

FEEDING RESOURCES OF POLLINATORS IN UKRAINE AND THE EU: SPATIO-TEMPORAL DYNAMICS OF SOWN AREAS OF MAJOR ENTOMOPHILOUS CROPS

Lisohurska Dina Volodymyrivna

PhD in Agricultural Sciences, Associate Professor
Polissia National University, Zhytomyr, Ukraine
ORCID: 0000-0002-2559-6520
lisogurskadina@gmail.com

Ján Brindza

PhD, Associate Professor
Slovak University of Agriculture in Nitra, Nitra, Slovakia
ORCID: 0000-0001-8388-8233
brindza.jan@gmail.com

Adamchuk Leonora Oleksandrivna

Doctor of Technical Sciences, Associate Professor
Institute of Veterinary Medicine of National Academy of Agrarian Sciences of Ukraine,
Independent Research Institute "Ukrainian Science Hub"
ORCID: 0000-0003-2015-7956
leonora.adamchuk@gmail.com

Furman Svitlana Volodymyrivna

PhD in Veterinary Sciences, Associate Professor
Polissia National University, Zhytomyr, Ukraine
ORCID: 0000-0002-1079-5797
svitlana.furman@ukr.net

Lisohurska Olha Viktorivna

PhD in Agricultural Sciences, Associate Professor
Polissia National University, Zhytomyr, Ukraine
ORCID: 0000-0002-3553-9351
lisogurskaya2016@gmail.com

*Major entomophilous agricultural crops play a key role in the functioning of agroecosystems, combining food production with the formation of the forage base for honey bees (*Apis mellifera* L.) and wild insect pollinators. Under conditions of intensive agriculture, reduction of natural and semi-natural habitats, climate change, and increasing anthropogenic pressure, the spatio-temporal structure of entomophilous crop areas becomes particularly important for the conservation of pollinator populations and the stability of the ecosystem service of pollination.*

*The aim of this study was to analyse the spatio-temporal dynamics of sown areas of major entomophilous agricultural crops – sunflower (*Helianthus annuus* L.), winter and spring oilseed rape (*Brassica napus* L.; in EU countries also turnip rape *Brassica rapa* L.), and buckwheat (*Fagopyrum esculentum* Moench) – in Ukraine and the countries of the European Union from the perspective of forming the forage base of pollinators as sources of nectar and pollen.*

The study was based on official statistical data from the State Statistics Service of Ukraine and Eurostat for the period 2016–2024. Statistical, comparative-geographical, and structural-share analyses were applied, combined with an ecological interpretation of the results. The findings were considered in terms of pollinator forage-base formation and the alignment of agricultural practices with the objectives of the European Green Deal and the EU Biodiversity Strategy.

The results showed that during 2016–2021 Ukraine experienced an increase in the sown areas of major entomophilous crops, whereas after 2022 a substantial reduction and regional reorientation of crop areas were recorded, driven by a combination of military, economic, and climatic factors. The Central region demonstrated the highest stability and concentration of entomophilous crops, while the Southern and Eastern regions suffered the greatest losses. In EU countries, the areas of entomophilous crops remained relatively stable, indicating higher resilience of agricultural systems and a stronger integration of ecological approaches into land use.

The results confirm that the sown areas of major entomophilous agricultural crops constitute an important spatial indicator of the potential forage base of pollinators and the resilience of agrolandscapes. Analysis of their spatio-temporal dynamics is therefore relevant for evidence-based decision-making in agricultural policy, spatial land-use planning, beekeeping development, and the implementation of biodiversity conservation strategies in Ukraine and the EU.

Key words: honey bee, sunflower, oilseed rape, buckwheat, biodiversity, European Green Deal.

DOI <https://doi.org/10.32782/bsnau.lvst.2026.1.7>

Introduction. Entomophilous agricultural crops are an essential component of agrolandscapes in Europe and Ukraine not only because of their economic importance, but also as key sources of forage resources – nectar and pollen – for honey bees (*Apis mellifera* L.) and other insect pollinators. The availability and spatial distribution of this forage base determine the abundance, activity, and effectiveness of pollinators in agricultural ecosystems and, consequently, the stability of pollination processes of insect-dependent crops.

As emphasized by Khalifa et al. (2022), entomophilous agricultural crops play a crucial role in sustaining honey bee populations by providing essential forage resources, while pollination efficiency directly affects crop yields and the economic value of agricultural production. At the same time, current global trends of declining insect populations, including key pollinator species, increasingly limit the realization of the potential of this forage base (Ghisbain et al., 2021). Intensive agriculture, loss of natural habitats, pesticide use, and other anthropogenic pressures contribute to insect population declines and negatively affect the availability of nectar and pollen in agrolandscapes (Wagner, 2020; Omelchun et al., 2025).

Insect pollination is one of the fundamental ecosystem services determining both the productivity and quality of agricultural output. According to the European Environment Agency, approximately 84% of crops in the European Union are partially or fully dependent on insect pollinators, whose contribution to the quantity and quality of agricultural production is indispensable in modern farming systems (European Environment Agency, 2025). Thus, the functioning of agricultural production is closely linked to the status of pollinator populations and the spatial structure of entomophilous crop cultivation.

Numerous studies convincingly demonstrate that effective pollination significantly increases the yields of major entomophilous crops. For sunflower (*Helianthus annuus*), it has been established that the intensity of bee visitation to crops is positively correlated with yield formation, whereas a deficit of pollinators leads to reduced yields and lower economic efficiency of production (DeGrandi-Hoffman & Watkins, 2000; Holland et al., 2020; Mota et al., 2024). Field experiments confirm these patterns: isolation of sunflower flowers from insects reduces seed number, seed weight, and overall yield by 12–30%, while increased activity of honey bees and wild pollinators substantially improves all productivity indicators (Amarilla et al., 2025; Bertleff et al., 2025).

At the same time, pollination efficiency is determined not only by pollinator abundance, but also by their spatial and temporal interactions with crops. Studies of sunflower agrocenoses show that niche complementarity among different pollinator groups enhances pollination processes and contributes to higher crop productivity (Zaragoza-Trello et al., 2023).

Similar patterns are observed for oilseed rape (*Brassica napus*). It has been demonstrated that insect pollination increases the number of seeds and pods and results in significantly higher yields compared with conditions without

pollination (Stanley et al., 2013; Holland et al., 2020; Yang et al., 2024). Fairhurst et al. (2022) showed that the combination of wind and insect pollination positively affects growth and reproductive traits of oilseed rape, increasing yield stability. Even in highly productive agroecosystems, both the level and stability of yields largely depend on the activity of honey bees and wild pollinators (Mota et al., 2024).

Buckwheat (*Fagopyrum esculentum*) occupies a special place among entomophilous crops, as it is strictly dependent on insect pollination. Research by Taki (2009) demonstrated that without the activity of honey bees and other pollinators, the formation of a full buckwheat yield is not possible.

Global syntheses confirm the large-scale nature of pollination deficits. In the United States, it has been shown that yields of most studied crops are limited by pollinator shortages, and declines in both wild and managed bee populations directly reduce agricultural productivity (Reilly et al., 2020). A meta-analysis of more than 1,100 experiments revealed that supplemental pollen addition increased yields by an average of 27%, indicating widespread limitations of natural pollination (Siopa et al., 2023).

In Europe, these processes have a pronounced spatial dimension. Approximately 12% of EU arable land is occupied by crops that require insect pollination and simultaneously serve as important sources of nectar and pollen (Madras-Majewska & Majewski, 2016). For example, in Portugal, more than half of cultivated crops depend on insect pollination, and the economic value of this ecosystem service exceeds €2 billion per year (Siopa et al., 2025).

In Ukraine, the provision of bee pollination is characterized by pronounced spatial heterogeneity: on average, 13.5 bee colonies correspond to 1 ha of buckwheat crops, whereas only 0.4 colonies are available per 1 ha of sunflower, indicating a clear imbalance between the area of forage resources and the actual presence of pollinators (Lisohurska et al., 2024).

Intensive agricultural practices, climate change, and the loss of natural habitats, combined with geopolitical factors, further increase the risks of pollinator biodiversity decline and disruption of the pollination ecosystem service (Richards, 2001; Raven & Wagner, 2021). Awareness of this challenge is reflected in EU policies, particularly in the EU Biodiversity Strategy for 2030, which emphasizes the need to restore agricultural landscapes and support pollinator populations as a foundation of sustainable agriculture (European Commission, 2020). Similar approaches are promoted by FAO, highlighting the role of entomophilous crops as key components of the forage base for pollinators (FAO, *Crops, Weeds and Pollinators*).

Thus, major entomophilous agricultural crops form the spatial basis for supplying nectar and pollen to honey bees and wild insect pollinators and determine the efficiency of the “agrocenosis–pollinators” system. Under these conditions, analysis of the spatial and temporal dynamics of entomophilous crop areas represents a key tool for assessing changes in pollinator forage resources and for providing a scientific basis for sustainable land-use planning in Ukraine and the countries of the European Union.

The aim of the study was to analyze the spatial and tem-

poral dynamics of the areas cultivated with major entomophilous agricultural crops in Ukraine and the countries of the European Union in order to assess their role in shaping the forage base of honey bees and wild pollinators as sources of nectar and pollen.

Materials and Methods. The study was based on official statistical data on the cultivated areas of major entomophilous agricultural crops – sunflower (*Helianthus annuus* L.), winter and spring rapeseed (*Brassica napus* L.; in EU countries also turnip rape *Brassica rapa* L.), and buckwheat (*Fagopyrum esculentum* Moench) – in Ukraine and the European Union over the period 2016–2024. For Ukraine, data from the State Statistics Service of Ukraine (State Statistics Service of Ukraine, 2026) were used, including official electronic databases on the structure of crop areas. For the European Union, Eurostat data were applied (Eurostat, 2026), particularly tables providing information on the areas of oilseed and cereal crops by EU-27 countries and years. The analysis covered exclusively the countries that were members of the European Union during the respective study period. In addition, official reference data on the total territorial area of EU countries and Ukraine, published by the European Commission and national statistical authorities, were used to calculate spatially relative indicators. A combination of statistical, comparative-geographical, and structural-share analyses was applied, followed by an ecological interpretation of the results. This approach made it possible to assess the spatial and temporal dynamics of entomophilous crop areas and to evaluate their significance for the formation of pollinator forage resources, as well as to examine the consistency of current agricultural practices with the objectives of the European Green Deal and the EU Biodiversity Strategy. Statistical analysis included the aggregation of absolute area indicators for sunflower, buckwheat, winter and spring rapeseed, and turnip rape by years and countries. Based on official statistics, total areas of the main entomophilous crops were calculated and their spatial-temporal dynamics over the study period were analyzed. Structural-share analysis was used to determine the proportion of entomophilous crops in the total area of each EU country and Ukraine, as well as to assess the percentage contribution of individual EU countries to the total entomophilous crop area within the Union and the contribution of regions and oblasts within Ukraine. Comparative analysis enabled a comparison of the spatial structure of entomophilous crop cultivation between the EU and Ukraine, an assessment of differences between the pre-war (2016–2021) and post-war (2022–2024) periods for Ukraine, and an evaluation of the concentration of forage resources for pollinators across EU countries and Ukrainian regions. Ecological interpretation was based on analyzing the obtained statistical indicators in terms of the formation of forage resources for honey bees and wild insect pollinators and their alignment with the strategic environmental priorities of the European Green Deal and the EU Biodiversity Strategy, particularly regarding pollinator conservation and the enhancement of agro-landscape ecological resilience. The study relies on aggregated official statistical data, which do not capture intra-regional variability within individ-

ual countries or within oblasts of Ukraine. Nevertheless, this approach is methodologically appropriate for identifying macro-level patterns in the formation of pollinator forage resources, ensures the validity of cross-country comparisons, and is suitable for providing analytical support for strategic spatial planning and agricultural policy development.

Results of the Study. According to official data from the State Statistics Service of Ukraine, the total cultivated area of the main entomophilous crops (sunflower, winter and spring rapeseed, and buckwheat) in 2016–2024 exhibited a clearly uneven temporal dynamics (Fig. 1).

In 2016, the total area under these crops amounted to 6,689.7 thousand ha. During the subsequent years (2017–2018), a gradual expansion of cultivated areas was observed, reaching 7,031.7 and 7,319.1 thousand ha, respectively. This trend reflected the increasing importance of entomophilous crops in the land-use structure and favorable conditions for the formation of a forage base for beekeeping. In 2019, the cultivated area remained almost unchanged (7,307.3 thousand ha), maintaining the previously achieved level. The highest total areas were recorded in 2020–2021, amounting to 7,677.5 and 7,761.5 thousand ha, respectively. This period can be characterized as the most favorable for providing bee colonies with pollen and nectar resources within Ukrainian agrocenoses, creating prerequisites for stable and prolonged honey flows.

From 2022 onwards, a sharp negative shift in the dynamics of cultivated areas occurred. In 2022, the total area of entomophilous crops declined to 6,515.2 thousand ha, which is more than 1,200 thousand ha lower than the peak value recorded in 2021. This reduction is directly associated with the consequences of the full-scale military aggression against Ukraine, including the loss of control over part of agricultural land, destruction of production infrastructure, landmining of arable areas, and a decrease in investment activity in the agricultural sector. In 2023, a partial recovery of cultivated areas was observed (6,781.1 thousand ha), indicating a certain degree of adaptation of agricultural producers to the new operating conditions. However, in 2024 the downward trend persisted, and the total area of entomophilous crops decreased to 6,378.6 thousand ha. Such dynamics point to the instability of the forage base for beekeeping under conditions of prolonged military and socio-economic risks.

During 2016–2024, the areas under cultivation of the main entomophilous crops in Ukraine generally increased until 2021, after which sharp spatial and temporal shifts occurred, most clearly manifested at the level of individual regions and macroregions. Regional dynamics revealed pronounced spatial differentiation in the formation of pollinators' forage resources: throughout the entire study period, the largest and relatively stable cultivated areas were concentrated in the central agricultural regions, primarily in Dnipropetrovsk and Kirovohrad oblasts. In Dnipropetrovsk oblast, a steady expansion of cultivated areas was observed, reaching a maximum in 2023, while Kirovohrad oblast also maintained high values with a more moderate dynamic pattern (Table 1). In the pre-war period, large cultivated areas were characteristic of the southern regions

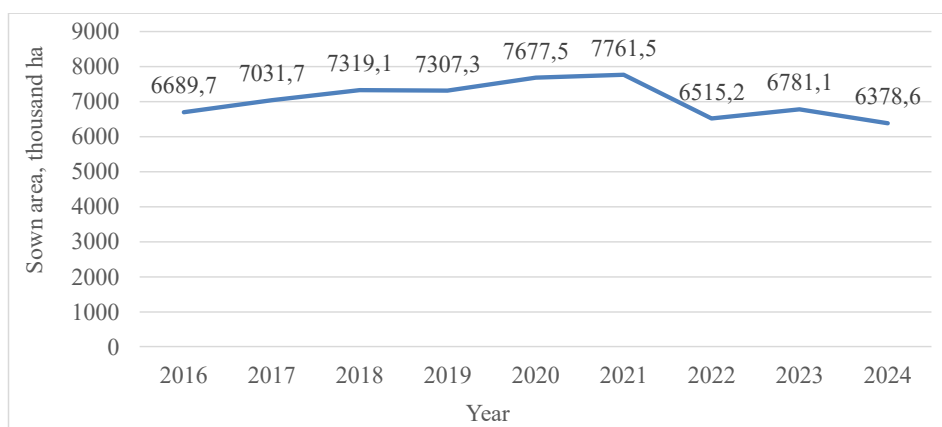


Fig. 1. Dynamics of the cultivated areas of the main entomophilous crops in Ukraine

(Mykolaiv, Odesa, Zaporizhzhia); however, since 2022 the southern and eastern directions have suffered the greatest losses. A sharp reduction in sown areas was recorded in Zaporizhzhia, Donetsk, and Luhansk regions, reflecting a profound disruption of agricultural production as a result of hostilities; in Kharkiv region, after a sharp decline in 2022, partial recovery occurred in 2023, without a return to pre-war levels. By contrast, regions of the central and northern parts of the country (Vinnytsia, Poltava, Cherkasy, Khmelnytskyi, Kyiv, Sumy, Chernihiv) demonstrated steady growth during 2016–2021 and, in 2022–2023, largely maintained stability or only moderate fluctuations, indicating higher resilience of their agri-production systems. Western regions traditionally had the smallest areas due to natural and climatic conditions and the mosaic nature of land use; nevertheless, Ternopil and Lviv regions showed gradual growth until 2021 with moderate fluctuations in 2022–2023, while Zakarpattia and Chernivtsi regions maintained minimal values. At the macro-regional level, the Central region dominated: its sown areas increased from 2,312.3 thousand ha in 2016 to 2,638.3 thousand ha in 2021 and reached a maximum of 3,037.4 thousand ha in 2023 (2,939.5 thousand ha in 2024), confirming its leading role in preserving the production potential of entomophilous crops.

The Southern region also had large areas up to 2021 (2,171.7 thousand ha in 2021), but in 2022 they decreased almost by half (to 1,244.1 thousand ha), followed by partial recovery in 2023–2024 without returning to previous levels. The Eastern region increased up to 2021 (1,396.5 thousand ha) but dropped to a minimum of 512.6 thousand ha in 2022 and remained unstable in 2023–2024. The Northern region strengthened until 2022 (1,201.3 thousand ha), after which it declined in 2023–2024 but remained above initial levels. The Western region had the smallest absolute areas, reached a peak in 2022 (551.6 thousand ha), and subsequently showed a decline, overall exhibiting a smaller amplitude of fluctuations than the Southern and Eastern regions.

Overall, the structure of entomophilous crop cultivation is dominated by the Central region, while the Southern and Eastern regions experienced the greatest losses in 2022–2024; the Northern and Western regions play a stabilizing role, supporting relative stability in national

dynamics. The identified patterns are important for assessing the spatial availability of the pollinator forage base and for developing regionally oriented approaches to the development of agricultural production and beekeeping.

During 2016–2024, noticeable structural shifts occurred in the distribution of sown areas of the main entomophilous crops among the macro-regions of Ukraine. These changes reflect not so much variations in the absolute scale of production as a spatial reorientation of agricultural land use under the influence of economic and military factors. In 2016–2021, the cropping structure remained relatively stable: the Central region dominated (34–35%), the Southern region accounted for a substantial share (28–31%), the Eastern region maintained a share of 17–18%, the Northern region 11–13%, while the Western region had the smallest proportion (5–7%).

From 2022 onward, the structure underwent sharp changes: the share of the Central region increased to 45% in 2022–2023 and reached 47% in 2024, indicating a concentration of production in the central part of the country as the most resilient to crisis impacts. At the same time, the role of the Southern region declined from 28% in 2021 to 19% in 2022–2023, with partial recovery to 21% in 2024. The most critical changes were recorded in the Eastern region: after pre-war stability (17–18%), its share dropped to 8% in 2022 and recovered only to 11% in 2023–2024, pointing to persistent structural disruptions in agricultural production. Against this background, the Northern region performed a compensatory function in 2022, increasing its share from 13% (2021) to 19% (2022); subsequently, it declined to 17% in 2023 and 15% in 2024, but remained above pre-war levels. The Western region, while retaining the smallest share, temporarily increased to 9% in 2022 (likely due to a redistribution of production toward relatively safer territories) and returned to 8% and 6% in 2023–2024, respectively.

The identified transformation of the spatial structure of crop areas has direct implications for the formation of the forage base for pollinators and beekeeping practices, as it alters the geography and predictability of nectar and pollen resources. The concentration of 45–47% of crop areas in the Central region during 2022–2024 indicates

Table 1

Dynamics of sown areas of major entomophilous crops by regions of Ukraine, thousand ha

Region/ Year	2016	2017	2018	2019	2020	2021	2022	2023
Vinnitsia	312.0	320.2	346.3	329.2	345.4	375.9	425.6	427.2
Volyn	26.9	48	68.8	84.7	89.5	90.8	92.4	82.6
Dnipropetrovsk	663.8	679.7	680.4	708.5	741.8	692.7	737.9	850.3
Donetsk	340.9	355.6	337.3	318.6	336.3	366.4	123.3	129.4
Zhytomyr	114.0	151.2	202.9	178.5	210.2	213.2	252.1	196.7
Zakarpattia	3.5	3.5	3.7	3.9	3.3	4.1	5.5	2.8
Zaporizhzhia	603.6	598.1	600.2	605.9	626.9	608.4	169.6	142.2
Ivano-Frankivsk	42.7	67.7	50.6	52.7	47.6	52.5	60.5	19.8
Kyiv	194.4	206.5	242.0	216.6	216.2	247.1	268.1	288.4
Kirovohrad	605.3	593	632.7	634.5	657.2	637.8	675.2	719.5
Luhansk	341.7	362.7	361.5	378.4	415.0	442.3	72.9	62.0
Lviv	76.3	101.6	106.6	93.4	100.8	96.8	96.6	102.4
Mykolaiv	573.4	567.4	601.8	588.8	592.1	582.9	506.7	545.2
Odesa	507.1	566.5	564.7	556	472.1	535.4	567.8	589.2
Poltava	322.5	326.6	346.1	325.5	389.0	400.8	470.7	447.9
Rivne	27.0	45.9	51.7	64.9	76.1	74.1	84.6	99.6
Sumy	222.3	236.5	244.7	255.7	289.2	273.5	345.5	323.8
Ternopil	108.8	143.4	153.5	138.7	157.7	158.8	192.3	203.3
Kharkiv	512.2	504.7	548.5	542.5	610.8	587.8	316.4	538.6
Kherson	408.7	409.3	405.4	441.2	425.5	445.0	–	–
Khmelnyskyi	173.5	214.6	235.1	221.8	258.3	255.1	299.4	287.8
Cherkasy	235.2	237.4	242.5	250.6	249.1	276.0	297.9	304.7
Chernivtsi	19.6	18.4	19.6	12.6	20.1	22.1	19.7	23.9
Chernihiv	229.6	239.7	255.9	247.8	271.6	283.4	335.6	317.4

that the most stable and predictable forage base is formed primarily in Vinnytsia, Dnipropetrovsk, Kirovohrad, Poltava, Cherkasy, and Khmelnytskyi regions, where conditions are favorable for the development of intensive and migratory beekeeping and for strengthening cooperation with agricultural producers (in particular with regard to pollination services and reducing risks associated with the use of plant protection products).

The increase in the share of the Northern region to 15–19% in 2022–2024 highlights its role as a “buffer” or insurance zone during periods of nationwide disruption: the combination of entomophilous crops with natural melliferous habitats in Kyiv, Zhytomyr, Sumy, and Chernihiv regions supports more stable conditions for stationary or semi-migratory beekeeping and biodiversity conservation measures.

In contrast, the decline in the share of the Southern region to 19–21% after 2021 reflects the loss of its position as one of the key centers of entomophilous agriculture. For Odesa, Mykolaiv, Kherson, and Zaporizhzhia regions, this implies increased instability of the forage base and the need for more cautious planning of migratory movements, diversification of nectar sources, and a transition to more flexible apiary management models focused not only on commercial honey production but also on the preservation of bee colonies.

For the Eastern region, where the share dropped to 8% in 2022 and subsequently recovered only partially, priority should be given to measures aimed at maintaining apiary viability, relying on local melliferous plants and,

where possible, seasonal relocation to regions with more favorable forage conditions. The Western region, despite having the smallest share of entomophilous crops, is characterized by relative stability and a reliance on natural forage resources, which creates favorable conditions for stationary and organic beekeeping focused on high value-added honey production.

An additional dimension of spatial change is reflected in the share of entomophilous crops within the total area of the regions. In 2016–2021, the highest proportion was characteristic of the Southern region (18.4–19.3%), which ensured a high honey production potential but was simultaneously associated with increased pesticide pressure and the need for close coordination with agricultural producers; after 2022, this indicator sharply declined to 10.9–11.7%, significantly narrowing the forage base. The Central region demonstrated the most consistent positive dynamics (15.1% in 2016 → 17.2% in 2021 → 18.9–19.8% in 2022–2024), effectively forming a core zone of stable forage supply for pollinators.

For the Eastern region, the transition from 14.1–16.5% in 2016–2021 to 6.1% in 2022 (with only partial recovery to 7.9–8.6% in 2023–2024) signifies a sharp deterioration of forage conditions and increased dependence of apiaries on supportive measures. The Northern region strengthened its position from 6.7% in 2016 to 10.6% in 2022, while the Western region consistently exhibited the lowest values (2.8–5.0%), compensating for this through the significant role of natural melliferous habitats.

At the national level, the share of Ukraine's territory occupied by the main entomophilous crops increased from 12% to 13% during 2016–2021, reaching a maximum in 2021; however, since 2022 it has declined to around 11–12% and in 2024 remained below the pre-war level. This reflects profound spatial and production-related transformations of the agricultural sector associated with the loss or restricted use of part of agricultural land, disruption of logistics, and changes in crop structure, and has direct implications for the formation of the pollinator forage base and the stability of beekeeping.

Overall, the results confirm that the share of entomophilous crops in land-use structure is an informative indicator of the spatial conditions shaping the forage base for pollinators and the potential of beekeeping. After 2021, a shift occurred from a relatively balanced spatial distribution toward a pronounced concentration of crops in the Central region, accompanied by a decline in the role of the Southern and especially the Eastern regions. This creates an objective need for regionally differentiated approaches: central and partly northern regions become a core zone of relative stability, whereas southern and eastern regions require adaptive strategies and greater flexibility in planning beekeeping activities. Accordingly, the integration of agricultural policy with the needs of beekeeping and pollinator conservation should be based on monitoring the spatial-temporal dynamics of entomophilous crops, aligning land use with ecological priorities, and developing national and regional support programs aimed at ensuring trophic continuity and the resilience of agricultural landscapes.

An analysis of the dynamics of sown areas of the main entomophilous crops in the European Union and Ukraine during 2016–2024 reveals both common trends and fundamental differences that reflect distinct agro-economic, spatial, and political conditions of agricultural development (Fig. 2).

In the EU countries, the total sown areas of sunflower and rapeseed (including turnip rape) remained relatively stable over the study period, fluctuating within 9.46–10.88 million ha. In 2016–2018, a moderate expansion was observed, reaching a local maximum in 2017

(10.50 million ha), followed by a noticeable decline in 2019 (9.46 million ha). Subsequently, in 2020–2021 the areas remained relatively stable, while in 2022–2023 a sharp increase was recorded, reaching the highest values for the entire observation period (10.82–10.88 million ha). In 2024, a slight decrease was noted (10.49 million ha); however, the overall level of entomophilous crop areas in the EU remained substantially higher than in the pre-crisis years.

In contrast to the EU, Ukraine exhibited much more pronounced amplitude fluctuations and a clear phase structure in the dynamics of sown areas of the main entomophilous crops. During 2016–2021, a steady expansion was observed – from 6.69 million ha in 2016 to a peak of 7.76 million ha in 2021. This period can be characterized as a phase of intensive development of the entomophilous segment of crop production, creating favorable conditions for the formation of the forage base for beekeeping.

Starting from 2022, the dynamics in Ukraine changed sharply: sown areas declined to 6.52 million ha, the lowest value over the entire analyzed period. In 2023, partial recovery was observed (6.78 million ha); however, in 2024 the negative trend persisted (6.38 million ha). This decline is directly associated with the consequences of the full-scale war, including the loss or restricted use of arable land, destruction of agricultural infrastructure, and transformation of cropping patterns.

Comparative analysis indicates that, despite some synchronous fluctuations in certain years (notably the decline in 2019 and growth in 2022–2023 in the EU), EU agrosystems demonstrate substantially higher stability of entomophilous crop areas than Ukraine. In the EU, these crops constitute a stable component of crop rotations and agroecological strategies, whereas in Ukraine they are much more dependent on external shocks and spatial constraints.

From a beekeeping perspective, these differences are of fundamental importance. In the EU, stable and extensive areas of entomophilous crops provide a relatively predictable forage base for pollinators within agricultural landscapes. In Ukraine, however, since 2021 an unstable forage base has been forming, with increased risks of spatial and seasonal deficits of nectar and pollen, necessitating adaptation

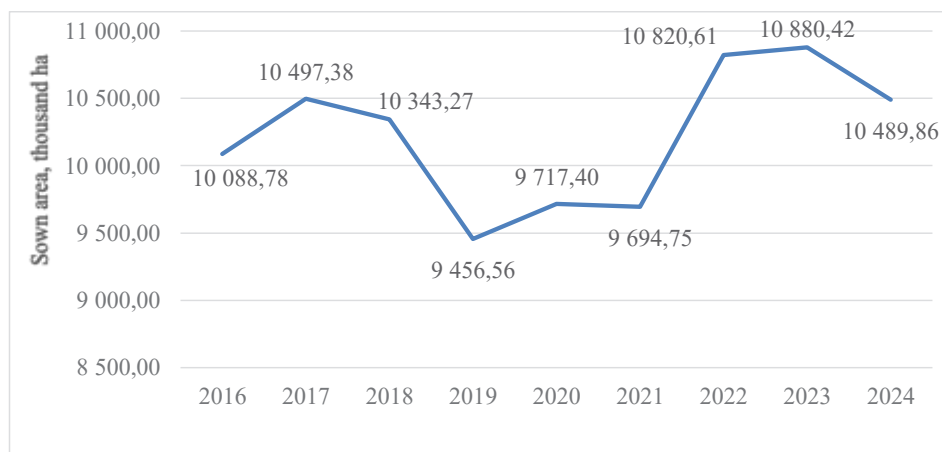


Fig. 2. Dynamics of sown areas of the main entomophilous crops in the EU

of beekeeping practices and more flexible planning of apiary placement.

The largest contributions to the total sown areas of the main entomophilous crops in the European Union during 2016–2024 were consistently provided by France, Germany, Romania, Spain, Poland, and Hungary. In different years, these six countries accounted for more than 65–70% of the total EU area under sunflower and rapeseed, indicating a high territorial concentration of the pollinator forage base and the dominance of a limited number of agricultural regions in shaping entomophilous farming at the European level (Table 2).

Romania stands out as one of the key countries in terms of the scale of entomophilous crop areas: its share of the EU total increased from about 15% in 2016 to nearly 17% in 2024, accompanied by an expansion of absolute areas of sunflower and rapeseed from 1.50 million ha to 1.77 million ha. This highlights the growing role of Romania as a major center for the formation of the pollinator forage base in South-Eastern Europe. France and Germany, whose shares ranged between 18–21% and 11–13%, respectively, exhibited more wave-like dynamics: significant reductions in 2019–2021 were followed by recovery after 2022. These fluctuations reflect the sensitivity of intensive agriculture to changes in agricultural policy, environmental

regulations, and oilseed market conditions. Spain, Poland, and Hungary together accounted for an additional 20–25% of the EU entomophilous crop areas, playing an important role in maintaining the spatial balance of the forage base, particularly in Central and Southern Europe, where sunflower and rapeseed are key melliferous crops of industrial importance.

At the same time, in a number of countries – Belgium, Luxembourg, the Netherlands, Ireland, and Slovenia – the share of entomophilous crops in the overall European structure remained below 1%, due to agroclimatic conditions, land-use patterns, and agricultural specialization. A similar situation is characteristic of Northern European countries (Finland and Sweden), where the limited distribution of sunflower and rapeseed significantly constrains the potential for industrial beekeeping and the formation of a stable pollinator forage base.

The obtained results confirm that the forage base of beekeeping in the European Union exhibits a clearly pronounced regional asymmetry. Central and South-Eastern Europe form the main spatial framework of entomophilous agriculture and provide the predominant share of nectar-producing crops, whereas Northern and North-Western Europe play a supporting role. Fluctuations in cultivated areas during 2019–2021 indicate the vulnerability of the pollinator forage

Table 2

Distribution of sown areas of the main entomophilous crops in EU countries, %

Country/ Year	2016	2017	2018	2019	2020	2021	2022	2023	2024
Austria	0.6	0.6	0.6	0.6	0.6	0.6	0.5	0.5	0.4
Belgium	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Bulgaria	9.8	10.1	9.4	8.6	7.4	7.3	6.4	5.6	5.6
Greece	0.9	0.9	0.8	0.8	0.8	1.0	1.3	1.1	1.0
Denmark	1.6	1.7	1.4	1.8	1.5	1.7	1.8	1.9	1.7
Estonia	0.7	0.7	0.7	0.8	0.7	0.8	0.8	0.7	0.6
Ireland	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2
Spain	8.0	7.8	7.4	7.9	7.7	8.1	8.2	8.0	7.8
Italy	1.2	1.2	1.1	1.4	1.4	1.4	1.2	1.4	1.3
Cyprus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Latvia	1.0	1.1	1.2	1.5	1.5	1.5	1.5	1.4	1.2
Lithuania	1.5	1.7	2.0	2.6	2.9	3.2	3.2	2.8	3.1
Luxembourg	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Malta	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Netherlands	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Germany	13.3	12.6	12.1	11.2	11.8	12.1	11.5	12.2	11.7
Poland	8.2	8.7	8.2	9.3	10.2	10.4	10.2	10.4	9.8
Portugal	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0
Romania	14.8	15.2	15.9	17.3	15.5	16.2	14.4	15.8	16.8
Slovakia	2.1	2.3	2.2	2.1	2.1	2.2	2.0	1.9	2.0
Slovenia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hungary	8.8	9.5	9.2	9.1	9.5	9.4	8.2	7.9	8.1
Finland	0.6	0.5	0.5	0.3	0.3	0.4	0.4	0.3	0.4
France	20.7	19.0	21.0	18.5	17.9	17.0	17.7	19.0	19.6
Croatia	0.8	0.8	0.9	0.8	0.8	0.7	0.5	0.4	0.4
Czechia	4.1	4.0	4.2	4.2	4.0	3.9	3.5	3.9	3.7
Sweden	0.9	1.1	0.9	1.1	1.0	1.1	1.2	1.1	0.9

base to changes in agricultural policy and climatic factors, highlighting the need to integrate beekeeping support with policies on sustainable land use, biodiversity conservation, and the implementation of the European Green Deal.

On average across the European Union, the share of land occupied by major entomophilous crops ranged between 1.2 and 1.5% of the EU territory. The highest values were recorded in 2017–2018 and 2023 (1.5%), while the lowest level was observed in 2019 (1.2%). This indicates a relative stability of the proportion of entomophilous crops at the pan-European level, despite short-term fluctuations driven by changes in agricultural policy and market conditions.

The most intensive use of land for entomophilous crops is characteristic of the Czech Republic, Lithuania, Denmark, Germany, Poland, Slovakia, and Hungary, where the share of such crops consistently exceeded 3% of the national territory and in some years reached 4–5%. The Czech Republic showed the highest values among all EU countries (4.3–5.2%), indicating a high concentration of sunflower and rapeseed in land-use structure. Lithuania demonstrated a steady increase in the share of entomophilous crops from 2.4% in 2016 to 5.0% in 2024, reflecting the growing importance of rapeseed as a key crop. Denmark and Poland maintained shares at the level of 3.0–4.9%, forming a strong forage base for pollinators in Central and Northern Europe.

Countries with a medium level of territorial saturation by entomophilous crops (1.5–3.0%) include Romania, France, Germany, Latvia, and Slovakia. Romania was characterized by considerable interannual variability (1.5–2.7%), consistent with fluctuations in sunflower and rapeseed areas. France, despite having the largest absolute sown areas in the EU, showed a relatively moderate share (1.8–2.9%), which is explained by its large overall national territory.

In a substantial number of countries, the share of land occupied by entomophilous crops remained below 1%. This group includes Austria, Belgium, Spain, Ireland, Italy, Croatia, Slovenia, Finland, and Sweden.

A separate subgroup consists of countries where entomophilous crops are virtually absent from the land-use structure (Cyprus, Malta, the Netherlands, Portugal), which is обусловлено both agro-climatic conditions and the specialization of agricultural production.

Overall, the results confirm the presence of a pronounced regional asymmetry in the formation of the pollinator forage base within the EU. Central and North-Eastern Europe are characterized by the highest intensity of entomophilous agriculture, whereas Southern and Northern Europe play a supplementary role.

Fluctuations in the share of entomophilous crops during 2019–2021 demonstrate the vulnerability of the pollinator forage base to changes in agricultural policy, climatic factors, and market conditions, underscoring the need to integrate beekeeping development with sustainable land-use policies and biodiversity conservation within the framework of the European Green Deal.

Discussion. The obtained results on the spatio-temporal dynamics of the sown areas of major entomophilous crops in Ukraine and the European Union confirm their deci-

sive role in shaping the forage base of honey bees and wild insect pollinators in modern agricultural landscapes. These crops constitute the main spatial sources of nectar and pollen, and the analysis of their sown areas represents a methodologically sound approach to assessing the potential of the pollination ecosystem service.

In EU countries, during 2016–2024, the sown areas of entomophilous crops were characterized by relative spatial stability, indicating their systemic integration into land-use structures and agroecological strategies. This is consistent with the findings of Madras-Majewska and Majewski (2016), who showed that over recent decades in the EU the areas of entomophilous crops increased much faster than the number of honey bee colonies, thereby increasing the risks of spatial and seasonal shortages of forage resources. Similar risks related to spatial mismatches between crop distribution and pollinator populations were also highlighted by Rahimi and Jung (2024), who reported a moderate level of spatial overlap between honey bees and pollination-dependent crops.

In Ukraine, an expansion of the sown areas of major entomophilous crops was observed in 2016–2021, contributing to the strengthening of the pollinator forage base. However, after 2022 a sharp reduction and spatial reorganization of sown areas occurred, driven by a combination of military, socio-economic, and climatic factors. This resulted in increased instability in the availability of nectar and pollen resources and in stronger regional contrasts in forage base formation. These patterns are consistent with the results of Lisohurska et al. (2024), who demonstrated pronounced spatial heterogeneity in pollination provision for major entomophilous crops in Ukraine and an imbalance between cropping structures and the actual presence of pollinators.

The ecological dimension of the obtained results aligns with the conclusions of Maggi et al. (2025) and Khalifa et al. (2022), who emphasize that entomophilous agricultural crops form the basic forage foundation not only for honey bees but also for a wide range of wild pollinators. Changes in the area and spatial arrangement of such crops, without considering the seasonal availability of nectar and pollen, may disrupt trophic continuity and reduce the stability of pollinator populations.

These issues become particularly relevant under conditions of intensive agriculture, loss of natural and semi-natural habitats, and simplification of landscape structure. As noted by Wagner (2020) and Raven and Wagner (2021), agricultural landscapes increasingly perform a compensatory function by providing forage resources for pollinators in contexts where natural habitats are lost or fragmented. At the same time, according to Hall and Martins (2020), effective pollinator conservation requires the integration of ecological, socio-economic, and spatial dimensions into agricultural land-use policies.

The obtained results have important implications for agricultural and environmental policy in the European Union. They are consistent with the objectives of the European Green Deal and the EU Biodiversity Strategy for 2030 (European Commission, 2019; 2020), which promote the integration of agricultural production with the conservation of ecosystem

services, particularly pollination. In this context, the area and spatial distribution of entomophilous crops should be considered not only as elements of agricultural economics, but also as components of the ecological infrastructure of agricultural landscapes.

Conclusions. The analysis of the spatio-temporal dynamics of the sown areas of major entomophilous crops in 2016–2024 has shown that they form a key spatial basis of the forage resources for honey bees and wild pollinators in agricultural landscapes of Ukraine and the EU. In EU countries, entomophilous crops are characterized by relative spatial stability, whereas in Ukraine, after 2022, significant regional transformations were recorded due to the combined effects of military, economic, and climatic factors. Pronounced differences between the macro-regions of Ukraine were identified, reflecting the uneven formation of pollinator forage resources and potential risks of nectar and pollen shortages. The scientific novelty of the study lies in the use of the sown areas of entomophilous crops as an integrated spatial indicator of the pollinator forage base at national and supranational levels. The obtained results can be applied to spatial land-use planning, optimization of apiary placement, and the substantiation of pollinator support measures within agri-

cultural policy frameworks and biodiversity conservation strategies.

Prospects for further research are associated with integrating the analysis of sown areas of major entomophilous crops with assessments of potential nectar and pollen yields of the corresponding lands, which will allow a more comprehensive characterization of the pollinator forage base in agricultural landscapes.

Acknowledgements. Dina Lisohurska (ID 52510347) and Svitlana Furman (ID 52510356) sincerely acknowledge the International Visegrad Fund for providing fellowships and research stays during which the results presented in this article were obtained. Leonora Adamchuk also gratefully acknowledges that the results of this study were achieved during a research stay in Slovakia supported by the National Scholarship Programme of the Slovak Republic (NSP), ID 57381.

Funding. The research was conducted with the support of the International Visegrad Fund, which provided grant funding to Dina Lisohurska (ID 52510347) and Svitlana Furman (ID 52510356). Certain stages of the work were carried out within the framework of the National Scholarship Programme of the Slovak Republic (NSP), with support granted to Leonora Adamchuk (ID 57381).

References:

1. Amarilla, L. D., Grilli, G., Huais, P. Y., Labuckas, D., Maestri, D., Ferrarese, M., Tourn, E., Szawarski, N., Grandi-netti, G., & Ferreira, M. F. (2025). Pollinators significantly enhance seed set, yields and chemical parameters of oil seed in sunflower crops. *Field Crops Research*, 322, 109736. <https://doi.org/10.1016/j.fcr.2025.109736>
2. Bertleff, D., Vey, V., Birnbeck, S., Volz H., Fiedler, J., Sauer, N., Zhang, J., Steffan-Dewenter, I., & Holzschuh, A. (2025). Wild pollinators and honeybees respond differently to landscape-scale organic farming and increase sunflower yields. *Journal of Applied Ecology*, 62(10), 2515–2528. <https://doi.org/10.1111/1365-2664.70156>
3. DeGrandi-Hoffman, G., & Watkins, J. C. (2000). The foraging activity of honey bees *Apis mellifera* and non-*Apis* bees on hybrid sunflowers (*Helianthus annuus*) and its influence on cross-pollination and seed set. *Journal of Apicultural Research*, 39(1–2), 37–45. <https://doi.org/10.1080/00218839.2000.11101019>
4. European Commission. (2019). The European Green Deal. https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en
5. European Commission. 2020. Communication from the commission to the European parliament, the council, the European economic and social committee and the committee of the regions. E.U. biodiversity strategy for 2030. Bringing nature back into our lives. COM(2020)380final. https://knowledge4policy.ec.europa.eu/publication/communication-com2020380-eu-biodiversity-strategy-2030-bringing-nature-back-our-lives_en.
6. European Environment Agency. (2025). Protecting and restoring Europe's wild pollinators and their habitats. <https://www.eea.europa.eu/en/analysis/publications/protecting-and-restoring-europes-wild-pollinators-and-their-habitats>
7. Eurostat. (2026). Rape, turnip rape, sunflower seeds and soya by area (dataset code: tag00100). European Commission. <https://doi.org/10.2908/tag00100>
8. Fairhurst, S., Jackson, G., Evans, A., & Cole, L. J. (2022). The effect of pollination on growth and reproduction of oilseed rape (*Brassica napus*). *Basic and Applied Ecology*, 63, 164–174. <https://doi.org/10.1016/j.baae.2022.06.007>
9. Food and Agriculture Organization of the United Nations. (n.d.). Crops, weeds and pollinators (FAO Knowledge Repository). Food and Agriculture Organization of the United Nations. <https://openknowledge.fao.org/server/api/core/bitstreams/61dd1e2e-d2e5-4060-8ce3-e2f040b096ce/content>
10. Ghisbain, G., Gérard, M., Wood, T. J., Hines, H. M., & Michez, D. (2021). Expanding insect pollinators in the Anthropocene. *Biological Reviews*, 96(6), 2755–2770. <https://doi.org/10.1111/brv.12777>
11. Hall, D. M., & Martins, D. J. (2020). Human dimensions of insect pollinator conservation. *Current Opinion in Insect Science*, 38, 107–114. <https://doi.org/10.1016/j.cois.2020.04.001>
12. Holland, J. M., Sutter, L., Albrecht, M., Jeanneret, P., Pfister, S. C., Schirmel, J., Entling, M. H., Kaasik, R., Kovacs, G., Veromann, E., Bartual, A. M., Marini, S., Moonen, A.-C., Szalai, M., Helsen, H., Winkler, K., Lof, M. E., van der Werf, W., McHugh, N. M., Smith, B. M., & Cresswell, J. E. (2020). Moderate pollination limitation in some entomophilous crops of Europe. *Agriculture, Ecosystems & Environment*, 302, 107002. <https://doi.org/10.1016/j.agee.2020.107002>
13. Khalifa, S. A. M., Elshafiey, E. H., Shetaia, A. A., Abd El-Wahed, A. A., Algethami, A. F., Musharraf, S. G., AlAjmi, M. F., Zhao, C., Masry, S. H. D., Abdel-Daim, M. M., Halabi, M. F., Kai, G., Al Naggar, Y., Bishr, M., Diab, M. A. M., & El-Seedi, H. R. (2022). Overview of bee pollination and its economic value for crop production. *Insects*, 12(8), 688. <https://doi.org/10.3390/insects12080688>

14. Lisohurska, D. V., Lisohurska, O. V., Furman, S. V., & Adamchuk, L. A. (2022). Zabezpechennia zapylennia bdzholamy osnovnykh silskohospodarskykh entomofilnykh kultur v Ukraini [Provision of bee pollination of the main agricultural entomophilic crops in Ukraine]. *Visnyk Sumskoho natsionalnoho ahrarynoho universytetu. Seriya: Tvarynyystvo*, (4) (47), 92–98. <https://doi.org/10.32845/bsnau.lvst.2021.4.16> (in Ukrainian).
15. Madras-Majewska, B., & Majewski, J. (2016). Importance of bees in pollination of crops in the European Union countries. In Proceedings of the 2016 International Conference “Economic Science for Rural Development” (No. 42, pp. 114–119). *Latvia University of Life Sciences and Technologies* (LLU ESAF), Jelgava, Latvia. https://lufb.ltu.lv/conference/economic_science_rural/2016/Latvia_ESRD_42_2016-114-119.pdf
16. Maggi, T., Pardo, L., & Chreil, R. (2025). Pollinator diversity and conservation strategies. *Pollinators*, 9, 33–48. DOI: 10.13140/RG.2.2.25553.39527
17. Mota, L., Loureiro, J., González, J. A., Hevia, V., Ortega-Marcos, J. J., Rad, C., Marks, E. A. N., & Castro, S. (2024). Optimizing sunflower yield: Understanding pollinator contribution to inform agri-environmental strategies. *Field Crops Research*, 319, 109651. <https://doi.org/10.1016/j.fcr.2024.109651>
18. Omelchun, Y. A., Shevchenko, L. V., Nikitina, L. M., Solomon, V. V., Mykhalska, V. M., Furman, S. V., Lisohurska, D. V., & Lisohurska, O. V. (2025). Pesticides as a cause of honeybee (*Apis mellifera*) mortality and their persistence in honey. *Biosystems Diversity*, 33(1), e2501. <https://doi.org/10.15421/012501>
19. Rahimi, E., & Jung, C. (2024). Spatial overlap between bees and pollinator-dependent crops in Europe and North America. *Journal of Sustainable Agriculture and Environment*. <https://doi.org/10.1002/sae2.70021>
20. Raven, P. H., & Wagner, D. L. (2021). Agricultural intensification and climate change are rapidly decreasing insect biodiversity. *Proceedings of the National Academy of Sciences of the United States of America*, 118(2), e2002548117. <https://doi.org/10.1073/pnas.2002548117>
21. Reilly, J. R., Artz, D. R., Biddinger, D., Bobiwash, K., Boyle, N. K., Brittain, C., Brokaw, J., Campbell, J. W., Daniels, J., Elle, E., Ellis, J. D., Fleischer, S. J., Gibbs, J., Gillespie, R. L., Gundersen, K. B., Gut, L., Hoffman, G., Joshi, N., Lundin, O., Mason, K., McGrady, C. M., Peterson, S. S., Pitts-Singer, T. L., Rao, S., Rothwell, N., Rowe, L., Ward, K. L., Williams, N. M., Wilson, J. K., Isaacs, R., & Winfree, R. (2020). *Crop production in the USA is frequently limited by a lack of pollinators*. Proceedings of the Royal Society B: Biological Sciences, 287(1931), Article 20200922. <https://doi.org/10.1098/rspb.2020.0922>
22. Richards, A. J. (2001). Does low biodiversity resulting from modern agricultural practice affect crop pollination and yield? *Annals of Botany*, 88(2), 165–172. <https://doi.org/10.1006/anbo.2001.1463>
23. Siopa, C., Castro, H., Loureiro, J., & Castro, S. (2023). PolLimCrop, a global dataset of pollen limitation in crops. *Scientific Data*, 10, Article 905. <https://doi.org/10.1038/s41597-023-02797-6>
24. Siopa, C., Gaspar, H., Castro, H., Loureiro, J., & Castro, S. (2025). Pollinator contribution to crop production: A temporal and economic assessment in Portugal. *Regional Environmental Change*, 25(4), Article 128. <https://doi.org/10.1007/s10113-025-02475-w>
25. Stanley, D. A., Gunning, D., & Stout, J. C. (2013). Pollinators and pollination of oilseed rape crops (*Brassica napus* L.) in Ireland: Ecological and economic incentives for pollinator conservation. *Journal of Insect Conservation*, 17(6), 1181–1189. <https://doi.org/10.1007/s10841-013-9599-z>
26. State Statistics Service of Ukraine. (2026). Areas, gross harvest and yields of agricultural crops (annual) [Data set]. <https://stat.gov.ua/uk/explorer>
27. Taki, H. (2009). Contribution of small insects to pollination of common buckwheat, a distylous crop. *Annals of Applied Biology*, 155, 121–129. <https://doi.org/10.1111/j.1744-7348.2009.00326.x>
28. Wagner, D. L. (2020). Insect declines in the Anthropocene. *Annual Review of Entomology*, 65, 457–480. <https://doi.org/10.1146/annurev-ento-011019-025151>
29. Yang, J., Wu, P., Zhao, Y., Olhnuud, A., Bai, J., Wu, K., Zhang, Y., & Liu, Y. (2024). Managed pollinators improve oilseed rape yield: A global meta-analysis. *Agriculture, Ecosystems & Environment*, 374, 109135. <https://doi.org/10.1016/j.agee.2024.109135>
30. Zaragoza-Trello, C., Vilà, M., Scheper, J., Badenhauer, I., Klein, D., & Bartomeus, I. (2023). Temporal and spatial niche complementarity in sunflower pollinator communities and pollination function. *Basic and Applied Ecology*, 67, 1–13. <https://doi.org/10.1016/j.baae.2023.01.001>

Лісогурська Д. В., кандидат сільськогосподарських наук, доцент, Поліський національний університет, м. Житомир, Україна

Бріндза Ян, PhD з біотехнології, доцент, Словацький сільськогосподарський університет у Німрі, м. Німра, Словаччина

Адамчук Л. О., доктор технічних наук, доцент, Інститут ветеринарної медицини Національної академії аграрних наук України, Незалежний дослідницький інститут «Український Науковий Хаб»

Фурман С. В., кандидат ветеринарних наук, доцент, Поліський національний університет, м. Житомир, Україна

Лісогурська О. В., кандидат сільськогосподарських наук, доцент, Поліський національний університет, м. Житомир, Україна

Кормові ресурси запилювачів в Україні та ЄС: просторово-часова динаміка посівів основних ентомофільних культур

Основні ентомофільні сільськогосподарські культури відіграють ключову роль у функціонуванні агроєко-систем, поєднуючи продовольче значення з формуванням кормової бази для медоносних бджіл (*Apis mellifera* L.)

та диких комах-запилювачів. В умовах інтенсивного землеробства, скорочення природних і напівприродних угідь, кліматичних змін і зростання антропогенного навантаження просторово-часова структура посівів ентомофільних культур набуває особливої ваги для збереження популяцій запилювачів та стабільності екосистемної послуги запилення. Метою дослідження є аналіз просторово-часової динаміки площ посівів основних сільськогосподарських ентомофільних культур – соняшнику (*Helianthus annuus* L.), ріпаку озимого і ярого (*Brassica napus* L.; у країнах ЄС також суріпиці *Brassica rapa* L.) та гречки (*Fagopyrum esculentum* Moench) – в Україні та країнах Європейського Союзу з позицій формування кормової бази запилювачів як джерел нектару і пилку. Матеріалом дослідження слугували офіційні статистичні дані Державної служби статистики України та Eurostat за 2016–2024 роки. Застосовано методи статистичного, порівняльно-географічного та структурно-часткового аналізу з екологічною інтерпретацією результатів. Отримані результати розглянуто з позицій формування кормової бази запилювачів і узгодженості аграрних практик із цілями Європейського зеленого курсу та Стратегії ЄС зі збереження біорізноманіття. Результати дослідження показали, що у 2016–2021 роках в Україні спостерігалось зростання площ посівів основних ентомофільних культур, тоді як після 2022 року зафіксовано суттєве скорочення та регіональну переорієнтацію посівів, зумовлену поєднанням воєнних, економічних і кліматичних чинників. Найбільшу стабільність і концентрацію ентомофільних посівів продемонстрував Центральний регіон, тоді як Південний і Східний регіони зазнали найбільших втрат. У країнах ЄС площі ентомофільних культур залишалися відносно стабільними, що свідчить про вищу стійкість аграрних систем та інтеграцію екологічних підходів у землекористування. Отримані результати підтверджують, що площі посівів основних сільськогосподарських ентомофільних культур є важливим просторовим індикатором потенціалу кормової бази запилювачів і стійкості агроландшафтів. Аналіз їх просторово-часової динаміки є доцільним для наукового обґрунтування рішень у сфері аграрної політики, просторового планування землекористування, розвитку бджільництва та реалізації стратегій збереження біорізноманіття в Україні та країнах ЄС.

Key words: бджола медоносна, соняшник, ріпак, гречка, біорізноманіття, Європейський зелений курс.



Стаття поширюється на умовах
ліцензії відкритого доступу CC BY 4.0

Дата першого надходження статті до видання: 30.01.2026
Дата прийняття статті до друку після рецензування: 27.02.2026
Дата публікації (оприлюднення) статті: 09.04.2026