Scientific Papers. Series B, Horticulture. Vol. LXV, No. 1, 2021
Print ISSN 2285-5653, CD-ROM ISSN 2285-5661, Online ISSN 2286-1580, ISSN-L 2285-5653

SOME OBSERVATIONS ON THE ECOLOGY AND MORPHOLOGICAL FEATURES OF A *HUMULUS SCANDENS* (LOUR.) MERR. (*H. JAPONICUS* SIEBOLD & ZUCC.) POPULATIONS FOUND ON THE DÂMBOVIȚA RIVER BANKS

Mihaela Ioana GEORGESCU[1], Elena SĂVULESCU[1], Vlad Ioan POPA[1, 2], Vasilica LUCHIAN[1], Emilia MOISESCU[1], Gabriel Cristian MILOȘ[1]

[1]University of Agronomic Sciences and Veterinary Medicine of Bucharest, Faculty of Horticulture, 59 Mărăști Blvd, District 1, Bucharest, Romania
[2]Research Center for Studies of Food and Agriculture Products Quality, University of Agronomic Sciences and Veterinary Medicine of Bucharest, 59 Mărăști Blvd, District 1, Bucharest, Romania

Corresponding author email: elena.savulescu@horticultura-bucuresti.ro

Abstract

Included today in the list of invasive plants of community interest in Europe, Humulus scandens (Lour.) Merr., an annual vine from East Asia, was introduced as medicinal and ornamental species in the middle of nineteen century first in North America and then in Europe. In România this species was reported first as a subspontaneous one, of unknown origin, becoming then a naturalized species. The populations of H. scandens that we found were established on the Dâmbovița river banks in a nitrophilous plant community, alongside Sambucus ebulus and Rubus caesius individuals. The observations that we made showed the trichomes types and their distribution on the vegetative organs (stem, leaves and bracts) of the H. scandens plants.

Key words*: Conietum maculati, Humulus scandens, trichomes.*

INTRODUCTION

In 1952, in Flora RPR, *Humulus scandens* (*H. japonicus*) appears as an ornamental species which occasionally could be found in some areas as sub spontaneous (Grințescu, 1952). There are no mentions regarding its introduction in the country.

A paper from 1969 indicates the presence of the species in Orșova town, in flooded areas of the Danube's banks (Morariu et al., 1969). In 1970, *H. scandens* was found in a *Bidens vulgata* association in the Timis meadow, alongside *Galinsoga parviflora*, *Chenopodium ambrosioides*, *Ch. album*, *Bidens tripartita Impatiens roylei*, *Helianthus tuberosus*, *Setaria viridis*, *Rubus caesius*, *Solidago serotina*, *Rudbeckia laciniata*, *Salix alba*, *Calystegia sepium*, *Humulus lupulus*, *Echinocystis echinata*, *Sicyos angulatus* (Vicol, 1970). In 1974, Roman indicates the presence of this species in the area of the former Ada-Kaleh island and at Gura -Văii, in a *Calistegyon* type alliance.

Still, in 1979, *H. scandens* was presented as an ornamental plant, suitable for pergola, kiosks and grilles due to the abundant growth and elegance of the foliage, with the 'Variegatus' variety being recommended in this regard (Preda, 1979).

In two successive works of Ciocârlan (2000, 2009) it is specified that this species is rarely found in our country; in addition to the formerly indicated sites, the area around the irrigation canals of Chirnogi village, Giurgiu county is also mentioned.

H. scandens is also listed among other species in Alien Plants of Romania by Sârbu & Oprea (2011).

In a bibliography synthesis supplemented by their own observations Otves et al. (2014) preserved the indication of the *H. scandens* presence in Timiș meadow and in wetlands of the Banat area.

With the Inventory Guide and distribution map of invasive and potentially invasive allogeneic plant species from Romania, in 2019, *H. scandens* is placed on the list of alarming alien species for the European Union. The species presence is also indicated in many parts of Romania, such as Banat, Maramureș, Muntenia, Oltenia, Transilvania (Anastasiu et al., 2019).

Regarded today as a transformer invasive species in Hungary and considered an alien species with a negative impact on native European flora only in the last decade, *H. scandens* is a native plant from the Far East (Balogh & Dancza, 2008). It grows in China, Japan, Mongolia, North and South Korea, Taiwan, Vietnam, Russian Federation (EPPO, 2019).

In the late nineteenth century *H. scandens* was introduced in both North America and Western Europe to be used as an ornamental and medicinal plant (as tonic in Asian medicine) (EPPO, 2019). The first record of the establishment of the species in the wild in Europe is a voucher herbarium specimen collected in 1893 from the wastelands along the road Cours Journu-Auber (Bordeaux); in North America the escape from cultivation and the naturalization of *H. scandens* were observed in the 1900s in Delaware.

Today the sale and cultivation of *H. scandens* as an ornamental vine are not yet regulated in different countries of Europe and North America (EPPO, 2019). However, in an assessment worksheet of the Minnesota Department of Natural Resources (2016) the status of *H. scandens* in 2012 is stipulated as that of a noxious weed thus prohibiting its sale.

In their original habitat *H. scandens* is found in woodland areas at the borders of the forests, in meadows, on river banks, in ruderale habitats or in wastelands (Balogh & Dancza, 2008). It was also described as a common weed in orchards, wheat or reed fields in Northern China (Li & Cao, 1981).

In invaded habitats *H. scandens* prefers sunny or partially sunny areas located mainly in riparian zones but it can be found in grasslands, hayfields, on roadsides or in open disturbed areas. It installs quickly on bare surfaces following temporary floods of streams' sides (Balogh & Dancza, 2008; EPPO, 2019; Briscoe et al. 2019).

In relation to *H. scandens*' environmental requirements, it is mentioned that it can appear in plant communities installed in soil with high pH and moisture (Oh et al., 2008). On the other hand, Balog & Dancza (2008) have observed that the plants are indifferent to soil pH but prefer over-fertilized soil rich in nitrogen. A study on the ecological plasticity of *H. scandens* in 2013 emphasized that it can adapt to a moderate hydric stress by lowering its size but that brings a decrease in its competition capacity (Pinston, 2013).

It can be found in various plant community such as *Humulus japonicus - Artemisia princeps, Chenopodium album, Setaria viridis - Echinochloa crus-galli, Galium spurium - Stellaria aquatica, Equisetum arvense, Persicaria thunbergii, Echinochloa crus-galli - Digitaria ciliaris* (Oh et al., 2008). In their native range *H. scandens* plants are included in two main associations: *Bidentetea tripartiti* and *Commelinetalia communis*, but in Hungary they are classified in *Calystegio-Impatienti glanduliferae* and *Arction lappae (Conietum maculati)* syntaxomomical units (Balogh & Dancza, 2008).

In France *H. scandens* was reported as invasive in communities similar to those with native species such as *Galium aparine, Rumex crispus, Persicaria lapathifolia, Veronica anagalis-aquatica* and *Convolvulus sepium* and non-native species such as *Ambrosia artemisiifolia, Artemisia verlotiorum, Artemisia annuua, Bidens frondosa, Helianthus tuberosus* or *Xanthium orientale* subsp. *italicum* (EPPO, 2019). Its impact on the native communities in the invaded areas is significant, causing a decrease in vegetation diversity and an alteration of ecosystems functions. A paper from 2009 analysed the impact of *H. scandens* on *Miscanthus sacchariflorus* and *Phragmites australis* communities. The growth of *H. scandens* until it overtopped other species determined the collapse of those two species and their rapid decomposition (Kim & Kim, 2009).

H. scandens has an impact on human communities too: the pollen produced was reported to provoke allergenic rhinitis in East Asia increasing the risk of asthma development, the

pollen count being higher than that produced by Artemisia or Ambrosia species (Park et al., 1999; Jeong et al., 2018).

The morphology of *H. scandens* as an annual dioecious vine was studied in comparison with that of *H. lupulus*, perennial vine (Ehara, 1955; Balogh & Dancza, 2008). The stem of both species is twining clockwise and has opposite leaves. On the aerial organs of both species there are hairs - pubescent, glandular on *H. lupulus* and rigid, spinulose on *H. scandens*. The opposite leaves are dark green and 3-5 lobate to *H. lupulus* and light green, 5-7 (-9) lobate to *H. scandens*. There are no lupulin-glands in female inflorescences of *H. scandens* unlike those of *H. lupulus*.

With a less economic value than *H. lupulus* - the absence of lupulin glands does not allow the use of the species in beer flavouring, however various research has been conducted on the properties of *H. scandens* plants as an anti-aging and antioxidant agent (Sung et al., 2015), for their anti-mycobacterial effects (Hong et al., 2014) or to dyeing silk fabrics (Ha & Lee, 2015).

The paper emphasizes a new location in Romania of a *H. scandens* population and describes the micro-morphological aspect of the plant's aerial organs.

MATERIALS AND METHODS

Micro-morphological observations were carried on plants collected in the last decade of October from a *H. scandens* populations found on the Dâmbovița river's sides, near Budești (Călărasi County), at 40.2322 latitude and 26.4545 longitude; the township is located on the 4'th National Road, 40 Km South of Bucharest.

A stereomicroscope type S8APO, equipped with a video camera Leica DFC 295 and a SEM FEI Inspect S50 were used to reveal the specific morphological and micromorphological features of the stem, leaves and bracts.

RESULTS AND DISCUSSIONS

The population of *H. scandens* was identified on the banks of the Dâmbovița River, on either side of the bridge located at the entrance to Budești township (Figure 1).

Figure 1. View from the bridge to the southern bank of the river Dâmbovița occupied by a population of *H. scandens*

Plants were settled only on the left riverside with southern exposure. Household's waste and garbage are stored in the bridge proximity and a large amount of organic nitrogen, in the advanced stage of mineralization stimulated the occurrence of a community of nitrophilous plants from the association *Conietum maculati* I. Pop 1968, facies with *Sambucus nigra*, *Urtica dioica* and *Ballota nigra* Cristurean et Țeculescu 1970 (Sanda et al. 2008) (Figure 2).

Figure 2. General view of the *Conietum maculati* association, *Sambucus ebulus* facies

The *H. scandens* population was also expanded in areas with characteristic waterfront vegetation (*Phragmites australis* and *Agrostis stolonifera*) (Figure 3).

Figure 3. *H. scandens* on stalks of *Phragmites australis* plants

Plants colonized both vigorous herbaceous plants and woody specimens of the *Salix*, *Fraxinus* or *Populus* species (Figure 4).

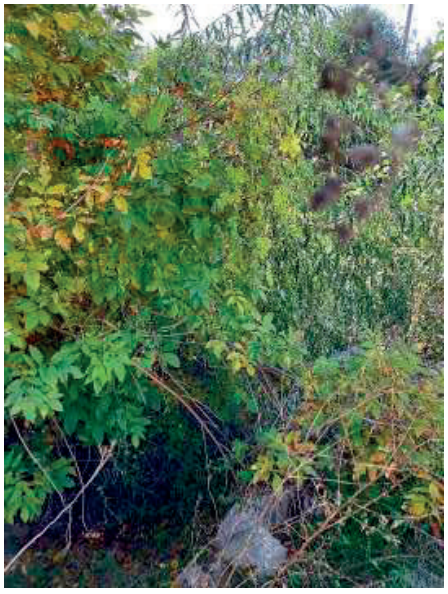

Figure 4. *H. scandens* on *Salix alba* plants

Plants were reached the maturity phase and were in seed-spreading phenophases; tested, their achenes showed a good germination capacity.

On some leaves it could be seen a strong attack of hop's powdery mildew *Podosphaera macularis* (*Spaherotheca macularis*) (Wallr.) U. Braun & S.Takaram (Figure 5).

Figure 5. Leaves of *H. scandens* attacked by *Podosphaera macularis*

The surface of the plants is rough, the stems, leaves and bracts being covered with different types of hairs and glands.

According to Ehara (1955), on the young stem and petiole there are double and single hooked climbing hairs and many types of conic hairs. But if we use the terminology for plant's hairs from Payne (1978) we can describe the adult stem, leaves and bracts as bearing anvil, hooked (uncinate) hairs and short bristle (uncinate) with cystolith.

Anvil hairs are spread among a mass of uncinate hairs on the branches of the stem and on the petiole (Figure 6).

Figure 6. Anvil hairs on *H. scandens'* petiole

On the adaxial side of the leaf lamina, towards the edges can be observed uncinate hairs; between or on veins there are short, uncinate

bristle with cystolith that make this surface very rough (Figure 7).

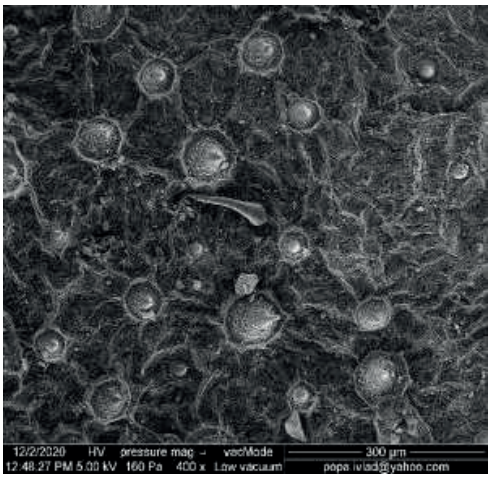

Figure 7. Short, uncinate bristle with cystolith on the adaxial side of lamina (SEM)

Uncinate hairs can be seen on the abaxial side of leaf lamina only on the main veins; also, there are glands scattered among the secondary veins (Figure 8).

Figure 8. Uncinate hairs and glands on the abaxial side of lamina

Bracts on the maturity are covered with uncinate hairs and it can be seen very rare glands on the abaxial side of them (Figure 9).

Figure 9. Uncinate hairs and glands on the adaxial side of bracts

CONCLUSIONS

The new location of a population of *Humulus scandens* (Lour.) Merr. in Romania confirms the occurrence of this species in association *Conietum maculati* I. Pop 1968, but in the facies with *Sambucus nigra*, *Urtica dioica* and *Ballota nigra* Cristurean et Țeculescu 1970.
Anvil, uncinate and short hairs with cystolith are spread on the aerial parts of the plant, and glands were observed on both leaves and bracts.

ACKNOWLEDGEMENTS

The paper is made under POIM/178/4/1/ 120008 project.

REFERENCES

Anastasiu, P., (Coord.), Sîrbu, C., Urziceanu, M., Camen-Comănescu, P., Oprea, A., Nagodă, E., Gavrilidis, Al. A., Miu, I., Memedem, D., Sîrbu, I., Manta, N. (2019). *Ghid de inventariere şi cartare a distribuţiei speciilor de plante alogene invazive şi potenţial invazive din românia*, tipar 2M Digital.

Balogh, L., & Dancza, I. (2008). Humulus japonicus, an emerging invader in Hungary. *Plant invasions: human perception, ecological impacts and management. Backhuys Publishers, Leiden*. 73-79.

Briscoe, R. D., Runquist, T. L., & Moeller, D. A. (2019, May 20). *Species Distribution Model Projections for Incipient Invasive Species of Minnesota*. *Retrived from* https://mitppc.umn.edu/sites/mitppc.umn.edu/files/2020-10/MN_10spp_Report_v2.pdf.

Ciocârlan, V. (2000). *Flora ilustrată a României: Pteridophyta et Spermatophyta*. Bucharest, RO: Ceres, Publishing House.

Ciocârlan, V. (2009). *Flora ilustrată a României: Pteridophyta et Spermatophyta*. Bucharest, RO: Ceres, Publishing House.

Ehara, K. (1955). Comparative morphological studies on the hop (Humulus lupulus L.) and the japanese hop (H. Japonicus Sieb. et Zucc.) *J.Fac.Agric.,* 10. 209-237.

Jeong, K. Y., Lee, J., Mistrello, G., Park, K. H., & Park, J. W. (2018). IgE Cross-Reactivity between Humulus japonicus and Humulus lupulus. *Yonsei medical journal*, *59*(7), 852.I.

EPPO (2019). *Humulus scandens* (Lour.) Merr. In European and Mediterranean Plant Protection Organization - Data sheets on pests recommended for regulation Bulletin. *OEPP/EPPO Bulletin (2019) 49 (2)*. 267–272

Grințescu, I. (1952). Familia Cannabinaceae. In *Flora RPR*, vol. I (pp. 331-336). Bucharest, RO: Academia RPR, Publishing House.

Ha, Y. K., & Lee, J. S. (2015). Combination Dyeing of Silk Fabrics with Extracts from Humulus japonicus and the Pruned Branches of Prunus persica Tree. *Textile Coloration and Finishing*, *27*(1), 80-95.

Hong, M. S., Son, E. S., Lee, S. J., Lee, S. K., Lee, Y. J., Song, S. D., & Eum, S. Y. (2014). Anti-mycobacterial effects of the extract of Humulus japonicus. *Korean Journal of Food Science and Technology*, *46*(1), 94-99.

Kim, S., & Kim, J. G. (2009). Humulus japonicus accelerates the decomposition of Miscanthus sacchariflorus and Phragmites australis in a floodplain. *Journal of Plant Biology*, *52*(5), 466-474.

Minnesota Noxious Weed Advisory Committee (NWAC) Assessment Worksheet (2016) *Japanese hops*. *Retrived from* https://misac.squarespace.com/s/JapaneseHops-MDARA00002JAHP-07-26-2016.pdf.

Morariu, I., Danciu, M., Ularu, P. (1969). Date noi din flora Porților de Fier. *St. Cerc. Biol, ser.Bot., 21, 1*. 17-22.

Oh, Y. J., Yoo, J. H., Moon, B. C., Sohn, S. I., Oh, S. M., & Kim, S. C. (2008). Habitat characteristic and community structures of Humulus japonicus in Korea's Middle region. *Korean Journal of Environmental Agriculture*, *27*(1), 72-79.

Otves Carola., Neacsu, A. G., & Arsene, G. G. (2014). Invasive and potentially invasive plant species in wetlands area of Banat. *Research Journal of Agricultural Science*, *46*(4), 146-161.

Park, J. W., Ko, S. H., Kim, C. W., Jeoung, B. J., & Hong, C. S. (1999). Identification and characteri. zation of the major allergen of the Humulus japonicus pollen. *Clinical and experimental allergy: journal of the British Society for Allergy and Clinical Immunology*, *29*(8), 1080-1086.

Payne, W. W. (1978). A glossary of plant hair terminology. *Brittonia, 30, 2 (apr.-jun.).* 239-255

Pinston, A. (2013). Étude de la plasticité écologique d'une plante invasive: Humulus japonicus Siebold & Succ.

Preda, M. (1979). *Floricultura* (ed. II). Bucharest, RO: Ceres Publishing House.

Roman, N. (1974). *Flora și vegetația din sudul Podișului Mehedinți*. Bucharest, RO: Academia RSR, Publishing House.

Sanda, V., Öllerer, K., Burescu, P. (2008). *Fitocenozele din România*. Bucharest, RO: Ars Docendi Publishing House.

Sârbu,C., Oprea, A. (2011). *Plante adventive în flora României*. Iasi, RO: Ion Ionescu de la Brad Publishing House.

Sung, B., Chung, J. W., Bae, H. R., Choi, J. S., Kim, C. M., & Kim, N. D. (2015). Humulus japonicus extract exhibits antioxidative and anti-aging effects via modulation of the AMPK-SIRT1 pathway. *Experimental and therapeutic medicine*, *9* (5), 1819-1826.

Vicol, E.C. (1970). Bidens frondosus în Flora României. *St. Cerc. Biol, ser.Bot., 22, 4*. 297-301