

NOTES ON ALIEN PLANT SPECIES *AMORPHA FRUTICOSA* NEW TO LITHUANIA

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Abstract

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Woody plant species in recent decades have increasingly often been recorded escaped from cultivation and naturalized. In 2013, a new alien woody species *Amorpha fruticosa* L. (Fabaceae) was first found in Lithuania. In several Central European countries, *A. fruticosa* is recognized as invasive species that pose serious threat to natural habitats and ecosystems. To date, *A. fruticosa* has been registered in three localities in Lithuania: two populations in Ukmergė district and one population in Prienai district. Considering the present state of revealed *A. fruticosa* populations, it is concluded that this species in Lithuania is already naturalized and potentially invasive. Estimated total area occupied by *A. fruticosa* in three known localities is about 0.2 ha. In certain areas this species can become abundant and invade significant areas of meadow, forest-edge and other open habitats. Therefore, its immediate control and subsequent eradication can reduce risk of future invasion. Cultivation of *A. fruticosa* should be forbidden outside the ornamental plantations.

Keywords: Distribution, Fabaceae, habitats, invasiveness, naturalization, woody alien species.

INTRODUCTION

For various purposes introduced numerous woody plant species in recent decades have escaped from cultivation, become naturalized and some of them become invasive (RICHARDSON, 1998; WILLIAMS & CAMERON, 2006; ELDRIDGE et al., 2012; RICHARDSON & REJMÁNEK, 2011; REJMÁNEK & RICHARDSON, 2013). In many parts of the world, alien trees and shrubs now feature prominently on the lists of invasive alien plants. Surprisingly, many woody plant species have become naturalized or invasive only recently (RICHARDSON & REJMÁNEK, 2011). In Lithuania, the list of legally invasive plants includes 19 species (APLINKOS MINISTERIJA, 2015) and six of these are woody plants: *Acer negundo* L., *Amelanchier spicata* (Lam.) K.Koch, *Cytisus scoparius* (L.) Link, *Prunus serotina* Ehrh., *Robinia pseudoacacia* L. and *Rosa rugosa* Thunb. (GUDŽINSKAS et al., 2014).

In 2013, a new alien woody species *Amorpha fruticosa* L. (Fabaceae) was first recorded in Lithuania. In several Central European countries, *A. fruticosa* is recognized as invasive species that pose serious threat to natural habitats and ecosystems (PYŠEK et al., 2002; ESSL & RABITSCH, 2002; BOTTA-DUKAT, 2008; RADULOVIĆ et al., 2008; SĂRĂȚEANU, 2010, etc.). One of the best predictors of invasiveness of introduced species is whether they have invaded in other parts of the world (GORDON et al., 2010, 2011). Therefore, particular attention should be paid to the spread and naturalization of *A. fruticosa* in the regions with similar climates.

Amorpha fruticosa is native to North America. The native range of the species extends from southern Canada to northern Mexico, west to California, and east to Florida (GLEASON, CRONQUIST, 1991), whereas in several states of the USA, it is regarded as a noxious weed (GLAD & HALSE, 1992; EVANS et al.,

2003; DiTOMASO et al., 2013). It is widely introduced in North Asia and Europe (WEBER & GUT, 2004; TAKAGI & HIOKI, 2013; JUNG, 2014).

Time of introduction of *A. fruticosa* in Lithuania is unknown, but probably it happened at the end of the 19th or in the first half of the 20th century. SNARSKIS (1954) reported that *A. fruticosa* is rarely cultivated ornamental shrub noted in Vilnius, Kaunas and Šilutė. Later this shrub was sometimes cultivated in gardens and parks as well as was planted in wind-break belts along railways (NAVASAITIS, 1971). In parks of Lithuania, *A. fruticosa* is very rarely cultivated (JANUŠKEVIČIUS, 2004). Several other species of the genus *Amorpha* (*A. californica* Nutt., *A. canescens* Pursh, *A. glabra* Desf. ex Pers. and *A. paniculata* Torr. et A.Gray) are also occasionally cultivated in private gardens and collections (NAVASAITIS, STRAIGYTĖ, 2006).

In Latvia, *A. fruticosa* was introduced in 1888 and it is still rarely cultivated in ornamental plantations. This shrub has been recorded in 18 localities and in some areas it occurs as escaped naturalized species (LAIVIŅŠ et al., 2009). Three other species of this genus have been recorded in parks and gardens of Latvia: *A. californica* Nutt., *A. nana* Nutt. and *A. paniculata* Torr. et A.Gray (LAIVIŅŠ et al., 2009).

The aim of this study was to evaluate the present state of *A. fruticosa* populations, the level of naturalization, and to estimate the potential of the species invasiveness.

MATERIALS AND METHODS

Investigations on *A. fruticosa* were performed in August 2013 and June–July 2014 under the project “Inventory of natural habitats of European Community interest in Lithuania”. Collected specimens of this species are deposited at the Herbarium of the Institute of Botany of the Nature Research Centre (BILAS). A map of distribution of this species in Lithuania is compiled using grid system (GUDŽINSKAS, 1993). In each locality, the limits of each population were registered using GPS device and later on the basis of these data the land area occupied by *A. fruticosa* was calculated.

Description of species was compiled on the basis of measurements of the collected herbarium samples

(see *Examined specimens*). Herbarium specimen from each locality contains from three to five vegetative and from five to 10 generative shoots.

RESULTS AND DISCUSSION

In August 2013, during the inventory of EU natural habitats in Ukmergė district (central Lithuania) earlier not registered alien plant species of the Fabaceae family was recorded. The study of specimens revealed that it was *A. fruticosa*. In summer of 2014, this species was recorded in two other localities in central and southern Lithuania.

Amorpha fruticosa L., Sp. Pl., 2: 713. 1753.

This species is deciduous 1–3(4) m tall shrub (Fig. 1). Young stems are pubescent. Leaves are imparipinnate, 10–15 cm long, with 11–25 leaflets, which are ovate to elliptic, 1–4 cm long and 0.6–2 cm wide. Stipules are bristle-like. Inflorescences are terminal or subterminal, 7–15 cm long, densely pubescent racemes (Fig. 2). Bracts are 3–4 mm long. Calyx is 2–3 mm long, with triangular tooth, which are shorter than the calyx tube. Standard dark purple or blue-violet, obcordate, about 6 mm long; wings and keel are absent. Stamens are bright yellow. Legume is indehiscent, dark brown, oblong, curved and contains a single seed, occasionally seeds are two.



Fig. 1. Shrub of *Amorpha fruticosa* at anthesis

To date, *A. fruticosa* has been recorded in three localities in Lithuania: two populations in Ukmergė district (environs of Pabaiskas, the Šaltupys forest and environs of Vepriai, Rizgonys village) and one population in Prienai district (environs of Stakliškės, Trečionys village) (Fig. 3).



Fig. 2. Inflorescence of *Amorpha fruticosa*

In the environs of Pabaiskas (Ukmergė distr.), in the Šaltupys forest, where *A. fruticosa* was first recorded in the wild, it occupies about 500 m² area. This population consists of about 200 individuals of various ages and sizes that grow in an old forest cutting area and in neighbouring forest glades. In the environs of Rizgonys village (Ukmergė distr.), *A. fruticosa* grows on the edge of forest, in an abandoned dry meadow overgrown mainly with young trees of *Pinus sylvestris* and *Betula pendula*. Population of *Amorpha fruticosa* occupies about 1400 m² area with uneven density of individuals. At the edge of the forest, this species forms dense stand, whereas in the open part of the meadow solitary individuals prevail. Over 500 shrubs of various sizes were estimated in the area. Most shrubs were less than 1 m in diameter and had a few shoots, whereas about 30 shrubs were very large, with numerous shoots and more than 2 m in diameter. In the vicinities of Trečionys village, *A. fruticosa* occupied about 190 m² area of dry aban-

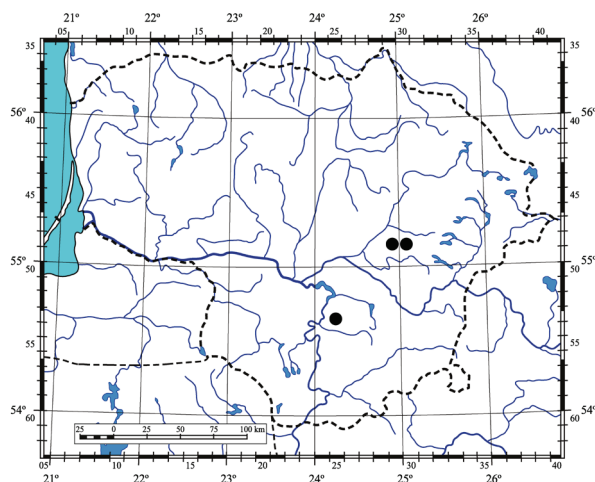


Fig. 3. Distribution of *Amorpha fruticosa* in Lithuania

doned meadow on a slope of the hill. The meadow was also overgrown with young trees of *Pinus sylvestris* and *Betula pendula*. Total number of *Amorpha fruticosa* individuals in this population tends to be lower to compare with population in the environs of Rizgonys village and was comprised of about 60 shrubs.

The height of *A. fruticosa* in all localities was slightly different. The tallest individuals (up to 3.5 m tall) were registered in the altupys forest, where they grow in wood cutting area. In the environs of Rizgonys village, individuals of about 2 m tall prevailed, whereas on dry slope in an abandoned meadow in vicinities of Trečionys village, most shrubs were of about 1 m tall and only solitary individuals were up to 1.5 m tall. In all surveyed localities, *A. fruticosa* flowered abundantly in June and at the beginning of July, however, seed production was not investigated. Reproduction by seeds is highly probable, because individuals of different stages of development in all populations were found. It is known that *A. fruticosa* primarily reproduces by seeds and vegetative reproduction is not characteristic of this species (DiTOMASO et al., 2013). Considering the present state of known *A. fruticosa* populations, we can conclude that this species is already naturalized in Lithuania.

According to the risk assessment, which is based on various biogeographical and ecological aspects of the species, *A. fruticosa* is a potential invasive plant species in Central Europe and its further observation is required (WEBER & GUT, 2004). However, in Lithuania, *A. fruticosa* and other invasive or

potentially invasive species (*Amelanchier spicata*, *Quercus rubra* L., *Robinia pseudoacacia*, etc.) are recommended to plant in pine and spruce plantations in order to prevent spread of conifer root and butt rot caused by *Heterobasidion annosum* (Fr.) Bref. (VASILIAUSKAS, 2000).

Importance of control and eradication of *Amorpha fruticosa* is emphasized by many researchers from Europe and Asia (ESSL & RABITSCH, 2002; WEBER & GUT, 2004; RADULOVIC et al., 2008; TAKAGI & HIOKI, 2013, etc.). In Czech Republic, France, Romania, Serbia, European part of Russia and other countries, the species proved a high capacity spread and is adapted to occupy many types of habitats such as various types of wetlands, river banks, forest edges, unvegetated or sparsely vegetated shores, water-fringing reedbeds, riverine and lakeshore scrubs, meadows, disturbed lands, etc. (ESSL & RABITSCH, 2002; PY EK et al., 2002; LOMBARD, 2007; RADULOVIC et al., 2008; SĂRĂȚEANU, 2010; DUMITRAȘCU et al., 2013).

Amorpha fruticosa is capable of effective symbiotic N₂ fixation (WANG et al., 1999; DEHAAN et al., 2006) and enriches soil by nitrogen compounds (NAVARRETE-TINDALL et al., 2003). Significant input of nitrogen compounds into the soil pose unwanted changes of natural habitat conditions and acts in the same way like other invasive species of the Fabaceae family, i.e. *Lupinus polyphyllus* and *Robinia pseudoacacia*. A case study in Japan revealed that in the areas populated by *A. fruticosa*, the diversity of plant species was lower compared to non-invaded areas (TAKAGI & HIOKI, 2013).

Amorpha fruticosa is tolerant of defoliation and capable to regrow to a height of 1 m after annual cutting to 10 cm for seven years (DEHAAN et al., 2006). Therefore, eradication of *A. fruticosa* by means of cutting can be a complicated and time-consuming process. It is reported that this plant is difficult to control mechanically as it vigorously resprouts from crowns. The best way of mechanical control is a repeated defoliation and digging of the root. *A. fruticosa* can be effectively eradicated by the treatment of cut stumps with herbicides (DITOMASO et al., 2013).

Because *A. fruticosa* is rarely cultivated in ornamental plantations in Lithuania, its rapid large-scale invasion is not probable. Currently, in Lithuania, it occurs in a small number of localities and occupies

rather small area. Estimated total area occupied by *A. fruticosa* in three known localities is about 0.2 ha. Nevertheless, in some areas this species can become abundant and invade significant areas of meadow, forest-edge and other open habitats. Therefore, its immediate control and subsequent eradication can reduce risk of future invasion. Cultivation of *A. fruticosa* should be forbidden outside the ornamental plantations (gardens and parks).

Examined specimens. (1) Ukmergė distr., ca. 6 km east of Pabaiskas, the Šaltupys forest, at the edge of spruce stand and in wood cutting area, abundant (55.163618° N; 24.663604° E). 21 August, 2013. Leg. et det. Z. Gudžinskas and L. Petrulaitis (BILAS); (2) Ukmergė distr., ca. 3 km to the south-west of Vepriai, Rizgonys village, at the edge of the Bečiai forest, abundant (55.127886° N; 24.553849° E). 18 June, 2014. Leg. et det. Z. Gudžinskas and E. Žalneravičius (BILAS); (3) Prienai distr., ca. 4 km to the north-west of Stakliškės, northern limit of Trečionys village, on the eastern hill slope, in an abandoned dry meadow, abundant (54.606370° N; 24.264975° E). 13 July, 2014. Leg. et det. Z. Gudžinskas and E. Žalneravičius (BILAS).

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REFERENCES

- APLINKOS MINISTERIJA, 2015: Dėl Lietuvos Respublikos aplinkos ministro 2004 m. rugpjūčio 16 d. įsakymo Nr. D1-433 „Dėl Invazinių Lietuvoje organizmų rūšių sąrašo patvirtinimo ir dėl kai kurių aplinkos ministro įsakymų pripažinimo netekusiais galios“ pakeitimo. – Teisės aktų registras, 2015-07-20, Nr. 11487.

- BOTTA-DUKAT Z., 2008: Invasion of alien species to Hungarian (semi-)natural habitats. – *Acta Botanica Hungarica*, 50: 219–227.
- DEHAAN L.R., EHLKE N.J., SHEAFFER C.C., WYSE D.L., DEHAAN R.L., 2006: Evaluation of diversity among North American accessions of false indigo (*Amorpha fruticosa* L.) for forage and biomass. – *Genetic Resources and Crop Evolution*, 53: 1463–1476.
- DiTOMASO J.M., KYSER G.B., ONETO S.R., WILSON R.G., ORLOFF S.B., ANDERSON L.W., WRIGHT S.D., RONCORONI J.A., MILLER T.L., PRATHER T.S., RANSOM C., BECK K.G., DUNCAN C., WILSON K.A., MANN J.J., 2013: Weed Control in Natural Areas in the Western United States. – University of California.
- DUMITRAȘCU M., DOROFTEI M., GRIGORESCU I., KUCSICA G., DRAGOTĂ C.-S., 2013: Key biological indicators to assess *Amorpha fruticosa* invasive terrestrial plant species in Romanian protected areas. – In: Proceedings of 9th WSEAS International Conference on Energy, Environment, Ecosystems and Sustainable Development, Recent Advances in Environmental Science: 144–149. – București.
- ELDRIDGE D.J., MAESTRE F.T., MALTEZ-MOURO S., BOWKER M.A., 2012: A global database of shrub encroachment effects on ecosystem structure and functioning. – *Ecology*, 93(11): 2499.
- ESSL F., RABITSCH W., 2002: Neobiota in Österreich. – Wien.
- EVANS J.R., NUGENT J.J., MEISEL J.K., 2003: Invasive Plant Species, Inventory and Management. Plan for the Hanford Reach National Monument. – Washington.
- GLAD J., HALSE R., 1992: Invasion of *Amorpha fruticosa* L. (*Leguminosae*) along the Columbia and Snake Rivers in Oregon and Washington. – *Madrona*, 40(1): 62–65.
- GLEASON H.A., CRONQUIST A., 1991: Manual of Vascular Plants of Northeastern United States and adjacent Canada (2nd ed.). – New York.
- GORDON D.R., RIDDLE B., PHELOUNG P.C., ANSARI S., BUDDENHAGEN C., CHIMERA C., DAEHLER C.C., DAWSON W., DENSLOW J.S., TSHIDADA N.J., LAROSA A., NISHIDA T., ONDERDONK D.A., PANETTA F.D., PY EK P., RANDALL R.P., RICHARDSON D.M., VIRTUE J.G., WILLIAMS P.A., 2010: Guidance for addressing the Australian Weed Risk Assessment questions. – *Plant Protection Quarterly*, 25: 56–74.
- GORDON D.R., TANCIG K.J., ONDERDONK D.A., GANTZ C.A., 2011: Assessing the invasive potential of biofuel species proposed for Florida and the United States using the Australian Weed Risk Assessment. – *Biomass and Bioenergy*, 35, 74–79.
- GUDŽINSKAS Z., 1993: Genus *Ambrosia* L. (*Asteraceae*) in Lithuania. – *Thaiszia*, 3(1): 89–96.
- GUDŽINSKAS Z., KAZLAUSKAS M., PILĀTE D., BALALAIKINS M., PILĀTS M., ŠAULYS A., ŠAULIENĖ I., ŠUKIENĖ L., 2014: Lietuvos ir Latvijos pasienio regiono invaziniai organizmai. Lietuvos un Latvijos pierobežas invazivie organismi. – Vilnius
- JANUŠKEVIČIUS L., 2004: Lietuvos parkai. – Kaunas.
- JUNG M.J., 2014: *Amorpha* L. (*Leguminosae*), a newly recorded naturalized genus in Taiwan. – *Taiwan Journal of Forest Sciences*, 29(4):285–290.
- LAIVIŅŠ M., KRAMPIS I., ŠMITE D., BICE M., KNAPE D., ŠULCS V., 2009: Latvijas kokaugu atlants. Atlas of Latvian woody plants. – Rīga.
- LOMBARD C., 2007: Etude et préconisation de gestion d'*Amorpha fruticosa*, plante invasive sur les dunes du Petit Travers à Mauguio (Hérault). BTSA Gestion et Protection de la Nature, option gestion des espaces naturels. – Montpellier.
- NAVARRETE-TINDALL N.E., VAN SAMBEEK J.W., STEVEN D., MCGRAW K., MCGRAW R.L., 2003: Adaptation of four *Amorpha* shrubs to four light levels. – In: VAN SAMBEEK J.W., DAWSON J.O., PONDER F., LOEWENSTEIN E.F., FRALISH J.S. (eds), Proceedings, 13th Central Hardwood Forest conference; 2002 April 1–3, Urbana: 203–205. – St. Paul.
- NAVASAITIS M., 1971: Amorfa – *Amorpha*. – In: NATKEVIČAITĖ-IVANAUSKIENĖ M. (ed.), Lietuvos TSR flora, 4: 357–358. – Vilnius.
- NAVASAITIS M., STRAIGYTĖ L., 2006: Skinderišio dendroparkas. – Kaunas.
- PYŠEK P., SÁDLO J., MANDÁK B., 2002: Catalogue of alien plants of the Czech Republic. – Preslia, 74: 97–186.
- RADULOVIĆ S., SKOČAJIĆ D., BJEDOV I., ĐUNISIJEVIĆ-BOJOVIĆ D., 2008: *Amorpha fruticosa* L. on wet sites in Belgrade. – *Bulletin of the Faculty of Forestry*, 97: 221–234.
- REJMÁNEK M., RICHARDSON D.M., 2013: Trees and

- shrubs as invasive alien species – 2013 update of the global database. – *Diversity and Distributions*, 19: 1093–1094.
- RICHARDSON D.M., REJMÁNEK M., 2011: Trees and shrubs as invasive alien species – a global review. – *Diversity and Distributions*, 17: 788–809.
- RICHARDSON D.M., 1998: Forestry trees as invasive aliens. – *Conservation Biology*, 12, 18–26.
- RICHARDSON D.M., 2006: *Pinus*: a model group for unlocking the secrets of alien plant invasions? – *Preslia*, 78: 375–388.
- SĂRĂȚEANU V., 2010: Assessing the influence of *Amorpha fruticosa* L. invasive shrub species on some grassland vegetation types from Western Romania. – *Research Journal of Agricultural Science*, 42(1): 536–540.
- SNARSKIS P., 1954: Vadovas Lietuvos TSR augalams pažinti. – Vilnius
- TAKAGI K., HIOKI Y., 2013: Autecology, distributional expansion and negative effects of *Amorpha fruticosa* L. on a river ecosystem: A case study in the Sendaigawa River, Tottori Prefecture. – *Landscape and Ecological Engineering*, 9(1): 175–188.
- VASILIAUSKAS A., 2000: Laikinosios rekomendacijos kovai su šaknine pintimi spygliuočių medynuose ir miško želdinių įveisimui žemės ūkiui netinkamose žemėse. – Vilnius.
- WANG E.T., VAN BERKUM P., SUI X.H., BEYENE D., CHEN W.X., MARTINEZ-ROMERO E., 1999: Diversity of rhizobia associated with *Amorpha fruticosa* isolated from Chinese soils and description of *Mesorhizobium amorphae* sp. nov. – *International Journal of Systematic Bacteriology*, 49: 51–65.
- WEBER E., GUT D., 2004: Assessing the risk of potentially invasive plant species in central Europe. – *Journal for Nature Conservation*, 12(3): 171–179.
- WILLIAMS P.A., CAMERON E.K., 2006: Creating gardens: the diversity and progression of European plant introductions. – In: ALLEN R.B., LEE W.G. (eds), *Biological invasions in New Zealand*: 33–47. – Berlin.

PASTABOSAPIE LIETUVOJE NAUJĄ SVETIMŽEMĘ AUGALŲ RŪŠĮ – KRŪMINĘ AMORFĄ (*AMORPHA FRUTICOSA*)

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Santrauka

Pastaraisiais dešimtmečiais vis dažniau aptinkama sulaukėjusių ir natūralizavusių svetimžemių rūšių medžių ir krūmų, kurie buvo introdukuoti ir auginami įvairiais tikslais, dažniausiai – kaip dekoratyviniai augalai. 2013 m. Lietuvoje pirmą kartą aptiktas sulaukėjęs pupinių (*Fabaceae*) šeimos augalas – krūminė amorfa (*Amorpha fruticosa* L.). Kai kuriose Europos šalyse ši rūšis yra laikoma invazine, nes intensyviai plinta ir skverbiasi į natūralias buveines, smarkiai keičia jų struktūrą ir rūšių sudėtį.

Iki šiol *A. fruticosa* Lietuvoje aptikta trijose vietovėse. Dvi populiacijos nustatytos Ukmergės r. (Pabaisko apyl., Šaltupio miške, miško aikštelėje ir senoje kirtavietėje ir Veprių apyl., Rizgonių k., Bečių

miško pakraštyje ir gretimose apleistose pievose), o viena aptikta Prienų r. (Stakliškių apyl., Trečionių k., kalvos šlaite, apleistoje pievoje). Sprendžiant pagal dabartinę populiacijų būklę, galima daryti išvadą, kad *A. fruticosa* Lietuvoje jau yra natūralizavusi rūšis ir yra potencialiai invazinė. Nustatyta, kad šių augalų sąžalynai trijose vietovėse iš viso užima apie 0,2 ha plotą. Įvertinus rūšies plitimą kitose šalyse, galima prognozuoti, kad Lietuvoje ji gali plisti, užimti didelius pievų, pamiškių ir kitų atvirų buveinių plotus. Dėl to reikia nedelsiant imtis kontroliuoti rūšies populiacijas ir jas naikinti, kad būtų laiku užkirstas kelias tolesniam plitimui ir sumažintas galimos invazijos pavojus.