ISSN 2075-1117, Russian Journal of Biological Invasions, 2018, Vol. 9, No. 1, pp. 29–37. © Pleiades Publishing, Ltd., 2018.
Original Russian Text © T.S. Dvirna, 2017, published in Rossiiskii Zhurnal Biologicheskikh Invazii, 2017, No. 4, pp. 36–46.

Asclepias syriaca L. in the Romensko-Poltavsky Geobotanical District (Ukraine)

T. S. Dvirna
Kholodny Institute of Botany, National Academy of Sciences of Ukraine, Kyiv, Ukraine
e-mail: dvirna_t@ukr.net
Received August 10, 2016

Abstract—The results of an integrated research of a potentially invasive species, *Asclepias syriaca*, in the Romensko-Poltavsky Geobotanical District (Ukraine) are given. The viability of the seeds of this species and their laboratory germinating ability are studied. Under natural conditions, the life strategy of the species is focused on vegetative reproduction. *A. syriaca* forms poor floral biocenoses and grows in the communities of the *Rudbeckio laciniatae-Solidaginetum canadensis* Tüxen et Raabe ex Anioł-Kwiatkowska 1974 and *Asclepiadetum syriacae* Láníková in Chytrý 2009 associations. This species is distributed mainly in type 1 biotopes, which are formed as a result of the constant effect of anthropogenic factors. According to the Invasive Species Assessment Protocol, the level of species invasiveness is high (I-Rank = 95), which indicates a serious threat to local species and natural communities under the influence of *A. syriaca* distribution.

Keywords: Asclepias syriaca, kenophyte, colonophyte, ergasiophyte, potentially invasive species, Romensko-Poltavsky Geobotanical District, Ukraine

DOI: 10.1134/S2075111718010058

INTRODUCTION

One of the successful ways to enrich the alien fraction of flora is the naturalization of some new edible, technical, ornamental, and other economically valuable plants that are purposefully introduced into cultivation and can then adapt to the conditions of the new region, thereby reaching different levels of naturalization (Dvirna, 2013; Protopopova and Shevera, 2013, 2014). The abundance and diversity of ergasiophytes (originated mainly from North America) has increased in the Ukraine in recent decades, which is of concern (Protopopova and Shevera, 2014).

The species that have actively distributed from cultivation in recent times include *Asclepias syriaca* L., which is mainly concentrated in the central part of Ukraine.

MATERIALS AND METHODS

The study area—the Romensko-Poltavsky Geobotanical District—is located in the central part of Ukraine and is one of the most anthropogenically transformed regions (Fig. 1). The study area is included in the left-bank Prydniprovsky subprovince of the East European Province in the forest-steppe zone according to the geobotanical zoning of Ukraine (*Geobotanichne raionuvannya*..., 1977) and in the forest-steppe zone according to the physical and geographical zoning (*Fiziko-geograficheskoe raionirovanie*..., 1968).

Common milkweed was studied from 2011 to 2016 in ten inventory plots with an area of 1 × 1 m in different parts of the region.

Population studies of the species (the determination of the viability of seeds and their laboratory germinating ability) were carried out using classical approaches (Zlobin, 1989, 2009; Zinchenko et al., 2010).

The characteristics of the species according to the time of its introduction, methods of introduction, and level of naturalization is given according to the classification of Kornaś (1968, 1977), and the invasiveness of the species is characterized according to Richardson et al. (2000).

The types of plant communities in which *A. syriaca* occurs were determined using the Braun-Blanquet method (Braun-Blanquet, 1928) and the type of spatial structure of species distribution was estimated according to the classification of Protopopova (1991). The biological analysis was performed according to the classification of biotopes of the forest and forest-steppe zones in Ukraine (Didukh et al., 2011).

The influence of *A. syriaca* on phytodiversity under the conditions of the region was assessed using the Invasive Species Assessment Protocol (Morse et al., 2004).

Fig. 1. The location of the Romensko-Poltavsky Geobotanical District in Ukraine.

A grid map with a grid size of 5 × 5 km in the UTM coordinate system was prepared for the region; the map is consistent with the map accepted in Atlas Florae Europaeae; the MapInfo system was used for developing the map (Budzhak and Dvirna, 2014).

RESULTS AND DISCUSSION

Asclepias syriaca (Asclepiadaceae) Sp. Pl. 214. 1753 (T.: Linn. Herb. London, no. *310. 14*, photo!). Synonym: *A. cornuti* Dcne. in Dc. Prodr. 8:564. 1844. (Based on *A. syriaca* L.). The species under study is a North American kenophyte; in the primary range, it is distributed in prairies and in alluvial deposits, meadows, and fields and on roadsides and railroads (Woodson, 1954). It is currently widespread in European countries (Baillon, 1890; Protopopova, 1991; Abbate G., 2005; Verloove, 2006; Bagi, 2008; Wallnöfer, 2008; Vinogradova and Kuklina, 2012; Pyšek et al., 2012; Bacieczko et al., 2013; Paukova et al., 2014; Protopopova and Shevera, 2014; etc.), where it is invasive.

Its cultivation in Ukraine was first mentioned in 1855. Baziner described the results of observations on the growth of the plants after cutting (Baziner, 1855). In 1863, *A. syriaca* was grown at the Botanical Garden of the Imperial University of Kyiv. It was recorded as a wild plant for the first time in Ukraine ("in the vicinity of Kyiv, in a ravine near the village of Novoselki, June 5, 1914") (*KW*, Yu.N. Semenkevich) in 1914. The species is currently common throughout the country; however, it occurs mainly in central regions, in anthropogenic (ruderal phytocenoses and agrocenoses and near primary cultivation centers, where it forms colonies and occupies considerable areas) and seminatural (forest edges and meadows) ecotones.

In the study region, *A. syriaca* is an ergasiophyte, a colonophyte, and a potentially invasive species (Dvirna, 2014, 2015). It is distributed mainly along rural roads, in roadside ecotopes and forest belts, along highways, in ruderal sites, and near areas of primary cultivation.

A. syriaca was mentioned in the Romensko-Poltavsky Geobotanical District for the first time in 1929, i.e., the year when it was included in the list of prospective new introduced plants by the All-Union Institute of Medicinal and Aromatic Plants (a branch in the village of Berezotocha in Lubensky district, Poltava region); from 1932 (to the end of the 1930s), it was also cultivated as a rubber-bearing plant for studying the chemical composition of seeds. It is currently grown in collection plots. A few localities of wild plants were recorded not far from the cultivation center; they are dispersed from here to the adjacent areas. The Ustimovkas Dendrological Park (at present, the Ustimovkas Experimental Plant Production Station of the Yuryev Plant Production Institute, National Academy of Sciences of the Ukraine), which is located in the vicinity of the study region, was another center of cultivation of the species. One of the goals of the dendropark was to grow milkweed as a rubber-bearing plant (oral communication of members of the station and dendropark). Today, *A. syriaca* is also cultivated in the Korolenko Botanical Garden of the Poltava National Pedagogical University in a collection plot (Dvirna, 2013).

The rhizome of common milkweed is plagiotropic and branched (Fig. 2). During the research (on the farm of V. Goncharov, 1927), the digging of a rhizome in the plot where milkweed had grown for over 30 years revealed that it penetrated to a depth of up to 2 m and had a number of branchings (Kuz'menko, 1929). According to the data of the reports of the Research Medicinal Plant Station, similar studies were also carried out in the 1930s; as a result, it was found that the

Fig. 2. Underground organs of *Asclepias syriaca* (photograph by T.S. Dvirna).

root was 4 m deep. This allows *A. syriaca* to successfully adapt to all types of soil, even very poor sandy soils. There are side branches of the second–third horizontal layers that extend from the vertical part of the rhizome and from which new aboveground shoots grow during the vegetation period.

The plant propagates by seeds or on a vegetative basis. According to the observations of Radde-Fomina at the Botanical Garden of the Kyiv University (1924–1927), *A. syriaca* distributes to the territory of the garden on the basis of active vegetative propagation. According to the opinion of the researcher, the plants that propagated by seed developed significantly worse; they can grow and intensely develop in the same place for over 50 years (Radde-Fomina, 1922).

In the case of seed propagation, *A. syriaca* effloresces in the second year; the plant sometimes blooms the first year after seed germination only under favorable conditions. The plant blooms from the lower part of the inflorescence toward the top.

One of the important parameters is the viability of seeds, i.e., their ability to form full-fledged sprouts. It has been established that the seeds of this species (both freshly collected and 5-year-old seeds) have 100% viability, which is a prerequisite for obtaining high yields.

The germinating ability of freshly collected *A. syriaca* seeds is extremely low. The results of experiments at the Iowan Experimental Station (United States) showed that sprouts developed only in 14% of seeds that sprouted 2 months after collection, while artificial measures increased the germinating ability to 75%. The seeds that sprouted 12 months after the second storage had a higher germinating ability than the previous ones. In addition, the germinating ability is influenced by moisture and temperature conditions during the germinating period (Gerhardt, 1929). In 1930 and 1931, the highest germinating ability of seeds under field conditions at the Keller Botanical Experimental Station (Voronezh) was recorded on May 5, 1930 (97%), while the lowest germinating ability was recorded on April 8, 1930 (35%) (Leisle, 1932; Makogon, 1932).

Taking into account these data, one can assume that the seeds have a narrow germinating optimum, since the germinating ability was 66% in the year of 1931, which is covered by the same period (1929–1931). At the Donetsk Experimental point of the All-Union Institute of Rubber, sprouts in 1931 emerged the ninth day after rain and significantly later in the case of less favorable conditions. During drought, the seeds do not germinate for a long time; for example, the seeds germinated only the 21st day after sowing at the Donetsk experimental point during drought (Stolbin, 1937).

Ukrainian scientist S.O. Khomyuk studied the germinating ability of seeds using stimulating agents, namely, fertilizers with different concentrations. According to her data, the germinating ability of *A. syriaca* seeds is high, varying from 75 to 100% (Khomyuk, 2011). The results of the experiments indicate that the use of a water solution with different NH_4NO_3 concentrations (from 0.015 to 3.2%) yielded germination of 92–100% and an increase in the concentration (to 1.6%) caused a trend toward a decline in the intensity of germination. The lower the concentration, the lower the germinating ability (to 14%); when the concentration of the water solution of ammonia nitrate was increased to 3.2%, seeds did not germinate at all.

We studied the laboratory germinating ability of seeds without using stimulating agents for 5 years in 6-fold replication (Table 1). It was established that the

Table 1. Germinating ability of *Asclepias syriaca* seeds

Year of seed collection and germination	Germinating ability of seeds at room temperature, %	Germinating ability of seeds after jarovization, %	Germination ability of seeds after scarification, %	Germinating ability of seeds in soil, %
2012	15	5	40	0
2013	10	0	50	27
2014	20	0	50	40
2015	6	0	45	26
2016	20	3	45	20

laboratory germinating ability was 6 to 20% at room temperature (19–25°C). After jarovization (the seeds were exposed to –30°C for 12 h), some seeds died. We had the best results after scarification; in this case, the germinating ability of seeds was 40–50%.

The mechanical damage of the seed coat (scarification) provides a better water absorption by seeds; in addition they germinate more rapidly when they are stored at favorable temperature (at +15°C or higher).

We attempted to germinate *A. syriaca* seeds directly in the soil sampled from natural habitats; the results were different: not more than four (40%) of the 10 to 15 seeds planted in the same vessel germinated (Table 1). Seeds planted into the ground in 2012 did not germinate.

The sprouts of seeds that sprouted in the soil reached no more than 7.5 cm and eventually died (Fig. 3).

So, the performed observations established that the laboratory germinating ability of *A. syriaca* seeds is low (from 25 to 50%). The propagation is basically vegetative, being quite effective, which is confirmed both by published data and by our observations.

We determined that the time of the emergence of seedlings depends on the temperature regime: the earlier the air temperature increases, the earlier the emergence of seedlings is observed. On the whole the first seedlings emerge in late April to early May. Aboveground shoots develop throughout the month: the height of the plant and the number of leaves increase; the blooming stage begins in July to August, followed by the fruiting stage in August to September; dissemination covers the period from September to the earliest frosts, followed by the dieback of shoots, remaining dry until spring.

The populations that we studied emerged in the vicinity of primary cultivation sites and remained in the same place for 50 years (according to the data of local residents), increasing its area from year to year. We cannot distinguish centers with the highest density of the species, which is due to a very close proximity of root buds to each other (a few millimeters), as a result of which the species forms dense colonies and displaces other species.

In the study area, *A. syriaca* was recorded in 41 localities (Fig. 4) (Dvirna, 2014, 2015). The distribu-

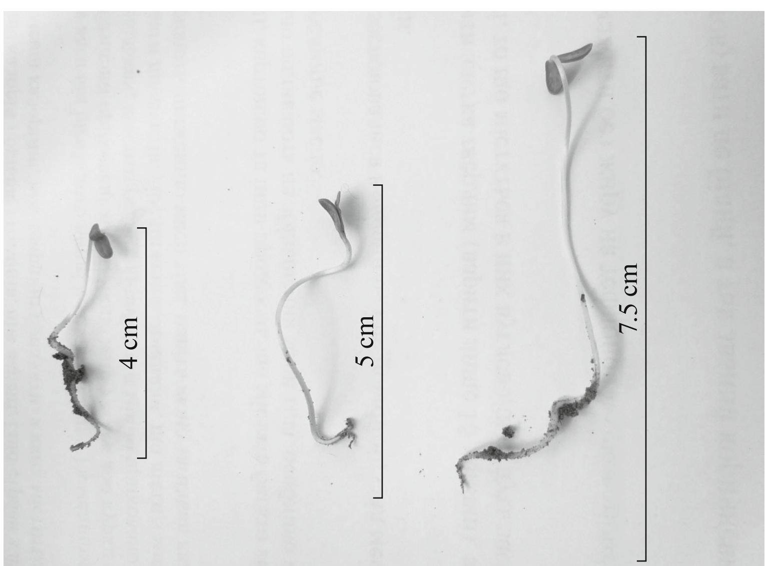

Fig. 3. Size of sprouts of seeds sprouted in soil (photograph by T.S. Dvirna).

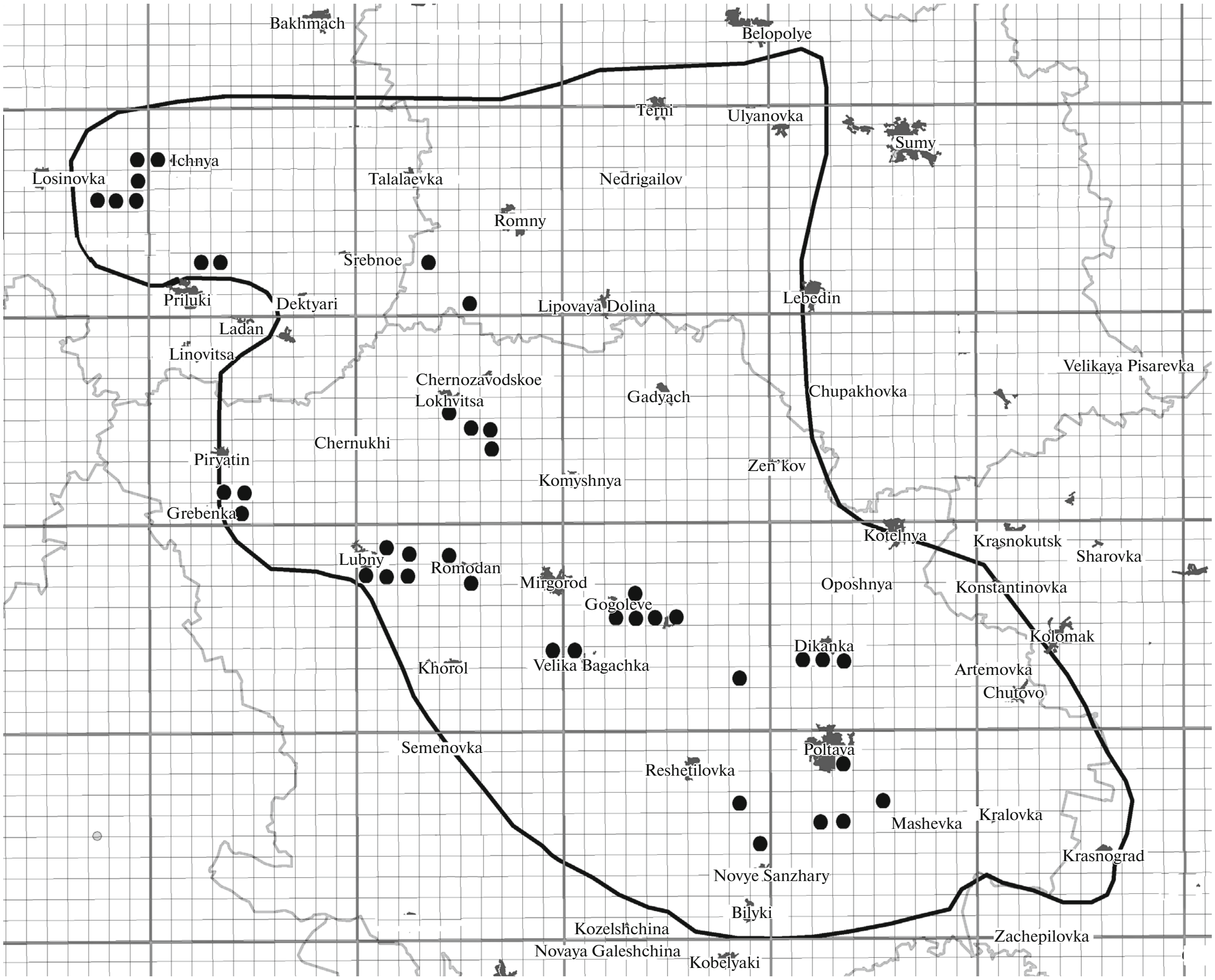

Fig. 4. Map of distribution of *Asclepias syriaca* in the Romensko-Poltavsky Geobotanical District.

tion is diffuse-banded local. Milkweed grows mainly on agricultural roadsides, in fields and vegetable gardens, in ruderal sites, and in the vicinity of primary cultivation centers, where it forms colonies and occupies considerable areas and can extend to forest edges and meadow cenoses. The species occupies the largest areas in Chernigov region, where it has been recorded in over 60% of map squares. In the central part of the region, *A. syriaca* occupies several types of ecotopes; apparently, it dispersed here from the Research Institute of Medicinal Plants, which is one of the cultivation centers (7 squares with an area of 5 × 5 m).

According to local residents, the current considerable areas where the species distribution were formed as result of long-term cultivation (over 50 years) of *A. syriaca* as an ornamental and nectariferous plant.

In the Romensko-Poltavsky Geobotanical District, *A. syriaca* populations were found as part of *Galio-Urticetea* Passarge ex Kopecký 1969 (the edge and ruderal type of vegetation), *Artemisietea vulgaris* Lohmeyer et al. ex von Rochow 1951 (the ruderal type), and *Festucetea vaginatae* Soó ex Vicherek 1972 (the psamophyte type).

A population of the species under study was revealed as part of ruderal communities of the association of *Rudbeckio laciniatae-Solidaginetum canadensis* Tüxen et Raabe ex Anioł-Kwiatkowska 1974 (union *Senecionion fluviatilis* Tüxen ex Moor 1958, order *Convolvuletalia sepium* Tx. ex Mucina 1993, class *Galio-Urticetea* Passarge ex Kopecký 1969), which were formed in disturbed open sites between the garden and forest belt along the road on the outskirts of the village of Berezotocha. The dense herbaceous cover (the total projective cover is 100%) is mainly formed by the diagnostic species of the association, *Solidago canadensis* L. (50–80%), which is admixed with *Phalacroloma annuum* (L.) Dumort. (5–15%) and *Artemisia vulgaris* L. (1–5%); *Conyza canadensis* L., *Oenothera biennis* L., *Setaria glauca* L., etc., also occa-

Fig. 5. Photograph of *Asclepias syriaca* with narrow leaf blade (image by T.S. Dvirna).

sionally occur here. The cover formed by *A. syriaca* varies from 1 to 30%.

In the study region, *A. syriaca* forms monospecies thickets, which are usually confined to roadsides, barrens, abandoned vegetable gardens, and desolate lawns. The total projective cover of the revealed plant communities is 90 to 100%. The composition of the communities is dominated by *A. syriaca* (up to 80%); sometimes, the share of *Artemisia vulgaris*, *Calamagrostis epigeios* (L.) Roth, *Elytrigia repens* L., *Lactuca serriola* L., *Poa angustifolia* L., and *Setaria glauca* is significant; *Achillea submillefolium* Klokov & Krytzka, *Convolvulus arvensis* L., *Conyza canadensis*, *Melandrium album* (Mill.) Garcke, and *Tanacetum vulgare* L. occur with a high permanence. The communities are floristically poor (the number of species in cenoses is 5 to 16). Such communities with a similar complex of species are described in the Czech Republic and assigned to *Asclepiadetum syriacae* Láníková in the Chytrý 2009 association (union *Dauco-Melilotion* Görs ex Rostański et Gutte 1971) (*Vegetace České republiky*..., 2009).

In the Romensko-Poltavsky Geobotanical District, the syntaxonomic position of the described communities remains unclear. With respect to the species composition, one can note the *Asclepiadetum* association, which is distributed in mechanically disturbed soils along the roads in the village of Nadezhda (Dikansky district), the village of Kuntsevo (Novosanzharsky district), the village of Kneshi (Shishaksky district), and the village of Berezotocha (Lubensky district) in Poltava region. Sometimes, the cenoses of the association (with dense thickets of *A. syriaca*) form long belts at the periphery of segetal complexes. For instance, not far from the village of Gogolevo, Shishaksky district, the communities of the association (the area is 10 × 2 m, the projective cover of *A. syriaca* is 50%) border on a potato field; in the vicinity of the village of Romondan, Mirgorodsky district, they occur on the border of *Zea mays* crops (the area is 15 × 3 m, the projective cover of *A. syriaca* is 60%). In the vicinity of the village of Voronyanshchina, Shishaksky district, a community with milkweed borders on *Glycine max* (L.) Merr. crops (the area is 5 × 4 m, the projective cover of *A. syriaca* is 80%).

It should be noted that these communities are resistant to cutting. Under cutting conditions, the involvement of *A. syriaca* increases owing to the fallout of species that are sensitive to this factor. We recorded a change in the shape of the leaf blade (from oval to narrow lanceolate shape (the width varies from 1 to 10 cm)) after a mechanical effect on the species (Fig. 5).

Analysis of the floristic composition of syntaxa with the involvement of *A. syriaca* in the study region suggests that the leading role in species adaptation for new communities is played by a high edaphic plasticity of the species, which allows it to penetrate into different habitats of degraded ruderal and segetal complexes, as well as into cultural phytocenoses (*Pinus sylvestris* stands in the vicinity of the village of Sudivka, Novosanzharsky district).

On the basis of the above-presented data, it was established that *A. syriaca* is widespread in different types of biotopes (Didukh et al., 2011):

G Phanerophyte-type biotas (forests and shrubs)
G1 Broad-leaved deciduous forests
G1.3 Shrub biotopes (Rhamno-Prunetea)
G1.31 Mesothermophylic shrub thickets (Berberidion: *Swida sanguinea*, *Rhamnus cathartica*, *Ligustrum vulgare*, *Berberis vulgaris*, and *Euonymus verrucosa*)
I Biotopes formed by human economic activity
I1 Agrobiotopes with intensive cultivation
I1.1 Agrobiotopes with annual cultivation (segetal type)
I1.11 Segetal-type agrobiotopes of grain crops
I2 Ruderal herbaceous biotopes
I2.2 Ruderal biotopes of perennial plants
I2.21 Ruderal biotopes of herbaceous perennial plants
I2.24 Ruderal biotopes of long fallows
I2.241 Ruderal biotopes of long fallows on rich lands
I2.242 Ruderal biotopes of long fallows on sands
I4 Man-made (cultivated) biotopes of trees and shrubs
I4.2 Decorative and fruit plantations (gardens and parks)
I4.23 Tree alleys
I5 Decorative artificial herbaceous-type communities
I5.2 Beds for decorative plant species and rock gardens

According to the above-given classification, *A. syriaca* is distributed mainly in type-I biotopes, which are formed as a result of the constant effect of the anthropogenic factor.

The influence of the selected species on biodiversity was determined using the Invasive Species Assessment Protocol (Morse et al., 2004). The species was assessed with respect to the total points from the answers on the posed questions.

The assessment of invasiveness (I-Rank) yielded the following results: (1) the ecological effect is high (Subrank I Intervals = 102; Subrank Values = 50); (2) the current distribution and density are high (Subrank II Intervals = 25; Subrank Values = 25); (3) the trends in colonization and density are moderate (Subrank III Intervals = 54; Subrank Values = 10); (4) the complexity of the control is high (Subrank IV Intervals = 50; Subrank Values = 10). The total I-Rank index is very high (I-Rank = 95), which poses a serious threat to local plant species and communities.

At the present time, methods of controlling *A. syriaca* are not used in the study region and throughout Ukraine, although there is a certain experience in this issue.

Studies on methods of controlling *A. syriaca* plants were carried out in Ukraine; different types of herbicides were used in Kyiv region. Roundup and Banvel 4S480 SL were chosen for the control; they were used both separately and in different amounts and as a whole, which induced the dieout of the aboveground part of *A. syriaca* and some damage of the underground part. The separate use of each herbicide also did not yield positive results (Khomyuk, 2011).

According to our observations, mechanical treatment increases the number of root buds and, accordingly, shoots. According to the preliminary data, in one of the sample areas (village of Kuntsevo, Novosanzharsky district, Poltava region; the period of observation from 2011 to 2016), *A. syriaca* was observed to be displaced by high-grass meadow plants; although the number of milkweed individuals decreases from year to year, these studies need to be continued. This problem should possibly be solved at the national level using a complex of methods of controlling this species, including the biological method. In our opinion, this species should be recommended for inclusion in the quarantine list of plants.

CONCLUSIONS

An integrated investigation of *A. syriaca*, one of the potentially invasive species in the Romensko-Poltavsky Geobotanical District, established that it forms clones. The viability of the seeds is high (100%); however, the laboratory germinating ability of the seeds of the species is low (25–50%). Under natural conditions, the life strategy is focused on vegetative reproduction. The communities with the involvement of *A. syriaca* are floristically poor; they belong to the *Rudbeckio laciniatae-Solidaginetum canadensis* Tüxen et Raabe ex Anioł-Kwiatkowska 1974 and *Asclepiadetum syriacae* Láníková in Chytrý 2009 associations. According to the Invasive Species Assessment Protocol, the level of species invasiveness is high in the studied region (I-Rank = 95), which indicates a serious threat to local species and natural communities owing to the

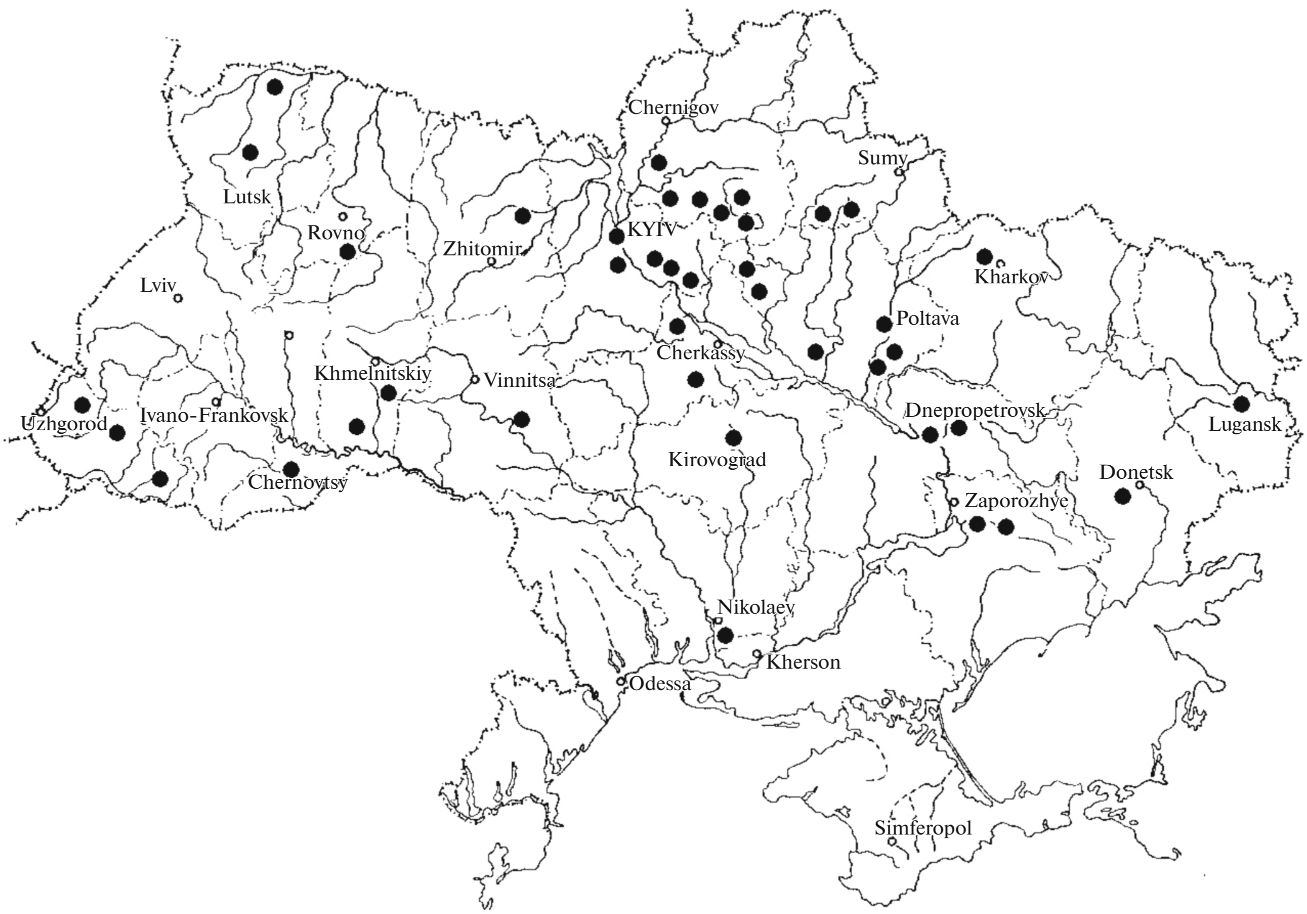

Fig. 6. Map of *Asclepias syriaca* L. distribution in Ukraine.

distribution of *A. syriaca*. In the future, this species may possibly rank as an invasive species.

In our opinion, taking into account the pattern of *A. syriaca* distribution in the Romensko-Poltavsky Geobotanical District and Ukraine as a whole (Fig. 6), the species will distribute more intensely and occupy considerable areas in the study region (most likely, northward and southeastward).

REFERENCES

Abbate, G., *An Annotated Checklist of the Italian Vascular Flora*, Conti, F., Abbate, G., Alessandrin, A., and Blasi, C., Eds., Roma: Palombi, 2005.

Bacieczko, W., Winiarska, M., and Baszutska, U., *Asclepias syriaca* L. from the family Asclepiadaceae—an invador in the flora of Poland, *Nauk. Visn. Nats. Leso-Tekhn. Univ., Ukraine*, 2013, vol. 23, no. 10, pp. 52–58.

Bagi, I., Common milkweed (*Asclepias syriaca* L.), in *The Most Important Invasive Plants in Hungary*, Botta-Dukàt, Z. and Balogh, L., Eds., Vácrátót: Inst. Ecol. Bot., Acad. Sci. Hung., 2008, pp. 151–159.

Baillon, H., *Histoire des Plantes*, Vol. 10: *Monographie des Asclepiadacees, Convolvulacees, Polemoniacees et Boraginacees*, Paris: Hachette, 1890, vol. 10, no. 3, pp. 221–304.

Baziner, F., Excellent melliferous perennial plant, *Zemledel. Gazeta*, 1855, no. 23, pp. 90–91.

Braun-Blanquet, J., *Pflanzensoziologie Grundzüge der Vegetationskunde*, Berlin: Springer-Verlag, 1928.

Budzhak, V.V. and Dvirna, T.S., Mapping of adventitious plant species of Romensko-Poltavsky geobotanical okrug, *Biol. Syst.*, 2014, vol. 6, no. 1, pp. 78–81.

Didukh, Ya.P., Fitsailo, T.V., Korotchenko, I.A., Yakushenko, D., and Pashkevich, N.A., *Biotopy lisovoi ta lisostepovoi zon Ukraini* (Biotopes of Forest and Forest-Steppe Zones of Ukraine), Kyiv: MACROS, 2011.

Dvirna, T.S., Ergasiophytes—unstable component of adventitious fraction of flora of the Romensko-Poltavsky geobotanical okrug, *Mater. mizhn. nauk. konf. "Rol' botanichnikh sadiv ta dendroparkiv u zberezhenni ta zbagachenni biologichnogo riznomanittya urbanizovanikh teritorii," Kiïv, 28–31 travnya 2013* (Proc. Int. Sci. Conf. "Role of Botanical Gardens and Arboretums in Preserving and Enriching the Biodiversity of Urbanized Territories," Kyiv, May 28–31, 2013), Kyiv: Megapolis Ecomonitoring and Biodiversity Research Centre, Natl. Acad. Sci. Ukraine, 2013, pp. 66–67.

Dvirna, T.S., *Asclepias syriaca* L.—history of cultivation and current distribution in Romensko-Poltavsky geobotanical district (Ukraine), *Mater. raboch. sovesh. "Invazionnaya biologiya: sovremennoe sostoyanie i perspektivy," Moskva, 10–13 sentyabrya 2014* (Proc. Working Meet. "Invasive Biology: Current State and Prospects," Moscow, September 10–13, 2014), Maiorov, S.R., Ed., Moscow: MAKS, 2014, pp. 82–88.

Dvirna, T.S., Distribution of selected invasive plant species in the Romensko-Poltavsky geobotanical district (Ukraine), *Biodivers. Res. Conserv.*, 2015, vol. 40, pp. 37–49.

Fiziko-geograficheskoe raionirovanie Ukrainskoi SSR (Physical-Geographic Zoning of Ukrainian SSR), Popov, V.P., Ed., Kyiv: Kyiv Univ., 1968.

Geobotanichne raionuvannya Ukraïns'koï SSR (Geobotanical Zoning of the Ukrainian SSR), Barbarich, A.I., Ed., Kyiv: Naukova Dumka, 1977.

Gerhardt, F., Propagation and food translocation in milkweed, *J. Agric. Res.*, 1929, vol. 39, no. 11, pp. 837–851.

Khomyuk, S.O., Features of germination of common milkweed, *Karantin Zashch. Rosl.*, 2011, no. 5, pp. 27–28.

Kornaś, J., A geographical-historical classification of synanthropic plants, *Mater. Zakł. Foitosoc. Stos. U.W.*, 1968, no. 25, pp. 33–41.

Kornaś, J., Analysis of synanthropic flora, *Wiad. Bot.*, 1977, no. 21, pp. 85–91.

Kuz'menko, A., *Asclepias cornuti* Decaisne distribution and culture in Ukraine, *Tr. Sil's'ko-Gospodar. Bot.*, 1929, vol. 2, pp. 1–26.

Leisle, V., Milkweed in the Central Chernozem Region, *Sovet. Kauchuk*, 1932, nos. 11–12.

Makogon, V.N., *Sovetskii natural'nyi kauchuk* (Soviet Natural Rubber), Moscow: Gos. Uch.-Pedagog. Izd., 1932.

Morse, L.E., Randall, J.M., Benton, N., Hiebert, R., and Lu, S., *An Invasive Species Assessment Protocol, Vers. 1: Evaluating Non-Native Plants for Their Impact on Biodiversity*, Arlington: NatureServe, 2004.

Paukova, Ž., Knápeková, M., and Hauptvogl, M., Mapping the occurrence of populations of alien species *Asclepias syriaca* and *Fallopia japonica* in agricultural areas of Ukraine, *J. Centr. Eur. Agr.*, 2014, vol. 15, no. 2, pp. 12–22.

Protopopova, V.V., *Sinantropnaya flora Ukrainy i puti ee razvitiya* (The Synanthropic Flora of Ukraine and the Ways of Its Development), Kyiv: Naukova Dumka, 1991.

Protopopova, V.V. and Shevera, M.V., Ergasiophytes as a potential reserve in Ukrainian alien fraction flora, *Mater. Mizhn. nauk. konf. "Rol' botanichnikh sadiv ta dendroparkiv u zberezhenni ta zbagachenni biologichnogo riznomanittya urbanizovanikh teritorii," Kiïv, 28–31 travnya, 2013* (Proc. Int. Sci. Conf. "Role of Botanical Gardens and Arboretums in Preserving and Enriching the Biodiversity of Urbanized Territories," Kiev, May 28–31, 2013), Kyiv: Megapolis Ecomonitoring and Biodiversity Research Centre, Natl. Acad. Sci. Ukraine, 2013, pp. 138–139.

Protopopova, V.V. and Shevera, M.V., Ergasiophytes of the Ukrainian flora, *Biodiv. Res. Conserv.*, 2014, vol. 35, pp. 31–46.

Pyšek, P., Danihelka, J., Sádlo, J., Chrtek, J., Jr., Chytrý, M., Jarošik, V., Kaplan, Z., Krahulec, F., Moravcová, L., Pergl, J., Štajerová, K., and Tichý, L., Catalogue of alien plants of the Czech Republic: checklist update, taxonomic diversity and invasion patterns, *Preslia*, 2012, vol. 84, pp. 155–255.

Radde-Fomina, O., Technical spinning plant *Asclepias cornuti* and its use in Ukrainian culture, *Visn. Sil's'ko-Gospodar. Nauki*, 1922, vol. 1, no. 2, pp. 62–63.

Richardson, D.M., Pyšek, P., Rejmánek, M., Barbour, M.G., Panetta, F.D., and West, C.J., Naturalization and invasion of alien plants: concepts and definitions, *Divers. Distrib.*, 2000, vol. 6, no. 2, pp. 93–207.

Stolbin, P.A., Milkweed (*Asclepias syriaca*) as an object for selections, in *Selektsiya kauchukonosnykh rastenii* (The Selection of Rubber Plants), Kuptsov, A.I., Ed., Moscow: Sel'khozgiz, 1937, no. 1, pp. 63–851.

Vegetace České Republiky, Vol. 2: Ruderální, plevelová, skalní a suťová vegetace (Vegetation of the Czech Republic, Vol. 2: Ruderal, Weed, Rock and Scree Vegetation), Chytrý, M., Ed., Praha: Academia, 2009.

Verloove, F., Catalogue of neophytes in Belgium (1800–2005), *Scripta Bot. Belg.*, 2006, vol. 39, pp. 1–89.

Vinogradova, Yu.K. and Kuklina, A.G., *Resursnyi potentsial invazionnykh vidov rastenii. Vozmozhnosti ispol'zovaniya chuzherodnykh vidov* (Resource Potential of Invasive Plant Species. Opportunities for Using Alien Species), Moscow: GEOS, 2012.

Wallnöfer, B., An annotated checklist of the vascular plants of the Cres-Losinj (Cherso-Lussino) archipelago (NE-Adriatic Sea, Croatia), *Ann. Naturhist. Mus. Wien*, 2008, vol. 109B, pp. 207–318.

Woodson, R.E., Jr., The North American species of *Asclepias* L., *Ann. Missouri Bot. Gard.*, 1954, vol. 41, pp. 1–211.

Zinchenko O.I., Koroteev A.V., Kalens'ka S.M., Demidas' G.I., Petrichenko V.F., Salatenko V.N., Fedorchuk M.I., Tkachuk V., and Bilonozhko, V.Ya., *Roslinnitstvo: Praktikum (laboratorno-praktichni zanyattya)* (Crop Production: Practical and Laboratory Manual), Vinnitsa: Nova Kniga, 2010.

Zlobin, Yu.A., *Printsipy i metody izucheniya tsenoticheskikh populyatsii rastenii* (Principles and Methods for Studying Cenotic Populations of Plants: Manual), Kazan: Kazan. Gos. Univ., 1989.

Zlobin, Yu.A., *Populyatsionnaya ekologiya rastenii: sovremennoe sostoyanie, tochki rosta* (Population Ecology of Plants: Current State, in Terms of Growth), Sumy: Univ. Kniga, 2009.

Translated by D. Zabolotny