosis with *Artemisia argyi* (photo by A. Oprea).

Lowermost leaves dried at flowering time. Middle cauline leaves long petiolated (1-3 cm); leaf blade broad ovate or suborbicular, 8-12 × 7-10 cm, 1 (-2)-pinnatisect, pale green, arachnoid pubescent (later glabrescent), white glandular punctate adaxially, densely tomentose abaxially; lobes 2(-3) pairs, basally attenuate, entire, lanceolate, 3-7 × 0.5-1 cm, or ± pinnatisect, ovate-lanceolate, 3-7 × 1-2.5 cm, with lobules linear-lanceolate, entire; all segments have weak revolute margins and acute, mucronulate apices. Pseudostipules 1-2 pairs, linear-lanceolate. Upper cauline leaves with shorter petioles, entire or 1-pinnatisect, with 1-2 pairs of (linear-) lanceolate lobes. Leafy bracts usually entire, linear-lanceolate. Inflorescences racemose, of 30(-40) × 10(-15) cm; branches oblique-ascendant, tomentose, ± nutant apically, the bottom ones up to 10-12 cm long; sometimes there are also short racemules (0.5 cm) with 2-5 capitula. Capitula ovoid-campanulate or ellipsoid, 3(-4) × 2-2.5 mm, ± nutant, subsessile, solitary or 2-5 in dense racemules; involucral bracts ovate, ovate-lanceolate, incanous arachnoid-tomentose, 3-4 seriated; receptacle glabrous. Florets approximately 2.5 mm long, with translucent and sessile glandules; peripheral florets pistillate, 8-10, with narrow tubular corolla, 2-toothed; central florets bisexual, 10-20, with tubular corolla, 5-toothed, purple-tinted; anthers whitish; style approximately as long as corolla, with divergent branches. Achenes oblong or obovoid.

Taxonomical notes and identification key

These 3 species belong to the section *Artemisia* Tourn. (Ling et al., 2006), and they are closely related to *A. verlotorum* Lamotte, another East Asian species widely naturalised in Europe (Tutin et al., 1976;

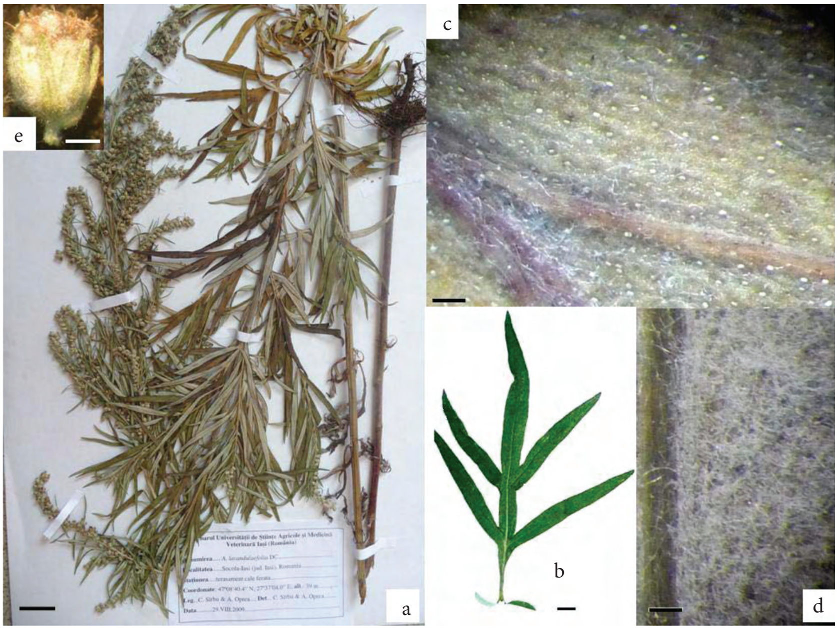

Figure 6. *Artemisia lavandulaefolia*: a) herbarium specimen, b) middle cauline leaf, c) adaxial surface of leaf, d) abaxial surface of leaf, e) capitulum. Scale bar: a = 2 cm, b = 1 cm, c and d = 0.25 mm, e = 1 mm.

Figure 7. Ruderal phytocoenosis with *Artemisia lavandulaefolia* (photo by C. Sîrbu).

Gabrielian & Vallès Xirau, 1996; DAISIE, 2009) but unidentified in Romania until now (Ciocârlan, 2009). They are also similar to *A. vulgaris* L., a widespread Eurasian wormwood species. These taxa are distinguished from each other as follows

1. Plants weakly aromatic, without stolons; leaves not white glandular punctate ....***A. vulgaris***

1. Plants strongly aromatic, ± stoloniferous; leaves white glandular punctate adaxially 2

2. Stems pubescent, later glabrescent, often purple nuanced; leaves green, glabrescent or glabrous adaxially; involucral bracts sparsely pubescent, then glabrescent 3

2. Stems incanous arachnoid-pubescent; leaves ± incanous pubescent adaxially; involucral bracts arachnoid-pubescent or tomentose 4

3. Lobes of middle leaves 3-4 pairs, lanceolate, 3-5 mm wide; capitula of 2-2.5 mm in diameter.......... ....***A. verlotorum***

3. Lobes of middle leaves 1-2 pairs, linear, (1-)2-3 mm wide, or middle leaves entire, linear; capitula of 1-1.5 mm in diameter ....***A. lancea***

4. Middle leaves pinnatisect; primary segments entire, lanceolate, or with 1 (-2) pairs of linear-lanceolate lobules; leafy bracts linear-lanceolate, or lanceolate ....***A. lavandulaefolia***

4. Middle leaves pinnatipartite; primary segments ± ovate, with irregularly serrate to partite margins; leafy bracts elliptic, elliptic-lanceolate ...***A. argyi***

Artemisia lancea was originally described from China (Vaniot, 1903) and then from Korea (as *A. feddei* H.Lév. & Vaniot) (Léveillé, 1910), subsequently being mentioned under 1 of the 2 names. Some authors have erroneously referenced this species in the literature, e.g. as *A. lavandulifolia* (Poljakov, 1961). The collected specimens from Romania have lower leaves (on young shoots) with long petioles, and capitula have 4-6 pistillate and 5-8 bisexual florets, while according to Ling et al. (2006) the basal and lowermost leaves of this species are short petiolate, and the number of florets in each capitulum is 1-3 and 2-5, respectively. All the other characters correspond to the description given by Ling et al. (2006).

In the species *A. argyi*, 2 varieties are recognised, namely var. *argyi* (middle cauline leaves pinnatifid) and var. *gracilis* Pamp. (middle cauline leaves pinnatipartite) (Ling et al., 2006). Specimens from the Socola railway yard (northeastern Romania) fit the second variety. However, contrary to the description given by Ling et al. (2006), the middle leaves of these specimens have petioles up to 2-3 cm long (not 2-3 mm) and the leaf lobes (primary segments) are 2-4 cm wide (not 2-4 mm). There were no details on these characters in the original diagnosis (Léveillé, 1910). However, when using other identification keys (Pampanini, 1929; Poljakov, 1961; Mosyakin, 1990; Leonova, 2002), the result was always the same: *A. argyi*. Furthermore, the description and drawings of leaves given by Pampanini (1929) for *A. argyi* fully correspond with the leaves of specimens that we collected.

Artemisia lavandulaefolia has a complicated taxonomic history, which is reflected by its numerous synonyms (see above). Mosyakin (1990) considered the name *A. lavandulaefolia* as "nom. ambig." (given its frequent erroneous use in literature) and passed it into synonymy with *A. umbrosa* (Turcz. ex. Besser) Pamp. We followed the taxonomic treatment from *Flora of China* (Ling et al., 2006), which rehabilitated the name of *A. lavandulaefolia*.

General distribution

All 3 species are native to eastern Asia, occurring in China, Korea, far eastern Russia, and Japan (Pampanini, 1929; Poljakov, 1961; Ohwi, 1965; Ling & Peng, 1998; Leonova, 2002; Ling et al., 2006). *A. argyi* and *A. lavandulaefolia* were also reported from Mongolia, and *A. lancea*, from India (Ling et al., 2006).

Distribution in Europe and Romania

Artemisia lancea was never before reported from Europe (Nyárády, 1964; Tutin et al., 1976; Ciocârlan, 2009; DAISIE, 2009). *A. argyi* was mentioned as casual or naturalised in the European part of Russia (Leonova, 2002) and Kiev, Ukraine (Mosyakin, 1990; Mosyakin & Yavorska, 2002; Bagatska, 2008). *A. lavandulaefolia* was also previously mentioned in eastern Europe, as a casual or naturalised species, under the name *A. umbrosa* by Russian and Ukrainian authors or *A. codonocephala* by others, as follows: Ukraine (Mosyakin, 1990; Mosyakin & Yavorska, 2002; Ostapko et al., 2009), Belarus (Mosyakin, 1990), central and northwestern European Russia (Mosyakin, 1990; Leonova, 2002), Lithuania (Gudžinskas, 1997), Latvia (Leonova, 2002), and Crimea (Greuter & Raab-Straube, 2005).

This is the first report of the 3 species in Romania. As was previously mentioned, they were all identified at the Socola railway yard near Iaşi, where they were introduced, probably accidentally, by railway transport from the former USSR. *A. lavandulaefolia* was found in 5 dense populations of 20-30 m^2. Each of the other 2 species was found in a single population, with an area of up to 10 m^2. The mean population density (individuals in different phenological stages/m^2) was 187.5 (*A. lancea*), 75.5 (*A. argyi*), and 93.8 (*A. lavandulaefolia*). The precise locations of these populations were as follows:

A. lancea: Northeastern Romania, Iaşi County, Socola railway yard, 47°08′44.5″N, 27°37′05.1″E, 40 m, 01.09.2008, ruderal place between railway lines, *C.Sîrbu* & *A.Oprea s.n.* (IASI 17916-17920).

A. argyi: Northeastern Romania, Iaşi County, Socola railway yard, 47°08′40.2″N, 27°37′03.3″E, 39 m, 29.08.2009, ruderal place along the track leading to Ungheni, Republic of Moldova, *C.Sîrbu* & *A.Oprea s.n.* (IASI 17921-17925).

A. lavandulaefolia: Northeastern Romania, Iaşi County, Socola railway yard, 47°08′40.4″N, 27°37′04.0″E, 39 m, 29.08.2009, ruderal place along the track leading to Ungheni, Republic of Moldova, *C.Sîrbu* & *A.Oprea s.n.* (IASI 17926); 47°08′40.5″N, 27°37′06.2″E, 39 m, 29.08.2009, ruderal place along the track leading to Ungheni, Republic of Moldova, *C.Sîrbu* & *A.Oprea s.n.* (IASI 17927); 47°08′44.6″N, 27°37′09.8″E, 40 m, 29.08.2009, ruderal place between railway lines, *C.Sîrbu* & *A.Oprea s.n.* (IASI 17928); 47°08′43.4″N, 27°36′76.7″E, 40 m, 29.08.2009, ruderal place between railway lines, *C. Sîrbu* & *A.Oprea s.n.* (IASI 17929); 47°08′39.6″N, 27°36′79.8″E, 40 m, 29.08.2009, ruderal place between railway lines, *C.Sîrbu* & *A.Oprea s.n.* (IASI 17930). Distances between the 5 populations ranged between 36 and 307 m.

Biology

All 3 species are perennial herbs, hemicryptophyte, and stoloniferous, and they overwinter through rhizomes. According to our field observations at the Socola railway station, *A. lancea* multiplies only clonally. Young shoots are mostly formed from the buds of the rhizomes near the previous year's stems, forming crowded clumps. *A. argyi* and *A. lavandulaefolia* reproduce mainly by stolons, but presumably also by seeds (see below), although no seedlings were observed in the field.

All 3 species bloom abundantly in August-September, and are wind pollinated, like all the other species of *Artemisia* (Jiang et al., 2005). Fruit (achenes) matures in September-October. They are very small, 1 × 0.4 mm, and they are probably spread by wind over great distances. *A. argyi* and *A. lavandulaefolia* bear a large number of fruits producing fertile seeds, but only barren fruit were found in *A. lancea*. Given the fact that there was only a single clonal population of this species found at the location mentioned above, there is the possibility that fertilisation fails due to self-incompatibility.

Seed germination, tested in laboratory conditions, was between 50% (in March 2010) and 85% (in February 2011) for *A. lavandulaefolia*, and 90% (in February 2011) for *A. argyi*. None of the *A. lancea* seeds germinated. Further investigation is necessary in order to determine to what extent seeds play a role in the spreading of this species in the wild. However, based on the data presented above and the ability of clonal propagation and fertile seed production, we can assess that *A. argyi* and *A. lavandulaefolia* are currently naturalised in the local conditions at Socola-Iaşi, while *A. lancea* has only a casual status within the meaning given by Richardson et al. (2000).

Artemisia lancea is known as a diploid species (2n = 16). The other 2 species have been mentioned both as diploid (2n = 18) and polyploid (2n = 34, 36, and 50 in *A. argyi*; 2n = 50 and 54 in *A. lavandulaefolia*) (Table). The studied populations of *Artemisia* from Socola-Iaşi (northeastern Romania)

Table. Chromosome numbers of the Romanian populations of *Artemisia* studied, with indication of previous reports.

Species names	Number of chromosomes (2n)		
	In Romania	Previous reports (other regions)	
A. lancea	16, 18, 19	16:	Japan (Matoba et al., 2007); Russian Far East (Volkova & Boyko, 1989; Hoshi et al., 2004); Korea (Park et al., 2009); Spain (from culture) (Pellicer et al., 2010)
A. argyi	22, 27, 36, 38, 40, 42	18:	Spain (from culture) (Pellicer et al., 2010)
		34:	Russian Far East (Hoshi et al., 2004)
		36:	Russian Far East (Hoshi et al., 2004)
		50:	China (Hoshi et al., 2004)
		34, 36, 50:	Korea (Park et al., 2009)
A. lavandulaefolia	16, 27, 36, 38, 40, 42, 45, 50	18:	North China (Sánchez-Jiménez et al., 2009)
		50:	Russian Far East (Hoshi et al., 2004; Pellicer et al., 2007); Spain (from culture) (Pellicer et al., 2010)
		54:	Mongolia (Garcia et al., 2006); Spain (from culture) (Pellicer et al., 2010)
		18, 50, 54:	Korea (Park et al., 2009)

exhibited a considerable cytogenetic heterogeneity, not only interspecific but also intraspecific and even intraindividual (more marked in *A. argyi* and *A. lavandulaefolia*), as shown in the Table. For *A. lancea*, the somatic chromosome number was 2n = 16, 18, and even 19, probably due to aneuploidisation. In *A. argyi*, the chromosome number ranged from 2n = 3x = 27 (triploidy) to 2n = 4x = 36 (tetraploidy), but other cytotypes were present (2n = 22, 38, 40, and 42), confirming the intraindividual aneuploid variation (aneusomaty or dysploidy) previously evidenced in Korean specimens (Park et al., 2009). In *A. lavandulaefolia*, we evidenced different degrees of ploidy. Pentaploid forms (2n = 5x = 45) were identified, but we also noted the mixoploid state (presence of cells having different ploidy degrees in the same cell population), with 2n = 3x = 27 and 2n = 4x = 36, or with 2n = 3x = 27 and 2n = 5x = 45. Other somatic chromosomes found in *A. lavandulaefolia* were 2n = 16, 30, 38, and 50. These results confirm the great genetic plasticity of the *Artemisia* species, which contributes to their wide ecological tolerance, ensuring a permanent geographic expansion of these species (Kreitschitz & Vallès, 2003; Garcia et al., 2004; Vallès et al., 2005; Pellicer et al., 2007a, 2007b, 2010; Abdolkarim et al., 2010).

In many species of *Artemisia*, polyploidy, dysploidy and aneusomaty are often associated with their vegetative reproduction and pioneer status (Vallès & McArthur, 2001; Kreitschitz & Vallès, 2003; Pellicer et al., 2007a). This finding appears to be also true in the case of *A. lancea*, *A. argyi*, and *A. lavandulaefolia*. A more detailed analysis on this specific subject will be done in a future study.

Ecology

According to Ling et al. (2006) and Poljakov (1961), within their native areas, *A. lancea*, *A. argyi*, and *A. lavandulaefolia* grow in steppe, forest steppe, and forest zones, both in natural and anthropogenic habitats (steppe vegetation, forest edges, scrubs, slopes, roadsides, waste places, and old fields), from low altitudes (300-400 m) up to 1500 m (*A argyi*), 1700 m (*A. lancea*), or even 3000 m (*A. lavandulaefolia*). In addition, *A. lavandulaefolia* vegetates in brushlands, canyons, river valleys, lakesides, wet meadows, and sometimes along sandy banks.

At Socola-Iaşi (northeastern Romania), all of these species grew in anthropogenic habitats, in warm and sunny ruderal places, in close proximity to railways, in the perimeter of the railway yard. Soils were skeletal, of anthropogenic origin, and relatively dry during the vegetation seasons. Together with other plant species, they constituted some dense ruderal phytocoenoses, in areas of about 10 m^2 (*A. lancea* and *A. argyi*) or 20-30 m^2 (*A. lavandulaefolia*). The general projective cover was 70% (phytocoenosis with *A. lancea*) and between 90%-100% (phytocoenoses with *A. argyi* and *A. lavandulaefolia*). All of these phytocoenoses belong to the alliance *Dauco-Melilotion* Görs, well represented in the species composition. Besides the characteristic species of class *Artemisietea vulgaris* Lohmeyer et al. ex von Rochow, which predominate (37%-66.6%), there were also species from segetal vegetation (*Stellarietea mediae* Tüxen et al. ex von Rochow) (0%-22.7%) or from adjacent grasslands, both xerophilous (*Festuco-Brometea* Br.-Bl. et Tüxen) (11.1%-30%) and mesophilous (*Molinio-Arrhenatheretea* Tüxen) (0%-37%). Xerophilous grassland species were more numerous in phytocoenoses with *A. lancea* (22.7%) and *A. argyi* (30%), while mesophilous grassland species were present in greater numbers (up to 37%) in some phytocoenoses with *A. lavandulaefolia*. This was consistent with the occurrence of the latter in habitats associated with watercourses from its native area.

In other eastern European regions of the invasion areas, Mosyakin (1990) reported *A. argyi* and *A. lavandulaefolia* in similar ruderal habitats from Kiev, Ukraine, within the limit of a railway complex, where they formed some small but dense colonies. *A. argyi* was also reported near Syne Lake in the Vynogradar residential area of the northwestern part of Kiev (Bagatska, 2008). Yena, in Greuter and Raab-Straube (2005), reported *A. lavandulaefolia* in disturbed urban habitats from Crimea.

Detrimental

According to Kil et al. (2000), aqueous extracts and volatile compounds of *A. lavandulaefolia* inhibit seed germination and seedling and root growth of some plant species (e.g. *Elsholtzia ciliata*, *Lactuca sativa*, and *Raphanus sativus*). No other data were found on the adverse impact of these species in natural and anthropogenic ecosystems. However, given their ability to form dense clonal populations, they are expected to affect other plant species living in similar habitats.

Beneficial

In Chinese traditional medicine, *A. lancea* is used as an antifebrile drug (Ling & Peng, 1998; Ling et al., 2006). The antimicrobial activity of the essential oil and some other compounds was recently demonstrated for this species by Cha et al. (2007). *A. argyi* is recommended for use as an antitumoural, antihaemorrhoidal (Lao et al., 1984), analgesic, haemostatic, and antipruritic (Woerdenbag & Pras, 2002). *A. argyi* is also used in making important antiphlogistic detoxifying drugs (Ling et al., 2006). In addition, according to Li et al. (2003), *A. argyi* accumulates large amounts of copper in its roots and leaves, so it has the potential to serve as a pioneer species for phytoremediation of copper-contaminated soils. *A. lavandulaefolia* is also used in traditional medicine in China (Ling et al., 2006). It has been shown that the essential oils of this species have strong effects against some pathogenic bacteria (Kil et al., 2000; Cha et al., 2005) and fungi (Kil et al., 2000).

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