



Agricultural sciences

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INVASIVE SPECIES OF PLANTS AND METHODS OF THEIR CONTROL IN THE WESTERN FOREST STEPPE OF UKRAINE

An invasive alien plant is any type of plant capable of having a negative/harmful effect on economic processes and even society and ecosystems in general. They are capable of intensively suppressing and displacing local plant species, provoking the degradation of biodiversity to the reduction of available fodder and local vegetation for animals, impoverishing the habitat of rare and endangered species, contributing to the loss of aesthetic values, and causing changes in the structure and functions of ecological diversity.

Certain types of plants are toxic to humans and animals, and can also show allelopathic symptoms noticeable to neighboring plants and even cause their death. The highest effect is provided by efforts to reduce their cumulative impact as a result of monitoring and a set of measures to prevent the course of these processes¹.

Invasive plant species, as noted by scientists from different countries² serve as agents and carriers/reservoirs of harmful plant pathogens and cause great harm to society and are a threat to ensuring free and full functioning biodiversity, in particular, cause:

- deterioration of agricultural culture, impoverishment of natural territories and natural ecosystems;
- negative impact on the general ecological state of the environment;
- deterioration of the state of recreational and protected areas, recreation centers, sanatoriums;
- poisoning of animal and human organisms;
- damage to people and animals as a result of direct contact with plants (*Ambrosia artemisiifolia* and *pollinosis*, *Heracleum sosnowskyi* and burns from it, etc.);
- partial and later complete displacement of all vegetation from the biodiversity as a result of aggression and localization of invasive plants-competitors and antagonists;
- negative impact on coastal areas of rivers, lakes, ponds;
- unconscious cultivation of individual antagonistic plants among the population and their subsequent uncontrolled spread over large areas;
- negative impact on productivity of agrocenosis, quality of products and economics of nature use.

Along with large loss of biodiversity, habitat degradation and other ecological consequences, invasive species cause huge economic losses in the billions of dollars annually, and some of them threaten human and animal health and even their lives³.

- 1 Tokarska-Guzik B., Dajdok Z., Zając M., Zając A., Urbisz A., Danielewicz W., Hołdyński C. (2012). Rośliny obcego pochodzenia w Polsce ze szczególnym uwzględnieniem roślin inwazyjnych. ISBN 978-83-62940-34-9. 106 p.; Shuvar I.A., Gudź V.P., Shuvar A.I. Particularly dangerous plants of Ukraine. Education manual / Editor's note I. A. Shuvar. K.: Center for Educational Literature, 2013. 192 p.
- 2 Shuvar I., Martyn V., Lipinska G., Vylupek T., Kurants P. Invasion of *Heracleum Sosnowskyi* Manden. in phytocenoses of Ukraine and Poland. International scientific internet conference: Current state of science in agriculture and nature management: theory and practice. (Ternopil, November 20, 2019). P.247-249; Dean R. Paini, Andy W. Sheppard, D.Cook, Paul J. De Barro, Susan P. Worner, Matthew B. Thomas. (2016). Global threat to agriculture from invasive species. Ecology.<https://doi.org/10.1073/pnas.1602205113>
- 3 Dean E. Pearson, Yvette K. Ortega, Justin B. Runyon, Jack L. Butler. (2016). Secondary invasion: The bane of weed management. Biological Conservation. Vol. 197, P. 8-17; Bhowmik P. (2014). Invasive weeds and climate change: past, present and future. Journal of Crop and Weed, 10(2):345-349; Kornaś J., Medwecka-Kornaś A. (2002). Geografia

Invasive alien plants threaten native species and habitats by competing for vital abiotic factors: water, sunlight, oxygen, soil (nutrients), temperature.

They are successful in the natural environment due to intensive growth, fertile reproductive opportunities and causing changes that favor their growth and spread. These plant species displace local species and lead to changes in the species composition and density of local plant communities, interfere with forest regeneration and natural succession, change soil agrochemistry, hydrological conditions, change fire regimes, cause genetic changes in natural plants through hybridization, and some serve as transmission agents harmful plant pathogens. Invasive plant species tend to present a real threat that can escalate to natural areas and ecosystems from local to regional and even global levels.

Aggressor plants adapt well to certain local conditions, grow quickly and overtake native plants. A significant number of invasive plants have a short life cycle, while others are extremely long-lived, whose seeds can remain viable in the soil for decades. Seed banks help plants germinate, cultivate and set seeds. Certain types of invasive plants significantly suppress native species by producing toxins that inhibit their growth and development. Since they are introduced to the new ecosystem, they are not affected or have no natural predators in the environment, which helps them to prevail over the native species⁴.

In view of this, it is important to monitor the territory and develop a set of effective measures to control the number of invasive plant species at different levels of the organization of social life: state departments, public institutions, farming and forestry enterprises, fishermen and local communities.

Although invasive plant seeds are dispersed by wind, water, domestic and wild animals, human activities are often the main cause of their spread. Thus, scientists have proven that invasive plant species spread often under the following conditions⁵:

roślin. Warszawa: Wyd. Nauk. PWN. ISBN 83-01-13782-7. 634p.; Shuvar I. A., Korpita H. M., Lipińska H., Wylupek T. Invasion of rare weed *Echinocystis lobata* in modern phytocenoses. Innovative technologies in crop production: problems and their solutions. The conference is dedicated to the 100th anniversary of the founding of the Faculty of Agriculture, June 2-3, 2022, Zhytomyr. C.415-418.

- 4 Shuvar I., Korpita H. (2021). Invasion of rare weed species and its impact on natural biodiversity. Collective monograph. Achievements of Ukraine and the EU in ecology, biology, chemistry, geography and agricultural sciences. DOI <https://doi.org/10.30525/978-9934-26-086-5>. P.365-3825.
- 5 Shuvar I., Korpita H., Balkovskiy V., Shuvar A., Kropyvnytskyi R. (2021). *Asclepias syriaca* L. is a threat to biodiversity and agriculture of Ukraine. BIO Web of Conferences. 36, 07010 doi: <https://doi.org/10.1051/bioconf/20213607010>; Shuvar I. A. (2013). After the soil is colonized by *Heracleum sosnowskyi*, nothing else grows on it. Zerno i khlib. No. 1. P.51-55.

- construction and maintenance of transport and utility connections, railway tracks, ships, highways, pipelines and power lines, movement and transportation of soil, gravel, etc.;
- forestry operations: construction and maintenance of roads, trails, movement of machinery during harvesting;
- functioning of pastures: livestock grazing, etc.;
- moving equipment;
- use of seed mixtures of cultivated plant species littered with seeds of invasive species;
- horticultural practices: import and planting of plant species that eventually become invasive, careless removal of garden waste, unintentional introduction of seeds into the soil;
- recreational measures: soil disturbance by transport, recreational activities, spread of invasive plants by tourists, vehicles, as well as dumping of aquatic plants into watercourses.

In recent years, such plants as *Heracleum sosnowskyi*, *Solidago canadensis*, *Ambrosia artemisiifolia*, *Cenchrus pauciflorus* Benth, *Hordeum murinum* L., *Phytolacca Americana*, *Ecballium elaterium* have been noted for their severity of negative impact in the territory of the Western Forest Steppe of Ukraine, and the spread of *Asclepias syriaca* has already been registered in the territory of the Ivano-Frankivsk region *syriaca*, which seeds with characteristic white silk hairs similar to cotton wool, easily spreads to new territories⁶ (Fig.).

The threat of such forms of plants is growing every year also in connection with global climate changes, as they migrated mainly from the Eurasian continents. And climatic changes in the territory of Ukraine over time acquire characteristics characteristic of desert conditions. The ability of invasive plants to develop under soil and climatic conditions that are not favorable enough for cultivated plants ensures their successful survival and competitive advantage. Global warming only contributes to this⁷.

6 Shuvar I.A., Korpita G.M., Halina L., Czerniawska-Piatkowska E. Invasion of the *Solidago Canadensis* L. in the Western Forest Steppe of Ukraine and Poland. The role of scientific and technical support for the development of the agro-industrial complex in modern market conditions. Materials of the All-Ukrainian Scientific and Practical Conference (February 25, 2021). Dnipro 2021.S. 326–328; Shuvar I.A., Korpita H.M. Invasion of *Hordeum murinum* on new territories. Innovative technologies in crop production III All-Ukrainian scientific internet conference (July 15, 2020). Kamianets-Podilskyi. P. 150–152; Shuvar I. A., Shuvar A. I., Shuvar A. M., Binert B. I., Boyko I. E. (2013). *Heracleum sosnowskyi* in culture and in the wild. Scientists of the Lviv National Agrarian University of Production: catalog of innovative developments / by general ed. V. V. Snitinsky, V. I. Lopushnyak. Vol. 13. Lviv: Lviv. national agrarian Univ. P. 30.

7 Shuvar I. A., Shuvar A. I., Vereshchynskyi R. A., Shuvar A. M. (2015). *Phytolacca Americana* is a new inhabitant of Ukraine's biodiversity. *Sil'skyy hospodar*. No. 1–3. P. 45–48; Bhowmik P. (2014). Invasive weeds and climate change: past, present and future. *Journal of Crop and Weed*, 10(2):345–349.



a).



b).



c).



d).



e).



f).



g).



h).

Fig. Invasive plant species: a). *Heracleum sosnowskyi* b). *Solidago canadensis* c). *Ambrosia artemisiifolia* d). *Phytolacca Americana* e). *Ecballium elaterium* f). *Asclepias syriaca* g). *Cenchrus pauciflorus* Benth h). *Hordeum murinum* L.

Global climate changes also have a positive effect on the intensive invasion of still little common weeds, in particular, *Cenchrus pauciflorus* Benth and *Hordeum murinum* L. According to our observations, if even 4 years ago these plants were practically impossible to find among the diversity of phytocenoses in the territory of the western forest-steppe of Ukraine, then in the period of 2021-2022⁸ in the territory of Lviv, Ivano-Frankivsk, Rivne and Ternopil regions, they appeared especially on sandy and loamy soils.

Invasive plants have various properties and adaptations that enable them to quickly invade new areas and compete with native plant forms for light, water, and nutrients.

In particular, they are characterized by:

- rapid growth rates;
- abundant reproduction by seeds and/or vegetative organs;
- a special device in seeds for movement by wind, water, animals;
- thorns, spikes, or sap, which can cause physical damage and repel animals;
- irregular germination, which allows it to spread under unfavorable conditions;
- the ability to change soil conditions in favor of only invasive species;
- allelopathic effect (production of chemicals that act as inhibitors of other plants);
- continuous and predominant growth and reproduction.

Programs to control the number of invasive plant species are usually long-term and can include organizational, preventative, mechanical, chemical, biological, and cultural measures. At the same time, it is important to assess the state of the territory in terms of the species of invasive plants and their density in the phytocenosis, to characterize their life cycle, and to determine which control measure or set of measures will be the most effective and economically feasible⁹.

The scientific community in Ukraine and the world constantly conducts scientific research and production tests related to the invasion of the most dangerous plant organisms for ecosystems, the introduction of an effective and efficient mechanism

8 Shuvar I., Korpita H., Lipińska H., Wylupek T. (2021). Harmful weed *Phytolacca americana* gets expansion. II International science and practice conf. "Modern trends in the development of agriculture: problems and ways to solve them" Zhytomyr. P.10-12; Shuvar I., Korpita H., Shuvar A., Shuvar B., Kropyvnytskyi R. (2021). Invasive plant species and the consequences of its prevalence in biodiversity. BIO Web of Conferences. Volume 31, 00024 doi: <https://doi.org/10.1051/bioconf/20213100024>; Shuvar I. A., Korpita H. M., Lipińska H., Wylupek T. Invasion of rare weed *Echinocystis lobata* in modern phytocenoses. Innovative technologies in crop production: problems and their solutions. The conference is dedicated to the 100th anniversary of the founding of the Faculty of Agriculture, June 2-3, 2022, Zhytomyr. C.415-418.

9 Herbaceous plants of Ukraine: Study guide / S.S. Moroziuk, V.V. Protopopova. National Pedagogical University named after M.P. Drahomanov, Institute of Botany named after Kholodnyi M.G. National Academy of Sciences of Ukraine. Ternopil: Educational book. Bohdan, 2007. 216 p. ISBN 966-408-029-2; Decree of the President of Ukraine On the decision of the National Security and Defense Council of Ukraine dated October 15, 2021 "On the Strategy of Biosafety and Biological Protection".

for dealing with biological agents, invasive alien species, namely: prevention of penetration, implementation of control over them by entering/spreading or entering natural ecosystems, removing and mitigating (minimizing) their negative impact.

Methods of localization of invasive species:

- prevention – information on the location and understanding of invasive species invasion are important aspects.
- early detection of new population groups and rapid response increases the likelihood of successful control, while keeping costs down.
- control – in many cases, an invasive species can be too widespread and have an excessive growth density. Therefore, it can be cost-effective to slow the spread of species through integrated monitoring and management planning.
- monitoring – periodic monitoring of target territories-corridors, access points after active activity, areas previously treated with drugs can lead to early detection and successful localization and destruction in the long term.
- restoration – an invasive species is more likely to colonize areas that have been disturbed. The sooner an area can be returned to a state of desirable natural vegetation or ways can be found to minimize disturbance to the area, the less vulnerable the area will be to invasion.

Preventive measures and early detection of new settlers spreading from the defined containment zone are a significant influence on slowing down the spread of invasive species. Containment steps may include inventorying and prioritizing habitats for containment, limiting activities to certain areas or to certain times of the year, minimizing travel to vulnerable areas, checking clothing and equipment to minimize species transport, and locating and controlling new breeding sites¹⁰.

Slowing the spread of an invasive species, also known as containment, refers to the process of containing the spread of an invasive species in a specific geographic area. If eradication of an invasive species is not possible, containment can be a very effective measure to slow its regional spread.

Monitoring facilitates periodic post-activity site inspections to identify new invasions and evaluate successful invasive plant control action plans. Early monitoring of new infestations ensures greater effectiveness of measures to control their number and reduces costs and makes it possible to evaluate the effectiveness of the control program.

Ecological restoration is the process of promoting the restoration of resilience and adaptive capacity of an ecosystem that has been degraded, damaged or destroyed.

¹⁰ Shuvar I. A. (2008). Green fire: *Ambrosia artemisiifolia*. Agricultural sector. No. 4-5. P.26-30; Shuvar I. A. (2013). A new settler of Ukrainian lands. *Ahrobiznes s'ohodni*. №3 (250). P. 24-27.

Often, the ecosystem in need of restoration has been altered by natural phenomena such as forest fires, floods, storms, or human activity, as a result of the intentional or unintentional spread of invasive species.

Invasive species can cause significant and irreversible changes in the surrounding natural environment. In particular, the way humans interact with the environment can be affected, as once invasive species cannot be fully controlled or eradicated, this will have negative consequences for ecosystems. Restoring an ecosystem to a balanced state may also be impossible or too expensive. Humanity and business may be forced to adapt their activities to accommodate the impact of invasive species. These adaptations may include increased operating costs and reduced recreational opportunities and reduced tourist attractions.

Using a combination of preventive and control measures, such as pulling, cutting, targeted pesticide application, biological control, and reintroduction of highly competitive native species is an effective way to control invasive species. This approach is often called an integrated control system.

Where eradication of an invasive species is not possible, control strategies must be balanced between the ecological impact of its spread and the economic realities of applying control measures.

Ensuring the increase and protection of plant biological diversity is a necessary condition for the implementation of the strategic national priority of the state – improving the quality of life of the country's citizens by guaranteeing high standards of life support, one of the highest priorities of the state policy of Ukraine and the main directions of preserving the national security of the state in the long term, a factor in guaranteeing its statehood. sovereignty, the main component of social and economic policy.

Invasive alien plant species are one of the main factors of the negative impact on biodiversity, which leads to a decrease in the number and disappearance of a number of local species of wild flora as a result of their suppression, changes in the structure of ecosystems, predation, competition and the spread of diseases, etc. Invasive alien species cause multimillion-dollar losses to agriculture and other areas of economic activity, and some species pose a threat to the quality of life and health of people and animals¹¹.

The issue of controlling the spread and combating invasive alien species is regulated by legislation in a fragmentary manner. Currently, there are shortcomings in the legislative and institutional aspects regarding the management of invasive

11 Shuvar I. A. (2020). A problem without status: why does *Heracleum sosnowskyi* not belong to the quarantine objects? *Ahrobiznes s'ohodni*. No. 18 (433) P.58-60.

alien species. Actions at the central and regional levels regarding methods and ways of combating invasive alien species also need coordination.

Limited knowledge about the range of threats posed by invasive alien species makes it difficult to mobilize the necessary efforts to control the spread of invasive alien species, even those that affect human health or basic economic interests. The problem of invasive alien species affects many social, economic and environmental interests, including trade, health, agriculture, forestry and water management, resource management, infrastructure development, horticulture, aquaculture, tourism and recreation¹².

To increase the level of awareness of the population, interested organizations, institutions, enterprises, farms of all forms of ownership regarding the biological features of alien (invasive) plant species and control their number, it is necessary to develop informational materials by scientific institutions, organize special thematic and educational events with the involvement of mass media dedicated to various aspects of the influence of alien species of plants on the state of the environment, economic activity and the health of the population.

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- 12 Shuvar I. A., Gudz V. P., Yunk A. V., Korpita H. M. (2018). *Herbological atlas-handbook of Ukraine*. Under the editorship I. A. Shuvar. Vinnytsia: "Nilan-LTD" LLC. 388 p.; Shuvar I. A., Korpita H. M., Dudar O. O. (2021). *Invasion of uncommon weed species and methods of controlling their numbers*. Scientists of the Lviv National Agrarian University of Production: catalog of innovative developments. Lviv. LNAU

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ДОСЛІДЖЕННЯ ЕКОЛОГІЧНИХ НОРМ ВИРОЩУВАННЯ СОНЯШНИКУ В ЛІСОСТЕПУ УКРАЇНИ

Сьогодні соняшник є одним з найбільш поширених в сільськогосподарському виробництві олійних рослин. У світі щорічно виробляється більше 10 мільйонів тонн соняшникової олії. Соняшник використовується головним