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The dominant lepidoptera insect-pests in maize and their management in the Poltava region

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Abstract. Intensive maize cultivation technologies in the Forest-Steppe zone of Ukraine are associated with phytosanitary risks caused by the spread of lepidopteran pests, which can lead to yield losses exceeding the economic threshold of harmfulness. The purpose of the study was to evaluate the effectiveness of monitoring and control methods for dominant lepidopteran pest species in regional maize agrocenoses. To achieve this goal, methods such as pheromone monitoring, visual inspection of plants, and larval population assessment were applied. Field research conducted in 2024 at the Velykoobukhivske agricultural enterprise (Poltava Oblast) confirmed the dominance of three pest species: *Ostrinia nubilalis* Hb., *Loxostege sticticalis* L., and *Helicoverpa armigera* Hb. Pheromone traps of types PH-668-1RR, PH-554-1RR, and PH-460-1RR proved highly effective for detecting the timing

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of peak pest flights, allowing for optimising insecticide application schedules. The results showed the highest reduction in larval density following treatment with Coragen 20 SC, which reduced larval numbers by 93.1%. Ampligo 150 ZC demonstrated slightly lower efficacy (91.6%), while Vantex SC only partially controlled the pest populations. Overall, the findings supported using an integrated approach that combines pheromone-based monitoring with chemical control as an effective strategy for managing lepidopteran pests in maize crops. The obtained data can be applied in agricultural practice to improve maize pest management systems, reduce yield losses, and contribute to sustainable farming. However, there is a clear need to develop integrated pest management strategies for maize cultivation, particularly given potential bans on certain insecticidal active substances in the context of harmonising Ukrainian legislation with EU requirements

Keywords: monitoring; agroecosystem; phytosanitary status; plant protection; pheromone traps; insecticides

INTRODUCTION

Maize remains one of the most productive and economically significant crops globally and in Ukraine due to its high genetic yield potential and adaptability to various agroecological conditions. However, achieving consistently high yields requires implementing effective crop protection strategies. Herbivorous insects, particularly lepidopteran species, represent one of the main limiting factors in maize production, causing substantial yield losses under favourable climatic and agronomic conditions. As maize cultivation intensifies in the Forest-Steppe of Ukraine, the phytosanitary load increases, creating a demand for improved and timely pest monitoring and management systems. Unpredictable climatic factors and expanding pest habitats further underline the urgent need for practical, adaptive, and integrated approaches to protect crops from economically significant pests.

This study addresses the growing relevance of managing lepidopteran pest populations, which increasingly infest maize agrocenoses, reduce yields, and challenge conventional crop protection practices. The transition toward environmentally safer, EU-compliant plant protection products also highlights the necessity of developing advanced pest control systems based on scientifically grounded monitoring tools and well-defined insecticide application thresholds.

Studies confirm the essential role of timely monitoring in controlling lepidopteran pests in maize systems. For instance, X. Qi *et al*. (2024) reported that early detection of *Spodoptera frugiperda* in southeastern China and timely insecticide treatments during the four-leaf stage significantly reduced crop damage. C.A. Deutsch *et al*. (2018) predicted climate change would intensify herbivorous insect populations, especially Lepidoptera, in temperate agricultural zones like Ukraine. L. Ma *et al*. (2023) warned about the increasing threat of *Loxostege sticticalis* (beet webworm) to cereal crops, particularly under unstable temperature and precipitation. EFSA Panel on Plant Health (PLH) *et al*. (2020), in an EFSA report, emphasised the need to harmonise pest monitoring systems across Europe, especially for regulated pests like *Ostrinia nubilalis* and *Helicoverpa armigera*. In Ukraine, Y. Liaska & O. Stryhun (2020) examined the development of *Helicoverpa armigera* in the Left-Bank Forest-Steppe of Ukraine and identified its first generation as particularly damaging to maize. They linked the pest's development to the accumulation of effective temperatures between 590°C and 610°C, which enables more accurate forecasting of high-risk periods.

Biological control strategies continue to play an important role in integrated pest management. L. Yuschenko & A. Tsyuk (2018) demonstrated that releasing *Trichogramma pintoi* in maize fields effectively reduced damage caused by *Ostrinia nubilalis*, offering an ecologically safe alternative to chemical treatments. Their findings support the use of biocontrol agents in the Forest-Steppe region. A.F. Abang *et al*. (2022) demonstrated that insecticide applications guided by pheromone trap catches effectively reduced *Spodoptera frugiperda* populations and minimised plant damage in maize fields, outperforming calendar-based schedules. F.E. Sári-Barnácz *et al*. (2024) further validated the effectiveness of monitoring approaches using advanced remote sensing for *H. armigera* detection.

Advanced monitoring tools, such as pheromone traps, have also proven effective under regional conditions. S. Szanyi *et al.* (2023) tested pheromone traps with synthetic lures for *Spodoptera frugiperda* in the Carpathian Basin, which includes parts of Ukraine. The traps successfully attracted the target species; however, the researchers reported unintended captures of non-target moths, underscoring the importance of improving specificity in monitoring systems. The Food and Agriculture Organisation (FAO, 2021) also recommended harmonising pest monitoring practices in Ukraine and outlined integrated pest management (IPM) approaches aligned with international standards.

Ukraine's agricultural sector is undergoing significant changes, especially in alignment with EU phytosanitary legislation. This transformation increases the urgency of developing reliable monitoring systems and environmentally safe pest control strategies. The gradual restriction of several insecticidal active substances reinforces the need to adopt sustainable, knowledge-based solutions that rely on accurate forecasting and real-time pest surveillance. The purpose of this study was to assess the effectiveness of integrated monitoring tools for lepidopteran pests and evaluate the performance of various insecticide treatments under field conditions in the Forest-Steppe zone of Ukraine, with a focus on optimising pest control timing and enhancing maize crop protection under intensifying environmental and legislative constraints.

MATERIALS AND METHODS

Field experiments during 2023-2024 took place on the territory of a private farm located in Velyka Obukhivka village, Velykoobukhivske, Myrhorod district, Poltava Oblast, Ukraine, within the Forest-Steppe zone (50° 8'28.80"N 33°55'42.23"E). The region features a moderately continental climate with warm summers, mild winters, and sufficient rainfall, which provides favourable conditions for maize cultivation. The study focused on the monitoring and control of three economically significant Lepidopteran pest species in maize agrocenoses: *Ostrinia nubilalis* Hbn., *Helicoverpa armigera* Hbn., and *Loxostege sticticalis* L.

Meteorological indicators, particularly the accumulation of effective temperatures above 10°C, served to determine the optimal period for monitoring pest flight activity. Based on these data, pheromone traps PH-668-1RR (for *O. nubilalis*), PH-554-1RR (for *L. sticticalis*), and PH-460-1RR (for *H. armigera*) were installed in early June, prior to the anticipated flight of the first generation. Traps were placed at a 1.5-1.7 m height along the field edges and within the maize fields, by EPPO standards (EPPO, 1997) and were inspected weekly until late August. Captured adults are counted for each trap, and mean values were calculated separately for each pest species. These data allowed the determination of the optimal timing for insecticide applications.

Insecticide treatments were carried out using a self-propelled Berthoud Raptor 4240 sprayer equipped with IDKT nozzles. Nozzles were selected and adjusted by the manufacturer's recommendations to ensure optimal droplet size and uniform application. The effectiveness of three insecticides was evaluated Coragen 20 SC (chlorantraniliprole, 200 g/l), Ampligo 150 ZC (chlorantraniliprole, 100 g/l + lambda-cyhalothrin, 50 g/l), and Vantex 60 CS (gamma-cyhalothrin, 50 g/l). Phytosanitary indicators included the average number of adults per trap for each pest species, number of larvae per 10 plants (before and after treatment), percentage of damaged plants, larval population reduction rate (%), and prevented yield loss compared to the untreated control.

Statistical analysis was performed using one-way analysis of variance (ANOVA). Differences among treatment means were evaluated using Tukey's Honestly Significant Difference (HSD) test at $\alpha = 0.05$, which is appropriate for multiple pairwise comparisons following ANOVA (McDonald, 2014). All statistical calculations were done using Microsoft Excel (Microsoft Corporation, Redmond, WA, USA). Experimental research on plants, including the collection of plant material, complied with institutional, national, or international guidelines. The authors adhered to the standards of the Convention on Biological Diversity (1992).

RESULTS

Pheromone traps were installed in maize fields at the Velykoobukhivske farm (Poltava Oblast, Myrhorod district, Velyka Obukhivka village) to monitor the flight dynamics of key lepidopteran pests: the European corn borer (*Ostrinia nubilalis* Hb.), beet webworm (*Loxostege sticticalis* L.), and cotton bollworm (*Helicoverpa armigera* Hb.).

The traps were positioned along the field edges and within the maize crops at uniform distances (25 metres between each trap) to ensure optimal coverage and data representativeness. (Fig. 1).

Figure 1. Monitoring of lepidopteran herbivore insects using pheromone traps in maize fields
Source: original photo by S. Moroz, S. Marskakov, 26.06.2024

The results of trap inspections (Table 1) illustrate the time dynamics of pest emergence and provide early warning signals for crop protection measures. Notably, the number of captured *O. nubilalis* increased more than fivefold between June 24 and July 4, 2024, indicating a population peak.

Table 1. Efficiency of monitoring of lepidopteran insects using pheromone traps at the Velykoobukhivske farm in 2024

Pheromone trap types	Insect pest name	Date of installation	Date of inspection	Adult Mean ± SD
PH-668-1RR	European corn borer (*Ostrinia nubilalis* Hb.)	14.06.2024	24.06.2024	3.1 ± 0.69
			04.07.2024	18.1 ± 1.91
PH-554-1RR	Beet webworm (*Loxostege sticticalis* L.)	14.06.2024	24.06.2024	0
			04.07.2024	9.7 ± 0.92
PH-460-1RR	Cotton bollworm (*Helicoverpa armigera* Hb.)	14.06.2024	24.06.2024	4.0 ± 0.76
			04.07.2024	12.3 ± 1.35

Note: "Adult Mean ± SD" refers to the average number of adult male moths captured per trap, with standard deviation
Source: developed by the authors

Low captures indicated the beginning of moth emergence in the first monitoring period (14.06-24.06). By the second period (24.06-04.07), trap data showed active flight and the onset of the peak pest phase, confirming the importance of timely intervention. Thus, the trap with the pheromone PH-668-1RR determined the change in the number of European corn borers (*Ostrinia nubilalis* Hb.) between the two sampling dates. In the first period (14.06-24.06), the number of captured individuals was 3.1 per trap, which indicates the beginning of population activity. In the second period (24.06-04.07), the number increased to 18.1 per trap, indicating the active phase of the pest development. Monitoring with pheromone traps did not detect the beet webworm (*Loxostege sticticalis* L.) as of 24.06.2024, possibly due to its low activity. In the second inspection of traps (24.06-04.07), the number of males caught was 9.7 per trap, which indicates an active adult summer. Cotton bollworm (*Helicoverpa armigera* Hb.) During the first inspection of traps, the average number was 4.0 per trap; in the second, it was 12.3 per trap. This increase indicates the transition of the population to the phase of mass flight, which served as a signal for protective measures.

Protection of maize from dominant lepidopteran pests such as beet webworm (*Loxostege sticticalis* L.), European corn borers (*Ostrinia nubilalis* Hb.), and cotton bollworm (*Helicoverpa armigera* Hb.) is an important task to ensure high yields. The study used preparations to control the dominant pest species in maize under the "Velykoobukhivske" farm conditions. Their effectiveness was evaluated on the 3rd, 7th, and 14th days after the application of insecticides (Table 2).

Table 2. Effectiveness of insecticides against lepidopteran herbivore insects in maize ($x \pm SD$, $n = 8$)

Variants	Beet webworm (*Loxostege sticticalis* L.) per 100 plants			Cotton bollworm (*Helicoverpa armigera* Hb.) per 100 plants			European corn borer (*Ostrinia nubilalis* Hb.) per 100 plants		
	Days after installation								
	3	7	14	3	7	14	3	7	14
Control (water) 120 l/ha	9.5 ± 0.40^a	9.21 ± 0.43^a	8.99 ± 0.44^a	12.0 ± 0.48^a	11.8 ± 0.64^a	11.6 ± 0.74^a	17.9 ± 0.44^a	17.5 ± 0.61^a	17.5 ± 0.14^a
Coragen 20 SC 0.13 l/ha (reference)	2.5 ± 0.26^d	1.5 ± 0.49^c	0.8 ± 0.05^c	3.1 ± 0.54^d	1.6 ± 0.41^c	1.0 ± 0.3^c	4.0 ± 0.51^d	2.11 ± 0.58^b	1.2 ± 0.12^d
Ampligo, 150 ZC 0.2 l/ha	3.10 ± 0.57^c	1.8 ± 0.39^b	1.0 ± 0.13^b	4.0 ± 0.48^c	2.1 ± 0.55^c	1.3 ± 0.53^c	4.5 ± 0.31^c	2.20 ± 0.50^b	1.5 ± 0.18^c
Vantex 60 CS, 0.15 l/ha	3.9 ± 0.58^b	2.33 ± 0.56^b	1.2 ± 0.28^b	5.1 ± 0.32^b	3.0 ± 0.07^b	2.0 ± 0.16^b	5.0 ± 0.40^b	2.9 ± 0.91^b	2.0 ± 0.08^b

Note: the letters indicate values significantly different within one column according to the result of the Tukey test ($p < 0.05$)
Source: developed by the authors

The data presented in Table 2 demonstrate the differences in effectiveness of the tested insecticides against the primary lepidopteran pests of maize *Loxostege sticticalis* L., *Helicoverpa armigera* Hb., and *Ostrinia nubilalis* Hb.at 3-, 7-, and 14-days post-application. The highest overall effectiveness was observed for Coragen 20 SC (0.13 l/ha), significantly reducing pest densities across all observation dates. For instance, the number of beet webworms decreased from 2.5 per 100 plants on the 3rd to just 0.8 species on 14th day. Similarly, the numbers of cotton bollworm and European corn borer were effectively suppressed, reaching only 1.0 and 1.2 per 100 plants by the 14th day. This consistent decrease indicates prolonged residual activity and high selectivity of chlorantraniliprole, the active ingredient in Coragen.

Ampligo 150 ZC (0.2 l/ha) also demonstrated substantial efficacy, particularly on the 14th day, when the population levels of all three pests dropped significantly compared to the control. However, its performance was slightly inferior to Coragen, particularly against *Ostrinia nubilalis*, where 1.5 per 100 plants were recorded on the 14th day, versus 1.2 with Coragen. Although effective, Vantex 60 CS (0.15 l/ha) showed comparatively lower suppression levels. For instance, on the 14th day, the population of *Helicoverpa armigera* was 2.0 individuals per 100 plants, nearly double that observed in the Coragen variant. The slightly lower efficacy could be attributed to its mode of action and active ingredient (gamma-cyhalothrin), which may provide a faster knock-down but shorter residual effect than Coragen's systemic action.

The control variant (water only) showed persistently high pest populations across all dates, confirming the necessity of chemical intervention under conditions of high pest pressure. Other factors may have influenced the effectiveness of the insecticide treatments. Environmental conditions like temperature and precipitation could have affected insecticide degradation rates and pest activity. In addition, the developmental stage of pests at the time of treatment is a key factor, since early instar larvae are typically more susceptible to insecticides. Moreover, the maize growth stage may impact the distribution and persistence of the active ingredients due to changes in canopy density. The most effective insecticide in this trial was Coragen 20 SC, due to its broad-spectrum activity, prolonged residual control, and minimal impact on non-target organisms. These results were consistent with yield data, where Coragen 20 SC treatment led to the highest maize productivity (Fig. 2).

The control variant recorded the lowest yield at 7.0 t/ha. The application of Vantex 60 CS (0.15 l/ha) increased the yield to 7.3 t/ha, Ampligo 150 ZC (0.2 l/ha) raised it to 7.6 t/ha, and Coragen 20 SC (0.13 l/ha) achieved the highest yield of 8.0 t/ha. The highest pest densities were recorded in the control variant (water treatment at a rate of 120 l/ha) throughout the observation period. Beet webworm populations ranged from 9.5 to 8.99 per 100 plants, cotton bollworm populations from 12.0 to 11.6 per 100 plants, and corn stem moth populations from 17.9 to 17.5 per 100 plants.

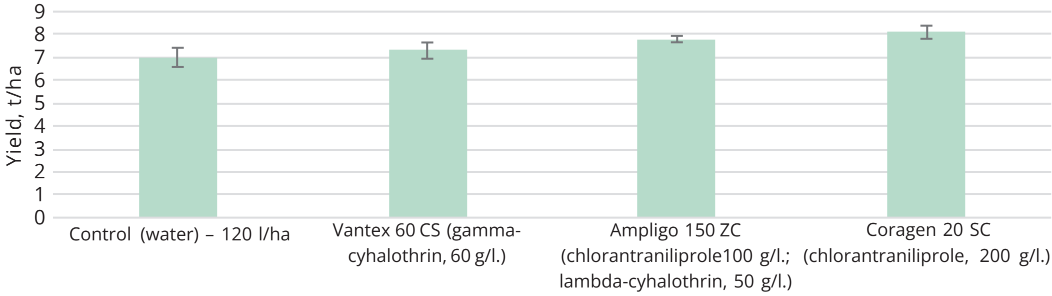

Figure 2. Development of maize yield in research (Velykoobukhivske, Poltava region)
Note: the letters (a, b, c, d) indicate values significantly different within one column according to the result of the Tukey test ($p < 0.05$)
Source: developed by the authors

The use of the Vantex 60 CS (0.15 l/ha) significantly reduced the number of all three types of pests. On the 3rd day, the number of meadow butterflies decreased to 3.9 per 100 plants, and on the 14th day, to 1.2 per 100 plants. A similar trend occurred for the cotton bollworm, with numbers decreasing from 5.1 to 2.0 specimens per 100 plants, and European corn borers, from 5.0 to 2.0 specimens per 100 plants. The use of the insecticide Amplico 150 ZC (0.2 l/ha) was somewhat more effective: on the 14th, the number of beet webworms was 1.0 per 100 plants, cotton bollworms – 1.3 per 100 plants, European corn borers – 1.5 per 100 plants. Coragen 20 SC demonstrated the highest biological effectiveness at a rate of 0.13 l/ha. On the 3rd day after treatment, the number of beet webworms decreased to 2.5 per 100 plants, and on the 14th day, to 0.8 per 100 plants. The number of cotton bollworms decreased from 3.1 to 1.0 per 100 plants, and European corn borers decreased from 4.0 to 1.2 per 100 plants. The effectiveness demonstrated by Coragen 20 SC indicates its feasibility for use in integrated maize protection systems in the Forest-Steppe of Ukraine (Fig. 3).

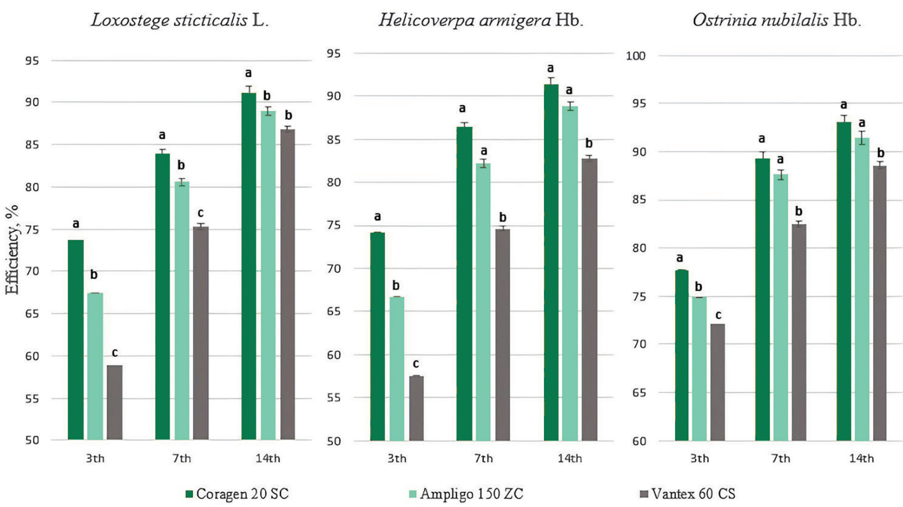

Figure 3. Technical effectiveness of insecticides against lepidopteran herbivore insects in maize (Poltava Oblast, Myrhorod district, Velyka Obukhivka)
Note: different letters indicate values significantly different within one column according to the result of the Tukey test ($p < 0.05$) ($x \pm SD$, $n = 8$)
Source: developed by the authors

The study evaluated the technical effectiveness of insecticides against the main lepidopteran pests of maize under field conditions at the Velyka Obukhivska (Poltava Oblast, Myrhorod district, Velyka Obukhivka village). Counts of beet webworm (*Loxostege sticticalis* L.), cotton bollworm (*Helicoverpa armigera* Hb.), and European corn borer (*Ostrinia nubilalis* Hb.) on the 3rd, 7th, and 14th days after trap placement showed a significant decrease in the population density of herbivore insects under the influence of the studied preparations. The use of Coragen 20 SC (0.13 l/ha) resulted in the highest rates of reduction in the number of all three pest species, with average values for the meadow butterfly reaching 73.7 ± 0.57, 83.9 ± 0.45, and 91.2 ± 0.31 specimens per 100 plants, respectively. Using Ampligo 150 ZC (0.2 l/ha) and Vantex 60, CS (0.15 l/ha) also decreased pest numbers, although the reduction was statistically significantly lower than the standard. The lowest average values were recorded in the Vantex 60, CS 58.9 ± 0.77, 75.3 ± 0.69, and 86.8 ± 0.49 specimens per 100 plants for the beet webworm on the corresponding days of accounting. The mean values and standard deviations confirm the stable effect of the preparations over time, and the Tukey test ($p < 0.05$) allowed establishing the reliability of differences between the variants within each observation period.

DISCUSSION

Field trials conducted at the Velykoobukhivske farm confirmed the utility of pheromone traps in monitoring the population dynamics of major lepidopteran pests of maize, including *Loxostege sticticalis* L., *Helicoverpa armigera* Hb., and *Ostrinia nubilalis* Hb. A marked increase in the number of captured *O. nubilalis* adults between 14-24 June and 24 June-4 July signalled the onset and escalation of flight activity. These results are consistent with the findings of O.I. Borzykh *et al*. (2024), who noted shifts in seasonal pest activity patterns in Ukraine, potentially linked to climatic factors such as elevated temperatures and altered precipitation regimes. This observation aligns with broader projections reported by C.A. Deutsch *et al*. (2018), who suggested that warming climates will likely increase crop losses from insect pests due to range expansions and altered phenology. S. Keszthelyi *et al*. (2011) showed that *Helicoverpa armigera* infestation substantially reduced the thousand-kernel weight of maize, demonstrating the importance of targeted pest control interventions. P.N. Sharma & P. Gautam (2011) observed that, without sufficient pest control, maize infestation levels could reach 80%, resulting in critical yield losses.

The yield impact of *O. nubilalis* and *H. armigera* remains significant. According to A. Taddele *et al*. (2020) and P.N. Sharma & P. Gautam (2011), lepidopteran infestations can reduce maize yields by 15-50%, depending on infestation severity. Similarly, R. Ndemah & F. Schulthess (2002) documented comparable yield reductions in West and Central Africa. In the present study, yield losses in untreated plots with high infestation pressure reached up to 2.3 t/ha, consistent with these prior estimates. Significant pest suppression was achieved using Coragen 20 SC (chlorantraniliprole, 200 g/l), which reduced pest densities to 0.8-1.2 individuals per 100 plants fourteen days post-application. G.P. Lahm (2007) described how chlorantraniliprole acts on insect ryanodine receptors, disrupting calcium ion balance and causing paralysis and death. This mode of action ensures selective toxicity and a low impact on beneficial organisms. T.C. Sparks & R. Nauen (2015) emphasised the importance of rotating insecticides with different modes of action to delay resistance, a recommendation supported by the current findings.

Ampligo 150 ZC (chlorantraniliprole + λ-cyhalothrin) demonstrated slightly lower but substantial efficacy, reducing pest densities to 1.0-1.5 individuals per 100 plants. R. Meena & K. Kumar (2024) observed similar outcomes in rice fields, reporting significant reductions in pest populations and improved rice yields after applying Ampligo 150 ZC, highlighting the effectiveness of the dual-action formulation. Vantex 60 CS (γ-cyhalothrin) provided statistically significant control, although its efficacy was lower than Coragen and Ampligo. EFSA (European Food Safety Authority) (2024) states that γ-cyhalothrin remains a valuable tool in insecticide rotation strategies due to its fast action and compatibility with resistance management programmes. While broad-spectrum pyrethroids can negatively affect non-target arthropods, the EFSA Panel on Plant Health (PLH) (2020) noted that selective insecticides such as chlorantraniliprole allow effective pest control with minimal disruption to beneficial insect populations. These findings support the incorporation of reduced-risk insecticides into integrated pest management (IPM) systems.

Real-time monitoring using pheromone traps was essential for optimising the timing of insecticide applications. Beyond selective insecticides, integrating biological control agents into maize protection programmes has shown promise. For example, J. Razinger *et al*. (2016) demonstrated that inundative releases of *Trichogramma brassicae* in maize fields across three European regions effectively controlled *O. nubilalis*, maintained mycotoxin levels below EU thresholds, and provided an economically sustainable alternative to chemical insecticides. Similarly, S. Oztemiz (2009) observed that field releases of *T. evanescens* in Turkish maize fields significantly reduced *O. nubilalis* egg masses and larval populations, confirming this parasitoid's efficacy under field conditions. These findings support incorporating *Trichogramma* species into integrated pest management strategies for maize.

Additionally, agronomic practices such as crop rotation, conservation tillage, and planting date manipulation can significantly influence pest pressure. E. Levine & H. Oloumi-Sadeghi (1991) reported that rotating maize with non-host crops effectively suppressed *Diabrotica virgifera virgifera* and other maize pests. These preventive strategies are cost-effective and environmentally benign, and when used alongside chemical and biological control methods, they serve as a foundation for sustainable crop protection systems. Chlorantraniliprole's low non-target toxicity and residual activity make it especially suitable for integrating other IPM components. A. Dinter *et al*. (2009) demonstrated its safety for key beneficial arthropods, including *Coccinellidae*, *Chrysopidae*, and hymenopteran parasitoids. Its compatibility with natural enemies and long-lasting efficacy justifies its recommendation for maize pest control under variable field conditions.

From a biotechnological perspective, the development of Bt maize has revolutionised pest management in many regions. J. Romeis *et al*. (2006) reported that transgenic maize expressing *Bacillus thuringiensis* (Bt) toxins such as Cry1Ab and Cry1F provides season-long protection against *O. nubilalis* and *S. frugiperda*, significantly reducing the need for chemical insecticides. B.E. Tabashnik *et al*. (2013) reviewed data from the first billion acres of Bt crops, showing how they contribute to pest suppression when implemented with resistance management strategies. Although Bt maize is not yet approved for commercial cultivation in Ukraine, A.J. Gassmann (2016) suggested that refuge strategies and future regulatory changes could support its eventual deployment. Emerging technologies such as CRISPR-Cas gene editing may allow the development of pest-resistant maize varieties without introducing transgenic DNA. K. Chen *et al*. (2019) highlighted how CRISPR could enhance societal and regulatory acceptance while providing precise pest-resistance traits. Combined with biopesticides and monitoring tools, such innovations offer a promising outlook for future maize pest management.

Economic considerations are equally important. J. Pretty & Z.P. Bharucha (2015) emphasised that although selective insecticides and biological control options may require a higher upfront investment, they reduce overall pesticide use, minimise yield losses, and improve ecosystem services, delivering strong economic returns over time. Findings support this conclusion, as plots treated in the study yielded significantly more than untreated controls, even when accounting for input costs. Integrating selective insecticides with pheromone-based surveillance proved effective under Ukrainian field conditions. This strategy reduced pest populations, preserved beneficial organisms, and contributed to higher yields. These outcomes align with IPM recommendations by FAO (2018) and underscore the importance of adaptive, data-driven pest management strategies.

Exploring synergies between chemical and biological control methods, such as *Trichogramma* spp., refining pest-specific economic thresholds, and incorporating climate-driven predictive models are key steps toward improving pest management. Continuous ecological monitoring remains essential for assessing the long-term impacts of insecticide use and enhancing the sustainability of maize production systems.

CONCLUSIONS

The research confirms the high effectiveness of integrated phytosanitary measures for controlling dominant Lepidopteran pests in maize crops within the Forest-Steppe zone of Ukraine. The application of pheromone traps, specifically models

PH-668-1RR, PH-554-1RR, and PH-460-1RR, enabled accurate identification of pest species such as *Loxostege sticticalis* L., *Helicoverpa armigera* Hb., and *Ostrinia nubilalis* Hb., and allowed for the precise timing of insecticide applications based on the detection of peak flight activity. Using pheromone traps ensured the optimal timing of insecticide treatments, targeting pest populations when they were most vulnerable.

The field experiments demonstrated that Coragen 20 SC (chlorantraniliprole) was the most effective among the tested insecticides. By the 14th day after application, Coragen achieved a 93.1% reduction in pest populations, showing consistent control across all pest species and observation intervals. This preparation exhibited prolonged residual activity and excellent selectivity, making it suitable for integrated pest management (IPM) systems. Ampligo 150 ZC, which contains a combination of chlorantraniliprole and lambda-cyhalothrin, also provided strong efficacy, especially against *Helicoverpa armigera*, with reductions exceeding 85% by the 14th day. Vantex 60 CS (gamma-cyhalothrin) showed moderate efficacy, with 60% to 70% reductions depending on the pest species and time after application. Although less effective than Coragen, Vantex still provided statistically significant suppression of pest densities compared to the untreated control.

Statistical analysis confirmed significant differences among treatments ($p < 0.05$), validating the superior performance of Coragen in terms of pest suppression. The significant yield increase observed in treated plots highlights the biological effectiveness and economic viability of the implemented IPM strategy. The research supports adopting integrated pest management practices that combine continuous monitoring with targeted, selective insecticide use. Such systems offer several benefits: minimising yield losses due to pest damage, reducing unnecessary pesticide applications, and lowering environmental risks. The integration of real-time pest surveillance with rational chemical control represents a sustainable solution for maize protection under Ukraine's current climatic and economic conditions.

Prospects for further research include the evaluation of combined insecticide and biological control agents (e.g., *Trichogramma* spp.), the development of predictive models for pest outbreaks based on weather and agronomic data, and the assessment of long-term environmental impacts of repeated insecticide use within IPM frameworks. Future studies should also focus on refining application thresholds for different pest species and enhancing farmer awareness of the advantages of integrated approaches in crop protection.

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Контроль чисельності домінуючих лускокрилих фітофагів у посівах кукурудзи в Полтавській області

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Анотація. Інтенсивні технології вирощування кукурудзи в умовах Лісостепу України супроводжується фітосанітарними ризиками, які пов'язані поширенням лускокрилих фітофагів, які можуть збільшувати рівень втрат урожаю, більше ніж економічний поріг шкодочинності. Метою дослідження було встановити ефективність сучасних засобів моніторингу та контролю чисельності домінуючих видів лускокрилих фітофагів у посівах кукурудзи в регіональних агроценозах. Для досягнення поставленої мети застосовували методи феромонного моніторингу, візуального обстеження рослин і кількісного обліку гусениць до та після інсектицидних обробок. Польові дослідження, що проводилися у 2024 році на базі агропідприємства АПОП «Великообухівське (Полтавська область), засвідчили домінування трьох видів шкідників *Ostrinia nubilalis* Hb., *Loxostege sticticalis* L. і *Helicoverpa armigera* Hb. Феромонні пастки типу PH-668-1RR, PH-554-1RR і PH-460-1RR продемонстрували високу ефективність для виявлення строків масового льоту шкідників, що дало змогу обґрунтувати строки інсектицидних обробок. Результати досліду свідчать, що найбільше зниження чисельності гусениць відмічено після обробки препаратом Кораген 20 КС, який знизив чисельність гусениць на 93,1 %, дещо меншу ефективність виявлено у Ампліго 150 ZC (91,6 %), тоді як Вантекс МК.С. забезпечив лише частковий контроль шкідників. Загалом результати підтверджують доцільність інтегрованого підходу, що поєднує феромонне спостереження з хімічним захистом, для ефективного зменшення чисельності фітофагів. Отримані дані можуть буди використані в агровиробництві для підвищення ефективності систем захисту кукурудзи, зменшення втрат урожаю та забезпечення сталого землеробства. Водночас доцільно відмітити необхідність формування інтегрованих систем захисту сільськогосподарських культур, зокрема кукурудзи, що пов'язано із потенційними заборонами ряду діючих речовин інсектицидів у рамках інтеграції Українського законодавства та стандартів до вимог ЄС

Ключові слова: моніторинг; агроценоз; фітосанітарний стан; захист рослин; феромонні пастки; інсектициди