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IDENTIFICATION AND MONITORING OF *CYDALIMA PERSPECTALIS* (WALKER, 1859) IN THE PRODUCTION FIELDS OF AN ORNAMENTAL NURSERY FROM THE IASI AREA

Iuliana Elena Golache[1,2], Ionuț Vasile Ungureanu[1,*], Ionel Perju[1], Iulia Mineață[1], Monica Herea[2], Mihai Tălmaciu[2]

[1] Research Station for Fruit Growing Iași, 3 Ion Vodă cel Viteaz, Miroslava, Romania
[2]'Ion Ionescu de la Brad' Iași University of Life Sciences, 3 Mihail Sadoveanu Alley, Iași, Romania

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Abstract
The box tree moth (Cydalima perspectalis Walker, 1859) is a harmful species native to subtropical regions of Asia. Its introduction into areas of America and Europe has led to it being classified as a biological invasion. This moth poses a significant threat to boxwood plants (Buxus spp.), as its larvae feed voraciously on the leaves and stems, causing defoliation and weakening of the plants. This study was conducted during 2023 within an ornamental nursery located in the Iași County both in the greenhouse and the outdoor production fields of buxus. The aim of this paper focuses on the identification and monitoring of Cydalima perspectalis (Walker, 1859) using pheromonal traps placed between May-September. In the greenhouse, the first adult moths were identified on April 3rd. Subsequently, the monitoring efforts in the outdoor production fields revealed the flight activity of the overwintered generation adults from May 15th to June 21st, while the flight activity of the following generation adults occurred 28 days later, beginning with July 19th and until August 24th.
The results obtained were processed and interpreted statistically and will constitute preliminary aspects in the control strategies of Cydalima perspectalis (Walker, 1859) substantiated and adapted to the zonal ecosystem.

Keywords: buxus, Cydalima perspectalis Walker, 1859, flight activity, monitoring.

1. INTRODUCTION

The box tree moth (*Cydalima perspectalis* Walker, 1859), a Lepidopteran pest native to East Asia, has rapidly established itself as a significant threat to ornamental boxwood plants (*Buxus* spp.) in various regions across Europe and America. Initially confined to its native subtropical habitats, *Cydalima perspectalis* was first detected in Europe in 2007, in Germany, and has since proliferated throughout the continent, causing extensive damage to boxwood populations (Bereś et al., 2022). The invasive nature of this species is largely attributed to its high reproductive capacity, rapid larval development, and lack of natural predators in the introduced regions (Wan et al., 2014).
The larval stages of *Cydalima perspectalis* are particularly destructive, as they consume the leaves and stems of boxwood plants, leading to severe defoliation and potential plant death if infestations are left unmanaged (Regier et al., 2012). Given the economic and ecological value of boxwoods in

*Corresponding author, E-mail address: ungureanu_ionut91@yahoo.ro

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horticulture and landscape architecture, the invasion of this pest poses a substantial challenge to nurseries and ornamental plant producers (Leuthardt et al., 2010; Plant et al., 2019).

Recent studies have highlighted the necessity of developing effective monitoring and control strategies to manage the spread of *C. perspectalis*. Pheromonal traps have emerged as a critical tool in this regard, offering a means to monitor adult moth populations and assess their flight activity patterns (Coyle et al., 2022). By understanding the seasonal dynamics of this pest, nursery managers can implement timely and targeted interventions to mitigate damage. Additionally, pheromonal trapping data can be integrated with other monitoring techniques, such as visual inspections and the use of sentinel plants, to enhance detection accuracy and provide an earlier time understanding of infestation levels (Witzgall et al., 2010). This multifaceted approach not only improves early detection but also facilitates the optimization of control strategies tailored to local environmental conditions and pest pressures (Van der Straten and Muus, 2010). Moreover, advances in molecular techniques have been employed to confirm the identity of captured moths, ensuring that monitoring efforts are specifically targeting *C. perspectalis* and not confounded by other sympatric species (Bras et al., 2019). The integration of these advanced monitoring tools contributes significantly to the precision and efficacy of pest management programs aimed at mitigating the damage caused by this invasive species.

The aim of this paper is to identify and monitor the presence and activity of *Cydalima perspectalis* (Walker, 1859) within the production fields of an ornamental nursery from Iași County. The detailed results obtained on the seasonal dynamics of this pest will contribute to the development of efficient, region-specific pest management strategies to protect boxwood plants (*Buxus* spp.) from the damaging effects of *Cydalima perspectalis* (Walker, 1859)

2. MATERIALS AND METHODS

Study Area

The study was conducted during 2023 within an ornamental nursery located in Iași County, subunit of National Forest Administration - ROMSILVA. The nursery includes both greenhouse and outdoor production fields dedicated to the cultivation of boxwood plants (*Buxus* spp.).

Placement the pheromonal traps

To monitor the population and flight activity of *Cydalima perspectalis*, pheromonal traps were utilized (AtraCYD). The atraCYD traps are specifically designed to attract male moths using species-specific sex pheromones.

Pheromonal traps were strategically placed in both the greenhouse and outdoor production fields. In the greenhouse, traps were installed at the beginning of April, while in the outdoor fields, traps were placed in early May. The monitoring period extended from May to September 2023. In the greenhouse the traps were positioned at a height of approximately 1.5 meters, ensuring they were placed among the boxwood plants to effectively capture moths. Also, the traps were placed at similar heights and distributed evenly throughout the outdoor production fields.

Data collection

Traps were checked weekly to record the number of captured adult moths. Captured moths were collected, counted, and identified to confirm their species as *C. perspectalis*. The data collection process included noting the date of each trap inspection and the number of moths captured in each trap. The flight activity of *C. perspectalis* was monitored by recording the number of adults captured in the traps over the monitoring period.

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Figure 1. The placement of traps within the experience

Environmental Conditions

Throughout the monitoring period, environmental conditions such as temperature, humidity, and rainfall were recorded using AgroExpert System. These parameters were used to correlate environmental factors with variations in moth captures, aiding in the understanding of the pest's behavior in relation to climatic conditions.

3. RESULTS AND DISCUSSIONS

The evolution of the climatic factors recorded during the study period at production fields of nursery tree was presented in table 1. Their dynamics highlights deviations from the multiannual averages, influencing the activity of *Cydalima perspectalis*. The average air temperature for the study period was 12.0°C, 1.5°C higher than the multiannual average of 10.5°C. This warming trend is particularly evident during the peak moth activity months: May (16.4°C, slightly below the multiannual average by 0.6°C), June (21.3°C, +0.8°C), July (23.3°C, +0.9°C), and August (24.0°C, +2.1°C). These elevated temperatures contributed to developmental acceleration in *Cydalima perspectalis*, resulting in increased moth captures. Precipitation during the study period totaled 363.6 mm, significantly lower than the multiannual average of 517.6 mm, with a deficit of 154.0 mm. The distribution of precipitation was uneven throughout the year, with certain months such as April and November having higher than average precipitation (+6.2 mm and +20.5 mm respectively), while critical summer months as June and July, recorded significant deficits (-57.8 mm and -9.6 mm, respectively). These deviations suggest that although overall drier conditions prevailed, sporadic heavy rainfall events created favorable microhabitats for larval development, contributing to the observed peaks in flight activity. Humidity levels were typically influenced by temperature and precipitation. This climate analysis highlighted the significant impact of warmer and drier conditions, interspersed with critical rainfall events, on the lifecycle dynamics of *Cydalima perspectalis*.

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Table 1. The evolution of climatic factors in the experimental field (Galata Nursery Iași, 2023)

Month	Air temperature (°C)			Precipitation (mm)		
	Av.	Multiannual	Deviation	Sum	Multiannual	Deviation
I	1.6	-1.9	+3.5	9.4	35.5	-19.6
II	2.7	-1.2	+3.9	16.9	32.1	-10.6
III	5.0	4.7	+0.3	31.4	71.2	+3.3
IV	9.9	11.4	-1.5	46.5	51.4	+6.2
V	16.4	17.0	-0.6	11.2	71.1	-41.3
VI	21.3	20.5	+0.8	17.3	82.9	-57.8
VII	23.3	22.4	+0.9	59.7	64.7	-9.6
VIII	24.0	21.9	+2.1	38.6	50.8	-19.0
IX	17.7	16.3	+1.4	40.3	36.5	-0.5
X	13.5	10.1	+3.4	19.3	34.4	-15.1
XI	6.7	5.4	+1.3	55.1	33.4	20.5
XII	1.7	0.1	+1.6	18.1	30.6	-10.8
Av./Sum	**12.0**	**10.5**	**+1.5**	**363.6**	**517.6**	**-154.0**

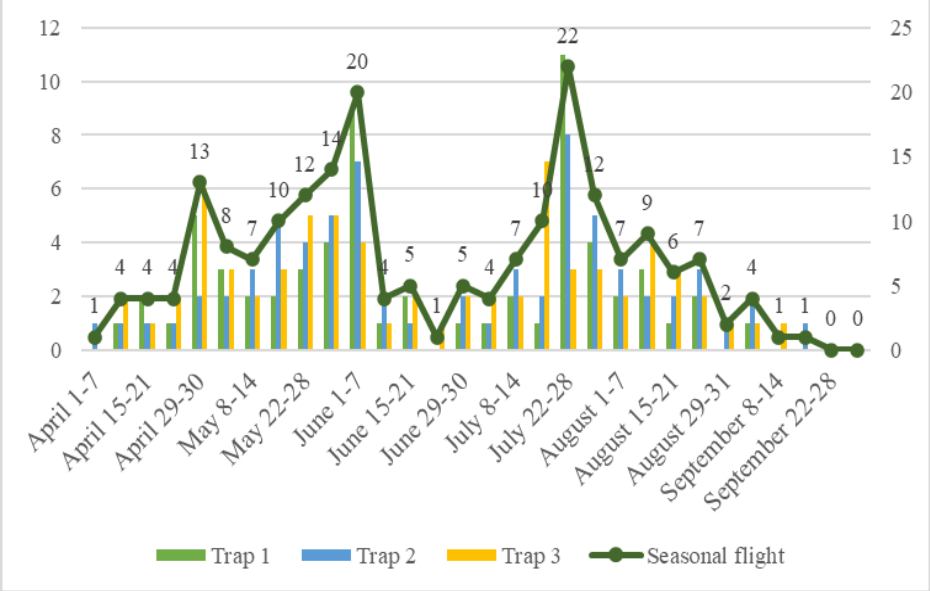

Figure 2. The seasonal dynamics flight of the adults captured in the greenhouse

The results obtained regarding the dynamics of *Cydalima perspectalis* adults captured with the help of pheromonal traps are presented in figures 2 and 3. In figure 2 the seasonal dynamics flight of the adults captured in the greenhouse between May and September is represented. Regarding the flight activity of hibernating generation, first adult was recorded in 3rd April. The significant capture of adult moths occurred between April 15-21, indicating the early emergence of *C. perspectalis* adults in the greenhouse. The captures of first generation are relatively low but consistent across all traps. The second, more substantial peak occurs between June 1-7, with a total capture of 20 adults. This peak aligns with the typical lifecycle of *C. perspectalis*, where the first generation reaches its maximum flight activity in late spring to early summer. A considerably decline in captures follows

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the June peak, with lower but steady activity observed from mid-June to mid-July. This period represents the transition between the first and second generations, where larval development predominates, and fewer adults are present. A significant increase in moth captures is noted from July 22-28, peaking at 22 moths. This peak indicates the emergence of the second generation of adult moths, stimulated by favorable climatic conditions such as high temperatures and moderate humidity. Post-August 1-7, there is a gradual decline in moth captures, with sporadic activity persisting into late September. The reduction in captures toward the end of the season corresponds with decreasing temperatures and the completion of the second generation's lifecycle. Adults captured in greenhouses in 2023 totaled 204.

Figure 3 highlights the seasonal flight activity of adults recorded using pheromonal traps in the outdoor production fields from May to September. The first adult moths were captured between May 15-21, marking the onset of flight activity in outdoor fields. Early captures were low, reflecting the emergence of first-generation adults. The first maximum peak in activity occurs from June 8-14, with a total capture of 38 adults. This peak indicates the culmination of the first generation's flight period, driven by optimal climatic conditions of rising temperatures and moderate rainfall. Following the June peak, a decline in captures is observed through July 1-7. This period likely represents the larval development phase between the first and second generations, with reduced adult activity. A significant second peak in flight activity is recorded from August 8-14, with a maximum capture of 40 moths. This peak signifies the emergence of the second-generation adults, influenced by favorable summer temperatures and sufficient humidity. After the peak in mid-August, there is a gradual decrease in moth captures, with minimal activity persisting into late September. The declining trend corresponds with cooler temperatures and the end of the second generation's lifecycle. The figure highlights the strong correlation between moth activity and environmental factors. Higher temperatures and moderate rainfall during peak periods facilitated increased moth activity, while lower captures during transitional periods reflect less favorable conditions for adult flight and emergence.

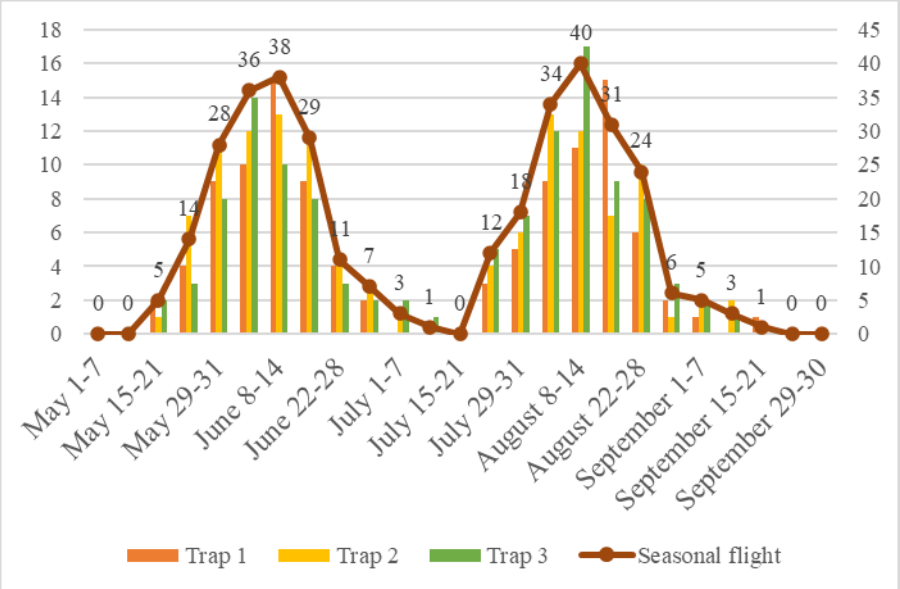

Figure 3. The seasonal dynamics flight of the adults captured in the production fields

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Comparing the flight activity of *Cydalima perspectalis* in greenhouse and outdoor production fields reveals distinct patterns influenced by environmental conditions. In the greenhouse, moth activity commenced earlier, with significant peaks in late April and early June, and a pronounced secondary peak in late July. This early and extended activity is due to the controlled environment, which maintains higher temperatures and stable humidity levels, conducive to continuous development and earlier emergence. In contrast, outdoor fields showed the first significant captures in mid-May, peaking sharply in early June and mid-August, aligning with natural climatic variations. Other studies highlight similar results regarding seasonal peaks (Bras et al., 2022; Leuthardt et al., 2010). Thus, regions with milder climates, such as parts of Southern Europe, report earlier and more protracted flight periods, correlating with higher average temperatures and longer growing seasons (Regier et al., 2012). The elaborated researches in UK indicates a slightly later start for outdoor moth activity, with peaks in June and September, influenced by cooler spring temperatures and higher rainfall (Nacambo et al., 2014). These findings underscore the importance of localized environmental conditions in shaping the lifecycle dynamics of *C. perspectalis*. Understanding these regional variations is crucial for developing effective, location-specific pest management strategies to mitigate the impact of this invasive species across diverse climatic zones (Witzgall et al., 2010).

Figure 4. Aspects of the study period (larvae-adult of C. perspectalis and damage)

The statistical analyzes reveal significant differences in *Cydalima perspectalis* activity variability between the greenhouse and outdoor production fields. The standard deviations for outdoor traps are higher than those for traps placed in the greenhouse, indicating greater variability in capture adults in production fields. Covariance values (T1, T2, T3) highlight a strong positive relationship between greenhouse and outdoor moth activities, suggesting synchronized peaks and troughs driven by environmental factors. These findings underscore the influence of external conditions on moth dynamics, necessitating tailored pest management strategies for each setting.

Table 2 summarizes the number of adults captured during periods of flight activity for each trap in both environments.

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Table 2. The dynamics of the capture of *Cydalima perspectalis* adults in the studied period

Period	Greenhouse			Outdoor production fields		
	T1	*T2*	*T3*	*T1*	*T2*	*T3*
April	9	6	11	0	0	0
May	14	19	18	15	19	13
June	20	24	19	25	31	27
July	19	23	18	40	44	37
August	19	19	17	47	55	43
September	16	15	13	47	52	43
Min	9	6	11	0	0	0
Max	20	24	19	47	55	43
Average	16.17	17.67	16.00	29.00	33.50	27.17
STDEV	4.17	7.20	2.68	18.71	20.65	16.34
COVAR S%				210.5	303.67	163.07

4. CONCLUSIONS

The results of the study demonstrated that environmental factors, particularly temperature and humidity, significantly influence the flight activity of *Cydalima perspectalis*. In both the greenhouse and outdoor environments, maximum adult samples captured corresponded to periods of high temperatures, confirming that temperature is a critical factor influencing moth emergence and activity. This aligns with previous research indicating that optimal temperature ranges accelerate the development cycles of this pest.

The statistical analysis revealed greater variability in moth activity in outdoor production fields compared to the greenhouse. Standard deviations for outdoor traps were higher, indicating that the box tree moth populations in outdoor environments are more susceptible to fluctuations in environmental conditions.

Covariance analysis showed a strong positive relationship between moth activities in the greenhouse and outdoor production fields. This synchronicity suggests that despite controlled conditions in the greenhouse, external climatic factors have a crucial role in shaping moth activity patterns across both environments.

The identification of peak periods of *Cydalima perspectalis* flight activity underlines the need to implement pest management strategies focused on these critical periods to mitigate the negative impact of this pest species on buxus.

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