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Contribution to the Knowledge of the Alien Flora of Romania: *Rudbeckia triloba* L. and *Senecio inaequidens* DC.

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Abstract

Two alien species new to the Romanian flora, namely *Rudbeckia triloba* L. and *Senecio inaequidens* DC (*Asteraceae* family) have been recorded during 2004-2009 period in different places of Moldavia and Maramures (Romania). *Rudbeckia triloba*, native of North America, is perennial specie, with 150 cm of length, glabrate stems, blades ovate to subcordate, or elliptic leaves, with serrate margins. The capitulas (10-30) are long pedunculate, with conic to sub hemispheric receptacles (8-15 x 10-15 mm), with the dark purple paleae (5-6.5 mm). There are 7-15 ray florets; the laminae is yellow-orange, linear to oblanceolate, 8-17 x 3-8 mm. *Senecio inaequidens* is a perennial herb, native of South Africa. The cross pollination with non-specialized insects ensures the production of a large number of seeds, but self-pollination have also been reported, increasing the chances of the specie to colonize new territory, where other sources of pollen are missing. Though for the moment these two species are sporadically met in the Romanian flora, at least one of them (*Senecio inaequidens*) might become in the near future a threat to the natural or agricultural national ecosystems.

Keyword: alien plants, flora, weeds, *Senecio, Rudbeckia*

Introduction

The *Asteraceae* plant family holds the first place as far as the number of alien taxa in the flora of our country (Sirbu, 2004; Anastasiu and Negrean, 2005). On a continental scale, this plant family also holds the first place in the structure of alien flora (Lambdon *et al.*, 2008; Daisie, 2009).

Many species of invasive alien weeds in Romania belong to this family: *Ambrosia artemisiifolia, Bidens frondosa*, *Chamomilla suaveolens*, *Conyza canadensis*, *Erigeron annuus, Galinsoga parviflora, Galinsoga quadriradiata*, *Helianthus tuberosus, Helianthus decapetalus, Iva xanthifolia, Rudbeckia laciniata, Solidago gigantea, Solidago canadensis, Xanthium spinosum, Xanthium orientale* ssp. *italicum* etc. (Ciocarlan, 2000; Sirbu, 2004; Anastasiu and Negrean, 2005; Oprea, 2005).

Materials and methods

Two alien species of the *Asteraceae* family, namely *Rudbeckia triloba* L. (an alien species new to the Romanian flora) and *Senecio inaequidens* DC have been recorded in between 2004 and 2009.

In the present research the information about the two species relates to the following: geographical locations in Romania; the native area; world spreading; morphological, ecological and biological features; assessments on their invasive character and mode of introduction. The taxonomy and nomenclature of species follow Tutin *el al.* (1976), Britton and Brown (1970) and Ciocarlan (2000). The definition of the invasive status is according to Richardson *et al.* (2000).

Results and discussion

Rudbeckia triloba L. (Fig. 1)

Species originating to North America, with a native area in the Eastern part of the U.S.A (Britton and Brown, 1970; Weakley, 2007; Grin, 2009), wherefrom it has spread, as an alien (naturalised) species, to the South-Eastern Canada and Western U.S.A (Smith, 2003; Grin, 2009; FNA, 2009).

In the early 1970s, *R. triloba* was mentioned in Austria (Essl *et al.*, 2002). Also, it is known as having escaped from culture in the British Isles (GCW, 2009), Podgorica, Montenegro (Stešević and Jovanović, 2008), as well as from Japan (Mito and Uesugi, 2004).

In Romania, this species has been encountered for the first time along the Tisa river meadows (Maramures county), on the railway embankments and afterwards in the riverbed of Agapia river (Neamt county).

It is certainly not clear how this species has been introduced in our country, however, seeing its ornamental features and the fact that it was discovered in the neighbourhood of some localities, one might suppose that it has been introduced as a garden plant, wherefrom it subsequently escaped.

Fig. 1. *Rudbeckia triloba* L., around the village of Agapia (Neamt county)

Fig. 2. *Senecio inaequidens* (on a ruderal ground, Iasi)

Fig. 3. *Senecio inaequidens* (leaves)

Fig. 4. *Senecio inaequidens* (insect pollination)

According to Britton and Brown (1970) and FNA (2009), *R. triloba* is a perennial species (rhizomatous), with 150 cm height. The specie present stems glabrate to hirsute or strigose (hairs 1-2 mm, basal retrorse, others spreading), branched. The leaves are blades ovate to subcordate or elliptic with serrate margins, the apices are acute to acuminate, faces hirsute to strigose; the basal leaves are 10-30 × 2-8 cm, petiolate with truncate bases or rounded to cordate; the cauline leaves are short petiolate or sessile, ovate to elliptic. Some or all of the leaves are 3-5-lobed, 2-20 × 1.5-8 cm (smaller, fewer lobed distally), bases rounded to attenuate. The capitula (10-30) are long pedunculate, in corymbiform arrays. Phyllaries are to 1.5 cm, faces moderately hirsute, ovate-lanceolate, acute, soon reflected, the inner ones shorter. The receptacles are conic to subhemispheric, 8-15 × 10-15 mm; paleae dark purple, 5-6.5 mm with cuspidate apices (tips awn like, 1.5+ mm), glabrous. The ray florets are 7-15; laminae yellow-orange (or the base brownish-purple), linear to oblanceolate, 8-17 × 3-8 mm, abaxially sparsely strigose. The Disc florets are numerously; corollas are yellowish, green to basally, otherwise brown-purple, 3-4 mm; the style branches are 1.2 mm long, brown, the apices is obtuse to rounded. The cypselae is 1.9-2.8 mm, brownish-purple, with four thin edges; pappus a minute crown, to 0.2 mm. 2n = 38; 57 (x = 19).

In its native area, *R. triloba* grows in mesic to wet woodlands, thickets, pastures, roadsides, railway embankments, meadows, generally on wet soils, at altitudes up to 1200 m. It is a heliophilous species, but can also tolerate partial shade. It prefers humus-rich soils, wet but well drained (Aniśko, 2008).

The flowering period stretches from June to October (Britton and Brown, 1970). The pollination is achieved by insects. The plant is reproduced by seeds which are dispersed by wind. The vegetative propagation is also possible, through the short ramifications of rhizomes.

Those two populations of *R. triloba* identified are now represented by a small number of individuals. It has been remarked the fact that in both places these individuals were robust, in full prosperity, with a great number of inflorescences, well integrated into the local environment. In addition, the seeds harvested from the herbarium specimens in September 2008, were germinated in June 2009, in the proportion of 43%.

Senecio inaequidens DC. (Fig. 2-4).

In Romania, *Senecio inaequidens* was previously identified by Anastasiu and Negrean (2008), in locations ranging from Bucharest.

In the present study this plant has been recently identified in Iasi, in the company of the following ruderal plants: *Arctium lappa, Ballota nigra, Lepidium ruderale, Conyza canadensis, Sonchus arvensis, Melilotus officinalis, Setaria viridis, Lactuca serriola, Elymus repens, Cirsium arvense, Malva sylvestris.*

As far as this species' move to Iasi, it has most probably arrived there accidentally, carried by wind.

S. inaequidens is native of South Africa and has been introduced in Europe towards the end of the nineteenth century through wool import. Consequently, the spreading of the species in Europe started in the surroundings of some wool factories from Germany (Bornkamm, 2002) and then from France, Italy and Belgium (Chater and Walters, 1976; Wittenberg, 2005; Heger and Böhmer, 2006; López-García and Maillet, 2005; EPPO, 2006).

Since the half of the last century, *S. inaequidens* has spread everywhere in Western, Central and Southern Europe, extending into new habitats. According to López-García and Maillet (2005), in the '70s this species became a weed in agricultural crops in France, especially in the vineyards, as well as along the edge of roads and in pastures, becoming a serious problem in natural habitats in 1990.

It has also introduced in other regions of the world, such as: Canada, Mexico (Heger and Böhmer, 2006), Japan (Mito and Uesugi, 2004), Taiwan, Hawaii, Argentina, Brazil, Columbia, Australia (EPPO, 2006).

S. inaequidens is a perennial herb, chamaephyte or hemicryptophyte (depending on winter temperatures)

(Bornkamm, 2002) and produces many seeds (cypselae) that are easily scattered by wind or by man (as impurities of agricultural goods). A single plant can produce over 10,000 seeds (López-García and Maillet, 2005) or even 29,000, which can survive in the soil up to 30-40 years (Heger and Böhmer, 2006).

Seed germination occurs at a wide temperature range (6-30°C), but maximum germination happens at about 20°C (López-García and Maillet, 2005).

The cross pollination with non-specialized insects (Fig. 4), ensures the production of a large number of seeds, but self-pollination populations have also been reported, increasing the chances of the species to colonize new territory, where other sources of pollen are missing (López-García and Maillet, 2005; EPPO, 2006). The plant can also reproduce itself on vegetative way, by the rooting of stem that touches the ground.

According to Lafuma *et al*. (2002), the European populations of *S. inaequidens* derived from some tetraploid populations originated in Lesotho region, South Africa.

Ecologically, *S. inaequidens* is a species with a pioneer character. In its native regions, it colonizes skeletal sectors on steep, moist and grassy slopes, as well as the sandy and gravelly banks of periodic streams at elevations between 1400 and 2850 m (Heger and Böhmer, 2006).

In Europe, *S. inaequidens* grows in open, ruderal places, with raised resources of light and temperature, often on sandy soils, near railways, roadsides, industrial habitats, pastures, vineyards, orchards (Bornkamm, 2002; Heger and Böhmer, 2006; EPPO, 2006; López-García and Maillet, 2005). Moreover, it occurs on near-natural sites as volcanic soils, rocky sites, and coastal dunes.

S. inaequidens is a species with a wide ecological tolerance, with a rapid growth in favorable conditions (López-García and Maillet, 2005). In European countries, it is spread from plains to mountain regions (EPPO, 2006). The recent tendencies of climatic changes favor the invasion of this species in Europe, taking into consideration the fact that the reproductive ability of this plant increase considerably with the climatic warming (Heger and Böhmer, 2006). On the other hand, the plant is destroyed by frost (temperatures less than -15°C) which prevent its spread in colder regions. Although *S. inaequidens* rather grows in open habitats, unoccupied by other plants, in some circumstances it could became a treat to the native species or plant communities, for instance it could change the floristic composition of the dune vegetation (Heger and Böhmer, 2006). Once established, *S. inaequidens* can cover up to 80% of the ground, displaces native vegetation (Wittenberg, 2005) and reduces the productivity and quality of grasslands. According to Dimande *et al*. (2007), this species is toxic to cattle, representing a serious threat to native biodiversity and agricultural crops where it is installed.

This species is associated with the following vegetation zones: temperate deciduous forests, temperate steppes and Mediterranean sclerophyllous forests and sclerophyllous shrubs succeeding them (EPPO 2006). According to Bornkamm (2002), in Germany, *S. inaequidens* invaded a large number of plant communities such as typical ruderal pioneer vegetation (*Sisymbrion, Salsolion*), trampled sites (*Polygonion*) disturbed meadows (*Arrhenatheretalia)*, ruderal grassland mainly on roadsides (*Convolvulo-Agropyrion)* and tall herbaceous vegetation (*Dauco-Melilotion*, *Arction)*, young shrubs (initial *Ailanthus* shrub and *Sambuco-Salicion)*, but never in dense thickets or in the deep shade of trees. In Romania, it is also spread in ruderal communities (*Sisymbrion, Arction*).

Therefore, it can be now considered that *S. inaequidens* is rather rare in our country; its great invasion capacity proved in other regions of the continent, can constitute an alarm signal on its future evolution in Romania.

Conclusions

Two alien plant species were recently recorded in the Eastern and Northern part of Romania, respectively: *Rudbeckia triloba* and *Senecio inaequidens*.

Though for the moment these two species are sporadically met into the flora of Romania, it is possible that in the near future at least one of them (*Senecio inaequidens*) will could become a threat to the natural or agricultural ecosystems of the country.

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