Scientific Papers. Series B, Horticulture. Vol. LXX, No. 1, 2026
Print ISSN 2285-5653, CD-ROM ISSN 2285-5661, Online ISSN 2286-1580, ISSN-L 2285-5653

INVASIVE AND POTENTIALLY INVASIVE SPECIES IN VEGETABLE CROPPING SYSTEMS OF NORTHEASTERN ROMANIA

Claudia BĂLĂIȚĂ[1, 3], Tina Oana CRISTEA[1], Andreea ANTAL TREMURICI[1], Mariana CALARA[1], Gabriel-Alin IOSOB[1], Milian GURĂU[2], Elena Maria DRĂGHICI[3], Petre Marian BREZEANU[1]

[1]Vegetable Research and Development Station Bacău, Calea Bârladului Street, No. 220, Bacău, Romania
[2]"Vasile Alecsandri" University of Bacău, Faculty of Science, Biology, 157 Calea Mărășești Street, Bacău, Romania
[3]University of Agronomic Sciences and Veterinary Medicine of Bucharest, 59 Mărăști Blvd, District 1, Bucharest, Romania

Corresponding author email: iosob.gabriel@gmail.com

Abstract

Vegetable crop production is increasingly affected by invasive and potentially invasive species, including weeds, insect pests, and plant pathogens. The aim of this study was to inventory weed species and to assess their role as ecological drivers influencing both pest incidence and beneficial entomofauna within vegetable agroecosystems.
Field observations were conducted to identify and document the weed species present in vegetable crops. In parallel, the incidence of major pests and beneficial entomofauna was analysed in order to evaluate their relationship with spontaneous flora. Among the 76 species identified, belonging to 26 botanical families, a total of 19 taxa were classified as invasive or potentially invasive in Romania.
The results showed that the presence of certain weed species shapes the dynamics and overall quality of the ecosystem, as some weeds can serve as hosts for important vegetable crop pests, while others provide essential resources for beneficial entomofauna, thereby mitigating pest pressure.

Key words*: biodiversity, beneficial arthropods, ecological services, weed-insect interactions.*

INTRODUCTION

Weeds are an integral component of ecosystems. Despite the common perception of weeds as detrimental, their role in promoting ecological balance, safeguarding biodiversity, preserving soil resources, and sustaining natural cycles within both natural and anthropized ecosystems is widely acknowledged.
Recent studies have underscored the heterogeneity of weed species and the composition of allogenic flora at both the European (Lambdon et al., 2008) and national levels (Anastasiu et al., 2024; Răduțoiu & Ștefănescu, 2022; Culiță, 2016).
Research has demonstrated that anthropogenic stressors, including habitat disturbance and herbicide use, can interact synergistically with climate-change stressors to expedite the evolution of weeds.
Perceived as a direct competitor to crops, weeds are understood to hinder agricultural productivity by utilizing vital resources such as water, light, heat, and nutrients, resulting in a decline in both the quality and quantity of crop yield (Kaur et al., 2018; Novac et al., 2021).
However, a nuanced understanding of agroecosystems reveals a much more complex interaction (Allen et al., 2022).
Vegetable production systems in Northeastern Romania are increasingly challenged by a diverse assemblage of invasive and emerging weed species, including highly competitive annual dicotyledons such as *Amaranthus retroflexus, Galinsoga parviflora,* and *Hibiscus trionum*, alongside perennial taxa like *Cirsium arvense* and *Convolvulus arvensis*, which collectively contribute to persistent weed pressure (Calara et al., 2023).
High constancy values observed for key species - such as *Senecio vulgaris* and *Echinochloa crus-galli*, reaching up to 100% occurrence before critical management interventions - highlight their strong establishment capacity and underline the need for targeted, stage-specific weed management strategies (Calara et al., 2024).

The objectives of this study are to identify invasive or potentially invasive weed species and to investigate the dual role of weeds, examining both their detrimental impact and their beneficial potential in maintaining ecological balance, with a particular focus on their relationships with invasive insect species.

MATERIALS AND METHODS

The study was conducted at the Vegetable Research and Development Station in Bacău, which is located in the northeastern region of Romania (46°35' north latitude, 26°55' east longitude, 165 m altitude). The area between the Bistrița and Siret rivers in Bacău County, particularly around their confluence (downstream from the city of Bacău), exhibits a geobotanical character typical of wide floodplains and low terraces. This character is strongly influenced by the hydrological regime and human activities.

The present study entailed the collection, identification, and inventorying of weed species present in vegetable crops. The collected botanical material was identified using specialized literature (Gurău, 2007).

In conducting this study, the binary nomenclature from Flora Europaea (Tutin et al., 1964-1980) and Flora R.P.R. (Săvulescu, 1952-1976) was utilized.

The plants were preserved and stored in the VRDS Bacău herbarium in accordance with standard practices described in the scientific literature.

For insects, the direct visual observation method was carried out by systematically examining the plants (leaves, stems, flowers and fruits). For each monitored plot, samples of 10-20 plants were randomly selected, and the presence of various species was recorded.

RESULTS AND DISCUSSIONS

A comprehensive taxonomic analysis of the collected biological material was conducted, resulting in the identification of 76 taxa belonging to 26 families, which were subsequently grouped into 16 orders. According to Figure 1, the best-represented order is Asterales with 16 taxa, followed by Caryophyllales (13), Poales (12), Lamiales (11), Fabales (7), Solanales (4), Apiales (2), Malpighiales (2), Rosales (2), Boraginales (1), Brassicales (1), Equisetales (1), Malvales (1), Papaverales (1), Ranunculales (1), Sapindales (1).

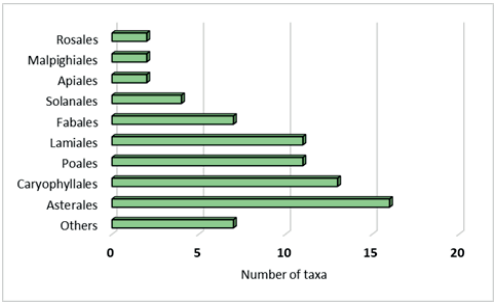

Figure 1. Graphical representation of orders

In the wake of observations made in vegetable crops within the VRDS Bacău, a concerted effort was made to collect, identify, and inventory weeds. This endeavour culminated in the formulation of the following list of weed species:

Fam. Amaranthaceae: *Amaranthus albus* L.; *Amaranthus blitoides* S. Wats; *Amaranthus blitum* L.; *Amaranthus hybridus* L.; *Atriplex patula* L.; *Chenopodium album* L.

Fam. Apiaceae: *Daucus carota* L.; *Torilis arvensis* (Huds.) Link.

Fam. Asteraceae: *Achillea setacea* L.; *Arctium lappa* L.; *Cichorium intybus* L.; *Cirsium arvense* (L.) Scop.; *Cirsium vulgare* (Savi) Ten.; *Erigeron annuus* (L.) Pers; *Erigeron canadensis* L.; *Galinsoga parviflora* Cav.; *Helianthus tuberosus* L.; *Lactuca serriola* L.; *Senecio vulgaris* L.; *Solidago gigantea* Alton.; *Sonchus asper* (L.) Hill; *Taraxacum officinalis* (L.) Weber ex F.H.Wigg; *Tripleurospermum inodorum* (L.) Sch.Bip.; *Xanthium strumarium* L.

Fam. Boraginaceae: *Symphytum officinale* L.

Fam. Brassicaceae: *Rorippa sylvestris* (L.) Besser.

Fam. Caryophyllaceae: *Saponaria officinalis* L.

Fam. Convolvulaceae: *Convolvulus arvensis* L.; *Ipomoea rubro-caerulea* Hook.

Fam. Equisetaceae: *Equisetum arvense* L.

Fam. Euphorbiaceae: *Euphorbia agraria* M. Bieb.

Fam. Fabaceae: *Coronilla varia* (L.) Lassen; *Gleditsia triacanthos* L.; *Medicago minima* L.; *Medicago sativa* L.; *Trifolium hybridum* L.; *Trifolium pratense* L.; *Trifolium repens* L.

Fam. Hypericaceae: *Hypericum perforatum* L.

Fam. Lamiaceae: *Ballota nigra* L.; *Glechoma hirsuta* L.; *Marrubium vulgare* L.; *Mentha longifolia* (L.) Huds; *Origanum vulgare* L.; *Prunella vulgaris* L.
Fam. Malvaceae: *Hibiscus trionum* L.
Fam. Papaveraceae: *Chelidonium majus* L.
Fam. Plantaginaceaea: *Kickxia spuria* Dumort.; *Plantago lanceolata* L.; *Plantago major* L.
Fam. Poaceae: *Bromus spp*., *Bromus sterilis* L.; *Calamagrostis epigeios* (L.) Roth*; Dactylis glomerata* L.*; Digitaria sanguinalis* (L.) Scop; *Echinochloa crus-galli* (L.) P.Beauv.; *Elymus repens* Gould; *Festuca drymeja* Mert. & W.D.J. Koch; *Lolium perenne* L.; *Phragmites australis* (Cav.) Trin. ex Steud.; *Setaria verticillata* (L.) P.Beauv.; *Setaria viridis* (L.) P.Beauv.
Fam. Polygonaceae: *Polygonum convolvulus* L.; *Polygonum aviculare* L.; *Polygonum lapathifolium* (L.) Delarbre; *Rumex crispus* L.; *Rumex sanguineus* L.
Fam. Portulacaceae: *Portulaca oleracea* L.
Fam. Ranunculaceae: *Clematis vitalba* L.
Fam. Rosaceae: *Agrimonia eupatoria* L.
Fam. Rutaceae: *Ruta graveolens* L.
Fam. Sapindaceae: *Acer negundo* L.
Fam. Scrophulariaceae: *Verbascum sp.*
Fam. Solanaceae: *Solanum nigrum* L**.**
Fam. Urticaceae: *Urtica dioica* L.
Fam. Verbenaceae: *Verbena officinalis* L.

In the realm of family classification, the Asteraceae family exhibits a predominant presence, constituting 21.05% of the total taxa identified within the study. Next in order are the families Poaceae (15.79%), Fabaceae (9.21%), Amaranthaceae (7.89%), Lamiaceae (7.89%), Polygonaceae (6.58%), Plantaginaceaea (3.95%), Apiaceae (2.63%), Convolvulaceae (2.63%). The remaining 17 families comprise 1.32% each (Figure 2).

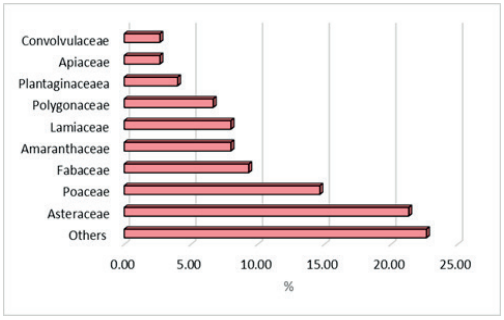

Figure 2. Graphical representation of botanical families

Of the total 76 species identified, dicotyledons predominated, accounting for 84%, with monocotyledons comprising a significantly smaller proportion (Figure 3).

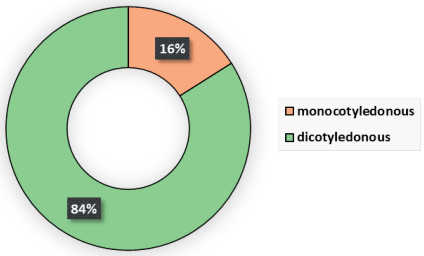

Figure 3. The relationship between monocotyledonous and dicotyledonous plants

Of the total number of species identified, the majority are classified as perennial weeds (67%) followed by annuals (29%) and then biennials (4%) (Figure 4).

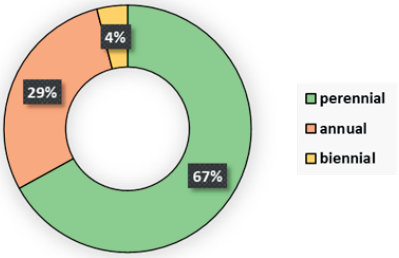

Figure 4. The ratio between annual, biennial, and perennial weeds

In vegetable crops within the VRDS Bacău, phytocenotic analysis showed that the most frequent, dominant, and abundant weed species were white amaranth (*Amaranthus albus* L.), cockspur grass (*Echinochloa crus-galli* (L.) P.Beauv.), green foxtail (*Setaria viridis* (L.) P.Beauv.), pale persicaria (*Polygonum lapathifolium* (L.) Delarbre), and gallant soldier (*Galinsoga parviflora* Cav.).

Identifying invasive or potentially invasive weed species

An important ecological consequence of global change is the invasion of alien species that can influence biodiversity.

Weeds, in general, have been shown to be deleterious to vegetable crops, affecting them from the germination stage through to harvest.

According to Reddy (2018), the presence of weeds and their density can cause significant losses during the early stages of plant growth. As the duration of interaction between weeds and crops increases, the intensity of competition between them escalates. This heightened competition gives rise to quantitative and qualitative changes in the crops, ultimately leading to a decline in yield.

Invasive or potentially invasive weed species have the potential to cause significant losses to agricultural production.

These losses can be classified as either direct or indirect. Direct losses manifest as a reduction in crop yield per hectare. Indirect losses are associated with the costs of controlling these pests, whether through mechanical, chemical, or biological means (Sîrbu, 2011).

A total of 19 taxa have been identified as invasive or potentially invasive species for our country, according to the invasive species inventory guide within the POIM 2014+ 120008 project. This classification is in accordance with EU Regulation 1143/2014 on the prevention and management of the introduction and spread of invasive alien species (Anastasiu et al., 2019; Anastasiu et al., 2022; Anastasiu et al., 2024).

The 19 taxa are grouped into eight families. The Asteraceae family has the highest number of invasive plant species (6), followed by the Amaranthaceae (4), Poaceae (3), Fabaceae (2) and the remaining four families (Convolvulaceae, Euphorbiaceae, Portulacaceae, and Sapindaceae) were represented by one species each. (Table 1).

Table 1. List of invasive or potentially invasive alien plants

Nr. Crt.	Taxon	Family	Native range	Initial reporting	Bioforma	Plant mono/di	Life span	Invasive potential
1	*Acer negundo*	Sapindaceae	NAm	1946	PhM	di	pe	High
2	*Amaranthus albus*	Amaranthaceae	NAm	1905	T	di	an	Moderate
3	*Amaranthus blitoides*	Amaranthaceae	NAm	1931	T	di	an	Moderate
4	*Amaranthus blitum*	Amaranthaceae	NAm	1816	T	di	an	Moderate
5	*Amaranthus hybridus*	Amaranthaceae	NAm	1898	T	di	an	High
6	*Bromus sterilis*	Poaceae	Eur	1816	T	mono	an/bi	Moderate
7	*Bromus spp.*	Poaceae	Eur	1816	T	mono	an/bi	Moderate
8	*Echinochloa crus-galii*	Poaceae	Eur	1866	T	mono	an	High
9	*Erigeron annuus*	Asteraceae	NAm	1936	TH	di	an/bi	High
10	*Erigeron canadense*	Asteraceae	NAm	1814	T	di	an/bi	High
11	*Euphorbia agraria*	Euphorbiaceae	Eur	1879	H	di	pe	Low
12	*Galinsoga parviflora*	Asteraceae	Sam	1866	T	di	an	High
13	*Gleditschia triacanthos*	Fabaceae	NAm	1898	PhM	di	pe	Moderate
14	*Helianthus tuberosus*	Asteraceae	NAm	1858	G	di	pe	High
15	*Ipomoea rubro-caerulea*	Convolvulaceae	SAm	1906	T	di	an	Low
16	*Medicago sativa*	Fabaceae	As	1879	H	di	an	Low
17	*Portulaca oleracea*	Portulacaceae	Eur	1879	T	di	an	Moderate
18	*Solidago gigantea*	Asteraceae	Nam	1900	H	di	pe	High
19	*Xanthium strumarium*	Asteraceae	Eur	1879	T	di	an	Moderate

As - Asia; Eur – Europa; Nam – North America; Sam – South America; G – geophytes; H – hemicryptophytes; PhM – megaphanerophytes; T – terophytes; TH – hemiterophytes; mono – monotiledonata; di – dicotiledonata; an – annual; bi – biennial; pe – perennial.

Table 1 presents a comprehensive list of the 19 identified invasive species, along with their respective family classifications, geographical origins, dates of first documentation in Romania, life forms (classified as either monocotyledonous or dicotyledonous), estimated lifespans, and levels of invasiveness.

In terms of geographic origin, the flora analyzed in Table 1 is dominated by species native to North America, in line with the trend observed in European adventive flora (Danci & Drăgulescu, 2023).

Two families, Asteraceae and Amaranthaceae, are particularly prominent in terms of species richness. This finding has also been reported in other regions of the country (Răduțoiu & Băloniu, 2021).

Many taxa were introduced either accidentally or intentionally (for agricultural, ornamental, or forestry purposes) and have since become naturalized.

The analysis of plant forms (Figure 5) reveals a high percentage of therophytes (63.16%), followed by hemicryptophytes (15.79%), megaphanerophytes (10.53%), hemitherophytes (5.26%), and geophytes (5.26%). The predominance of therophytes is congruent with the study's execution within an agricultural ecosystem under temperate seasonal climate conditions. The low abundance of perennial forms (hemicryptophytes, geophytes, and phanerophytes) suggests that many of the analyzed species are adventive or ruderal species, adapted to short life cycles and rapid dispersal.

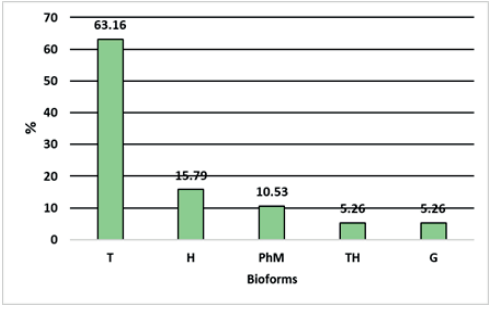

Figure 5. Percentage distribution of bioforms (G – geophytes; H – hemicryptophytes; PhM – megaphanerophytes; T – terophytes; TH – hemiterophytes)

Most of the invasive species identified are neophytes (introduced after 1492), and only a few are archaeophytes, having been introduced before 1492: *Amaranthus blitum* L.; *Portulaca oleracea* L. (Culiță, 2007, 2011)

According to the scientific literature, only three species have a low potential for invasiveness. The others have a moderate potential, which is on par with those with a high potential. Among the highly invasive species, *Echinochloa crus-galii* (L.) P. Beauv stands out as the worst weed (Holm et al., 1977).

Invasive pest species of economic interest for vegetable crops in the Bacău region

The spread of invasive insects of tropical origin in Romania's agricultural ecosystems is exacerbated by global warming. Some species are increasingly being recognized as quarantine pests, posing a significant threat to national plant health. Among the most important species at the national and regional levels for vegetable crops are:

• *Bemisia tabaci* Gennadius (silverleaf whitefly), a quarantine pest (non-European populations), listed in Annex 1, Section 1 of Government Decision No. 563/2007. It is an extremely polyphagous species, capable of feeding on over 600 host plant species (Martin et al., 2000). Its main danger lies not only in feeding on plant sap, but also in its ability to transmit over 100 types of viruses (Soumia et al., 2020; Ghosh et al., 2022).

Regarding the presence of whiteflies in horticultural areas in Bacău County, different trends were observed among species. For example, *Trialeurodes vaporariorum* (Westwood) showed an extremely low infestation level, while *Aleyrodes proletella* (L.) had a higher incidence in field cabbage crops. However, the infestation pressure of the latter remained below the critical threshold, with a maximum infestation rate of 2.2% during 2024.

• *Leptinotarsa decemlineata* Say (Colorado potato beetle) is one of the most well-known and destructive pests of solanaceous crops, including potatoes, tomatoes, and eggplants. It is notable for its extraordinary ability to develop resistance to over 50 different insecticides, often within just a few years of their introduction (Chen et al., 2023).

• *Tuta absoluta* Meyrick (tomato leaf miner) has become a major pest of tomato crops in Romania, causing extensive damage. It mainly attacks plants of the Solanaceae family, feeding on all the above-ground parts of the plant, with a clear preference for tomatoes (Savranschii et al., 2000). In the Bacău area, the species has been reported but does not have a level of infestation that requires control measures.

• *Nezara viridula* L. (green stink bug): A polyphagous species native to Africa that has spread globally and become a permanent presence in temperate regions. It prefers legumes and other plants with fruits or pods, injecting toxic saliva into plant tissues and facilitating the penetration of pathogens (Mitchell et al., 2018; Jones, 1988). In the Bacău area, the species has been reported but does not have a degree of attack that requires control measures.

The role of beneficial invasive insect species

In an attempt to control agricultural pests, certain insect species considered "beneficial" have been intentionally introduced. A notable

example is *Harmonia axyridis* (Asian ladybird) (also present at VRDS Bacău), brought to Europe to control pest populations (Roy et al., 2016). However, this seemingly "noble" intervention has generated a new set of ecological challenges. The Asian ladybird has become an invasive species itself, competing with native ladybirds for resources and, moreover, consuming their larvae, thus destabilizing the natural balance of the local entomofauna. This paradox highlights the complexity of ecological management (Roy et al., 2016; Farrow, 2023). An external biological solution can, over time, become a new threat to biodiversity, demonstrating that ecological balance is not static and that any intervention, even one with positive intentions, requires careful monitoring and long-term evaluation (Roy et al., 2016).

Weeds as host plants and reservoirs for pests and diseases

Weeds play a pivotal role in the epidemiology of agricultural crops, functioning as ecological "bridges" that facilitate the transmission of pest and pathogen populations from one growing season to the next.

This mechanism of pest survival and proliferation is a direct causal relationship, essential to understanding how infestations are maintained and spread (Ansar & Ghatak, 2019; Gupta & Thind, 2018). A salient example can be found in the relationship between weeds of the Solanaceae family and

specialized pests. Notable examples of such species include *Solanum nigrum* (black nightshade), which is listed among the identified weeds and which has been found to play a significant role in serving as an alternative host for pests such as the Colorado potato beetle (*L. decemlineata*) and the tomato leaf miner (*T. absoluta*) (Ben-Abdallah et al., 2019; Kroschel et al., 2020). The presence of these weeds facilitates the completion of the life cycle of pests, thereby enabling their survival between vegetable crops. This, in turn, creates the conditions for a subsequent massive invasion once new crops are planted (Reddy, 2018).

Table 2. Correlation between weed families and invasive pests and assimilated diseases

Weeds family	Weeds species	Invasive pests	Transmitted viral diseases
Solanaceae	*Solanum nigrum*	*Leptinotarsa decemlineata*	
Solanaceae	*Datura stramonium*	*Tuta absoluta*	
Amaranthaceae	*Amaranthus* sp.	*Aphids, Bemisia tabaci*	Tomato Mosaiv Virus (ToMV)
Polygonaceae	*Festuca drimeja*	*Aphids, Bemisia tabaci*	Cucumber Mosaic Virus (CMV)

Furthermore, weeds act as reservoirs for viruses, with major implications for plant health (Wisler & Norris, 2005). A number of viruses, including tomato mosaic virus (ToMV) and cucumber mosaic virus (CMV), have been observed to infect and persist in various weeds, such as chickweed and lamb's quarters (Naik & Chaudhary, 2025). These viruses are then transmitted to crops by mobile vectors, such as aphids and whiteflies. A single generation of aphids has been shown to transmit over 50 viruses to crops, thereby demonstrating the rapid and extensive dissemination of pathogens. Conversely, the whitefly (*B. tabaci*) has been identified as the exclusive vector for the tomato yellow leaf curl virus (TYLCV), which has the capacity to infect weeds, beans, and peppers (Brown & Czosnek, 2002; Sarwar et al., 2020).

This intricate interplay constitutes a causal chain:

• *Presence of weeds*: Species from families such as Solanaceae and Amaranthaceae are ubiquitous in agricultural ecosystems.
• *Reservoir effect*: These weeds act as alternative hosts for polyphagous pests (aphids, whiteflies) and specialized pests (Colorado potato beetle).
• *Virus vectors*: Pests feed on infected weeds, becoming virus carriers themselves.
• *Disease transfer*: Due to their high mobility, vectors rapidly transfer viruses from weeds at the edge of crops to vegetable plants, triggering widespread epidemics.

The beneficial role of weeds in maintaining beneficial insect fauna

In the context of an agroecological approach, it has been acknowledged that certain weeds and plants in the spontaneous flora can exert a beneficial role, thereby supporting biodiversity and ecosystem services. These organisms can

function as a source of sustenance (i.e., nectar and pollen) and a habitat for beneficial insects, thereby contributing to natural biological control and reducing reliance on chemical interventions (Jordan & Vatovec, 2004; Gaba et al., 2014, 2016).

A notable example is represented by nectar-producing plants, such as those in the Lamiaceae family (sage, rosemary, lavender), which attract natural predators of pests, such as ladybugs (Coccinellidae), lacewings (Chrysopa), and hoverflies (Syrphidae). These predators consume aphids, thereby helping to regulate their population levels and prevent them from reaching levels that would cause economic damage. It has been demonstrated that other families of weeds, such as Apiaceae, which are renowned for their ability to attract beneficial insects, can be employed in a strategic manner to enhance the agricultural landscape (Smith & Hagen, 1956; Elekcioğlu, 2020; Chellappan & Ranjith, 2023).

The positive impact of weeds on soil fertility has been well documented (Parks & Gallandt, 2023). Weeds belonging to the Fabaceae family (legumes) possess the capacity to fix atmospheric nitrogen in the soil, thereby enhancing its structure and fertility. This process is analogous to that of cover crops (Xu & Deng, 2017). These practices, which are part of a broader framework of conservation agriculture, demonstrate that not all weeds are necessarily detrimental and that intelligent management can leverage their ecological functions (Monteiro & Santos, 2022). The following is a description of this beneficial chain:

• *Strategic presence of functional plants*: Weeds are maintained or plants from the spontaneous flora with insect-attracting properties are introduced.

• *Attracting beneficial entomofauna*: These plants provide food sources and shelter for a variety of beneficial insects, predators, and pollinators.

• *Strengthening biological control*: Beneficial insect populations thrive, exerting natural and effective control over pests, which reduces the need for pesticides.

CONCLUSIONS

An analysis of phyto-entomological interactions at the Vegetable Research and Development Station Bacău reveals a complex and dynamic picture of the agricultural ecosystem. Weeds, it should be noted, play a dual role in this ecosystem. They serve as both hosts and reservoirs for invasive pests and the viruses they transmit. At the same time, weeds can act as a potentially beneficial element that supports natural biological control. The relationship between weeds and invasive insects is deeply interconnected, and their impact is dynamic, accelerated by climate change, which allows the geographical expansion of pests such as the green tomato bug. In order to develop sustainable and region-specific management strategies, further research is needed. It is recommended that future studies at the Bacău Resort focus on:

• *Identification and Quantification*: Conduct in-depth local studies to identify specific species of beneficial entomofauna and pests, quantify their distribution in relation to the prevalence of weeds within the spontaneous flora.

• A *long-term evaluation* is necessary to ascertain the effectiveness of the intervention. It is imperative to monitor the long-term impact of invasive species, such as *H. axyridis*, in order to comprehensively understand their effects on native biodiversity. This monitoring is necessary to develop a stricter regulatory framework for the introduction of new organisms for biological control purposes.

• *Predictive models*: The development of predictive models is imperative, with these models being based on local climatic conditions and weed and insect population dynamics. The anticipation and prevention of major infestations are best achieved through the implementation of such predictive models.

The effective management of weeds and invasive insects at the Vegetable Research and Development Station Bacău should not aim to eradicate them; rather, it should focus on an ecological approach that capitalizes on the beneficial role of certain elements of spontaneous flora in maintaining a dynamic balance in the agroecosystem. This approach is imperative to ensure long-term sustainability.

ACKNOWLEDGEMENTS

This study was conducted as part of the project Construire Centru de Cercetare Leg(O)Nest - cofounded by the European Union, the Romanian Government, Regio Nord Est Programm 2021- 2027, ADR NORD EST, call PR/NE/2024/P1/RSO1.1/1/2 - Infrastructuri CDI, contract nr. 651/26.03.2025 Smis code 335392.

REFERENCES

Allen, W. J., Bufford, J. L., Barnes, A. D., Barratt, B. I., Deslippe, J. R., Dickie, I. A., ... & Tylianakis, J. M. (2022). A network perspective for sustainable agroecosystems. *Trends in Plant Science*, *27*(8), 769-780.

Anastasiu Paulina (Coord.), Sîrbu Culiţă, Urziceanu Mihaela, Camen-Comănescu Petronela, Oprea Adrian, Nagodă Eugenia, Gavrilidis Alexandru-Athanasios, Miu Iuliana, Memedemin Daniyar, Sîrbu Ioana, Manta Nicolae (2019). Managementul adecvat al speciilor invazive din România, în conformitate cu Regulamentul UE 1143/2014 referitor la prevenirea și gestionarea introducerii și răspândirii speciilor alogene invazive.

Anastasiu, P., Miu, I., V., Gavrilidis, A., A., Preda, C., Rozylowicz, L., Sirbu, C., ... & Sirbu, I. M. (2024). Alien plant species distribution in Romania: A nationwide survey following the implementation of the EU Regulation on Invasive Alien Species. *Biodiversity Data Journal*, 12, e119539.

Anastasiu P., Gavrilidis A., A., Miu V., I. and Niculae, M. I., 2022 – Raport inițial privind distribuția speciilor de plante alogene din hot-spot-uri și căile prioritare de pătrundere, Proiectul POIM2014+120008, Managementul adecvat al speciilor invazive din România, în conformitate cu Regulamentul UE 1143/2014 referitor la prevenirea și gestionarea introducerii și răspândirii speciilor alogene invazive, București, Ministerul Mediului, Apelor și Pădurilor și Universitatea din București, http://invazive.ccmesi.ro/, 333. (in Romanian).

Ansar, M., & Ghatak, A. (Eds.). (2019). The Vegetable Pathosystem: Ecology, Disease Mechanism, and Management. CRC Press.

Ben-Abdallah, S., Cáceres, L. A., Wang, Z., Renaud, B., J., Lachâal, M., Karray-Bouraoui, N., ... & Scott, I. M. (2019). Host plant defenses of black (*Solanum nigrum* L.) and red nightshade (*Solanum villosum* Mill.) against specialist Solanaceae herbivore *Leptinotarsa decemlineata* (Say). *Archives of Insect Biochemistry and Physiology*, *101*(2), e21550.

Benelli, G., Pavela, R., Cianfaglione, K., Nagy, D. U., Canale, A., & Maggi, F. (2019). Evaluation of two invasive plant invaders in Europe (*Solidago canadensis* and *Solidago gigantea*) as possible sources of botanical insecticides. *Journal of Pest Science*, *92*(2), 805-821.

Bîtlan, I. (2025). Noi contribuții în sistemul integrat de combatere a dăunătorilor cartofului (Doctoral dissertation, Universitatea Tehnică a Moldovei).

Brown, J., K., & Czosnek, H. (2002). Whitefly transmission of plant viruses.

Calara, M., Munteanu, N., Avasiloaiei, D., I., Brezeanu, C., Brezeanu, P., M., & Hlihor, M. (2023). Assessing the Allelopathic Potential of Various Species for Weed Control in Organic Farming on a Climbing Bean Crop. *Lucrări Stiințifice, Seria Horticultura*, *68*.

Chen, Y. H., Cohen, Z., P., Bueno, E., M., Christensen, B., M., & Schoville, S. D. (2023). Rapid evolution of insecticide resistance in the Colorado potato beetle, Leptinotarsa decemlineata. *Current Opinion in Insect Science*, *55*, 101000.

Culiță, S. (2007). Considerations regarding the alien plants from Moldavian flora (Romania), deliberately introduced by man. *Journal of Plant Development*, 14.

Culiță, S., Adrian, O., & Peter, F. (2011). New contribution to the study of alien flora in Romania. *Journal of Plant Development*, *18*.

Culiță, S., Vîntu, V., Samuil, C., & Stavarache, M. (2016). Invasive neophytes in natural grasslands of Romania. *Romanian Journal of Grassland and Forage Crops*, *13*, *57.*

Danci, O., & Drăgulescu, C. (2023). Riparian invasive alien plant species in Southern Transylvania (Romania): History of introduction, chorology and ecology. *Transylvanian Review of Systematical and Ecological Research*, *25*(1), 1-26.

Farrow, R. A. (2023). An invasive ladybird in rural habitats: Harmonia Axyridis (Coleoptera: Coccinellidae) in the UK (Doctoral dissertation, Anglia Ruskin Research Online - ARRO).

Gaba, S., Fried, G., Kazakou, E., Chauvel, B., & Navas, M. L. (2014). Agroecological weed control using a functional approach: A review of cropping systems diversity. S. Gaba et al. *Agronomy for Sustainable Development*, *34*(1), 103-119.

Gaba, S., Gabriel, E., Chadœuf, J., Bonneu, F., & Bretagnolle, V. (2016). Herbicides do not ensure higher wheat yield, but eliminate rare plant species. *Scientific Reports*, *6*(1), 30112.

Ghosh, Sunil. (2022). Infestation of whitefly (Bemia tabaci) on eggplant and related crops and use of safe pesticides for biodiversity conservation.

Gupta, S., K., & Thind, T. S. (2018). Disease problems in vegetable production. Scientific Publishers.

Gurău, M. (2007). *Botanică sistematică*. Editura Alma Mater, Bacău.

Holm, L., G., Plucknett, D., L., Pancho, J., V., & Herberger, J. P. (1977). *The world's worst weeds: Distribution and biology* (pp. 610-pp).

Jones, W. A. (1988). World review of the parasitoids of the southern green stink bug, Nezara viridula (L.) (Heteroptera: Pentatomidae). *Annals of the Entomological Society of America*, *81*(2), 262-273.

Jordan, N., & Vatovec, C. (2004). Agroecological benefits from weeds. In *Weed biology and management* (pp. 137-158). Dordrecht: Springer Netherlands.

Kaur, S., Kaur, R., & Chauhan, B. S. (2018). Understanding crop-weed-fertilizer-water interactions and their implications for weed management in agricultural systems. *Crop Protection*, 103, 65-72.

Kroschel, J., Mujica, N., Okonya, J., & Alyokhin, A. (2020). Insect pests affecting potatoes in tropical, subtropical, and temperate regions. In *The potato crop: Its agricultural, nutritional and social contribution to humankind* (pp. 251-306). Cham: Springer International Publishing.

Lambdon, P., Pyšek, P., Basnou, C., Hejda, M., Arianoutsou, M., Essl, F., ... & Vilà, M. (2008). Alien flora of Europe: Species diversity, temporal trends, geographical patterns and research needs.

Martin, J., H., Mifsud, D., & Rapisarda, C. (2000). The whiteflies (Hemiptera: Aleyrodidae) of Europe and the Mediterranean basin. *Bulletin of entomological research*, *90*(5), 407-448.

Mitchell, P., L., Zeilinger, A., R., Medrano, E., G., & Esquivel, J. F. (2018). Pentatomoids as vectors of plant pathogens. In *Invasive Stink Bugs and Related Species (Pentatomoidea)* (pp. 611-640). CRC Press.

Monteiro, A., & Santos, S. (2022). Sustainable approach to weed management: The role of precision weed management. *Agronomy*, *12*(1), 118.

Naik, A., & Chaudhary, A. (2025). Tomato Mosaic Virus. In *Compendium of Phytopathogenic Microbes in Agro-Ecology: Vol. 2 Viruses and Viroids* (pp. 329-347). Cham: Springer Nature Switzerland of vegetable crops and to protect vital ecosystem services.

Novac, T., Fala, A., Timuș, A., Conovali, V., & Țurcan, E. (2021). Bunele practici în legumicultură în contextul schimbărilor climatice.

Parks, J., W., & Gallandt, E. R. (2023). Testing a tine weeder with artificial weeds in the controlled conditions of a soil bin. *Weed Research*, *63*(5), 328-337.

Răduțoiu, D., & Băloniu, L. (2021). Invasive and potentially invasive alien plants in the agricultural crops of Oltenia.

Răduțoiu, D., & Ștefănescu, D. M. (2022). Invasive native plants in anthropogenic ecosystems from Oltenia, Romania. *Scientific Papers. Series B. Horticulture*, *66*(1).

Reddy, C. (2018). A study on crop weed competition in field crops. *Journal of Pharmacognosy and Phytochemistry*, *7*(4), 3235-3240.

Roy, H. E., Brown, P., M., Adriaens, T., Berkvens, N., Borges, I., Clusella-Trullas, S. ... & Zhao, Z. (2016). "The harlequin ladybird, Harmonia axyridis: global perspectives on invasion history and ecology. Biological invasions, 18(4), 997-1044.

Sarwar, M., Shad, N., A., & Batool, R. (2020). Integrated management of vectored viral diseases of plants. In *Applied Plant Virology* (pp. 707-724). Academic Press.

Savranschii, D., Todiraș, V., Tretiacova, T., Guşan, A., & Hudeacova, O. (2020). Metode de monitorizare și combatere a dăunătorului molia minieră a tomatelor (*Tuta absoluta*) în spațiile protejate. In *Protecția plantelor-realizări şi perspective* (pp. 100-103).

Săvulescu T. (ed.) 1952-1976. *Flora României*. *Vol. 1-13*. București: Edit. Academiei Române

Schoville, S., D., Chen, Y. H., Andersson, M., N., Benoit, J., B., Bhandari, A., Bowsher, J., H., ... & Richards, S. (2018). A model species for agricultural pest genomics: the genome of the Colorado potato beetle, Leptinotarsa decemlineata (Coleoptera: Chrysomelidae). Scientific reports, 8(1), 1931.

Sirbu, C., Miu, I., V., Gavrilidis, A., A., Gradinaru, S., R., Niculae, I., M., Preda, C., ... & Anastasiu, P. (2022). Distribution and pathways of introduction of invasive alien plant species in Romania. *NeoBiota*, *75*, 1-21.

Soumia, P., S., Guru Pirasanna Pandi, G., Krishna, R., Ansari, W., A., Jaiswal, D., K., Verma, J., P., & Singh, M. (2020). Whitefly-transmitted plant viruses and their management. In Emerging Trends in plant pathology (pp. 175-195). Singapore: Springer Singapore.

Tutin T.G., Heywood V.H., Burges N.A., Moore D.M., Valentine D.H., Walters S.M., & Webb, D.A. (ed.) 1964-1980. Flora Europaea. Vols. 1-5. Cambridge: Cambridge University Press.

Xu, Z., & Deng, M. (2017). Fabaceae or leguminosae. In *Identification and Control of Common Weeds: Volume 2* (pp. 547-615). Dordrecht: Springer Netherlands.

Wisler, G., C., & Norris, R. F. (2005). Interactions between weeds and cultivated plants as related to management of plant pathogens." Weed Science, 53(6), 914-917.