

COMPARISON OF TWO TYPES OF PHEROMONE TRAPS IN MONITORING OF *HELICOVERPA ARMIGERA* HUB. (LEPIDOPTERA: NOCTUIDAE)

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ABSTRACT

The tobacco budworm is the most economically significant pest of tobacco in seed production. Therefore, regular control measures are taken to manage this pest. Continuous monitoring is crucial for determining the dynamics of flight, and consequently, for predicting the intensity of larval emergence. The most commonly used method for monitoring *H. armigera* is through the use of sex pheromones. For this reason, in this study, two traps, Csalomon VARL and Csalomon RAG, were compared. In both seasons, with the use of the RAG trap, a longer active flight period was recorded, but it captured fewer adult individuals. With the VARL trap, on the other hand, a shorter active flight period was registered, but it captured a significantly higher number of adults in the two seasons. The combination of both trap types provides the most accurate results for the dynamics and intensity of the flight of *H. armigera*.

Key words: *Helicoverpa armigera*, pheromone trap, monitoring, tobacco

СПОРЕДБА НА ДВА ТИПА ФЕРОМОНСКИ ЛОВИЛКИ ПРИ МОНИТОРИНГ НА *HELICOVERPA ARMIGERA* HUB. (LEPIDOPTERA: NOCTUIDAE)

АПСТРАКТ

Тутунската семенарка е економски најзначаен штетник на тутунот при производството на семе. Поради тоа редовно се преземаат мерки за контрола на овој штетник. Континуираниот мониторинг е значаен за одредување на динамиката на летот, а со тоа и оценување на интензитетот на појава на ларвите. Најчесто користен метод на мониторинг на *H. armigera* е преку употреба на сексуален феромон. Поради тоа во ова истражување беа споредени две ловилки Csalomon VARL и Csalomon RAG. Во двете сезони со RAG ловилката беше регистриран подолг период на активен лет, но помал број на уловени адулти. Со VARL ловилката беше регистриран пократок активен лет, но значително поголем број на уловени адулти во двете сезони. Комбинацијата од двата типови на ловилки дава најпрецизни резултати за динамиката и интензитетот на летот на *H. armigera*.

Клучни зборови: *Helicoverpa armigera*, феромонски ловилки, мониторинг, тутун

INTRODUCTION

The tobacco (cotton) bollworm, *H. armigera* is an important pest of tobacco plants causing damages to the buds, flowers, top leaves. Especially severe damages can be made on tobacco seed (Krsteska et al., 2007).

This pest represents a significant challenge in tobacco seed production. Monitoring its seasonal population density is a critical method for making informed decisions in pest management. By tracking the population trends throughout the season, more effective strategies can be implemented to control this pest.

Monitoring of *H. armigera* can be performed using several different methods, with radar being used to track seasonal migration (Feng et al., 2009). The preference of moths from the Noctuidae family for light has been exploited, and monitoring can be carried out using light traps (Vasilev, 1976). This method has several disadvantages, such as the need for sorting and determination of species, because a large number of insects are attracted to light during the night (Xu et al., 2019).

Light trapping often involves high-temperature devices, killing numerous pests and beneficial insects, complicating their classification (Yao et al., 2020).

Sex pheromone trapping is highly sensitive, very specific, and convenient. It is currently

the most important monitoring method for *H. armigera* adults (Shah et al., 2011; Li et al., 2019). Monitoring of *H. armigera* is largely based on the utilization of different types of traps, with pheromone-baited traps being the most popular, since the discovery of the male attractant of this species as a mixture of (Z)-11-hexadecenal and (Z)-9-hexadecenal (Karakantza et al., 2023).

Many researchers explore the use of sexual pheromones as a monitoring tool, but also as a potential method for pest control. For example, Karakasis et al. (2021) examined the effect of different trap heights and various colors of funnel traps. Karakantza et al. (2023) also investigated the effect of different trap colors. Stavridis et al. (2008) studied the effect of adding insecticides to funnel traps. Burgio et al. (2020) investigated the possibility of using the sexual pheromone for controlling *H. armigera* through the method of mate disruption.

In this study, two types of insect traps were compared, the lure of which was the female sex pheromone. The focus was on the total number of adults caught, as well as the identification of the mass flight of the adults. The aim was to determine whether there was a difference between these types of traps and, if so, what their practical application was.

MATERIAL AND METHODS

The experiments were carried out in the experimental field of the Scientific Tobacco Institute in Prilep on the variety 'PP 66 9 7' during the 2023 and 2024 growing seasons. We used two types of insect traps. The first trap is a funnel type, it has a cylindrical shape

with a diameter of 18 cm and a height of 25 cm. The pheromone bait is placed on the top lid secured with a rubber band. Insects enter from the upper invaginated conical opening of the trap, which is significantly narrower in the lower part and insects cannot easily exit.

The funnel trap is baited with a commercial sex pheromone (VARL, Csalomon®).

The second trap is a delta trap, shaped like a triangular prism, with three sides of the same size, 23 cm long and 12 cm wide. A sticky liner is placed on the underside of the trap to capture the adults. The sticky liner measures 16.5 cm in length and 11 cm in width. The pheromone bait is attached to the top-center of the plastic trap using a securing pin. The

trap is baited with a commercial sex pheromone (RAG, Csalomon®).

The two traps were positioned in a tobacco plantation on an area of 4 hectares, placed on a T-shaped metal stand at a height of 1.5 m from the ground. The distance between the traps is 120 m. Pheromone baits were replaced every 20 days. Monitoring of the traps was carried out on a weekly basis.

RESULTS AND DISCUSSION

Season 2023

In 2023, a total of 271 male adults were captured simultaneously on both traps. The flight period started on June 10 and lasted until September 30. Only 6% of the moths were captured in June, which indicates minimal activity during that month. A gradual increase in catches occurred at the beginning of July, lasting until the middle of the month, followed by a decrease in catches towards the end of the month. In July, 11% of the total adults were captured. The highest intensity of *H. armigera* flight was observed

from early August to the end of September, during which 80% of the total moths were captured. Throughout this period, both traps consistently captured moths, with three distinct peaks. The RAG trap registered an active flight period of 16 weeks, from June 10 to September 30. The maximum number of adults captured was 59, accounting for 22% of the total adults caught. The highest number of moths captured in a one-week period occurred on August 5, with 8 adults caught (Figure 1).

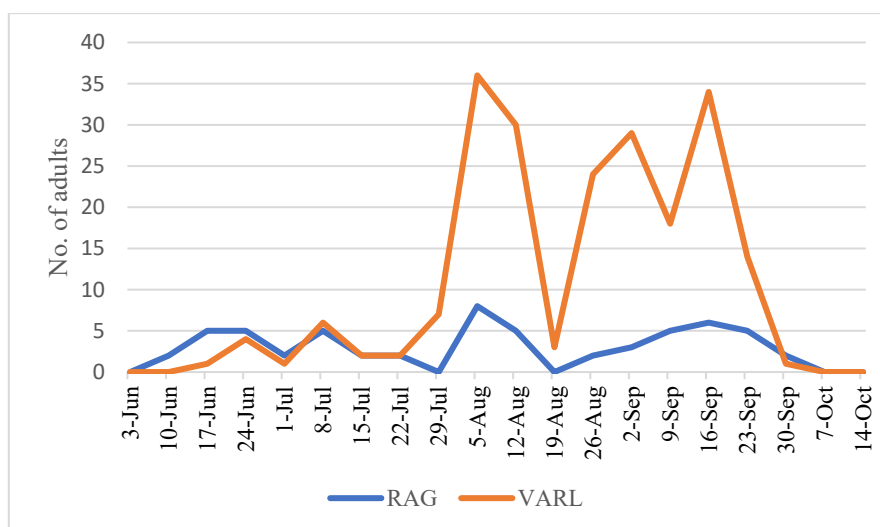


Figure 1. Flight dynamics of *H. armigera* – 2023

According to the VARL trap, the active flight period of *H. armigera* lasted for 15 weeks. The first recorded catch occurred on June 17, and the last on September 30. The total number of moths captured was 212, which

represents 78% of the total moths captured during the season. The maximum number of moths captured in a one-week period was 36, which occurred in the first week of August (Figure 1).

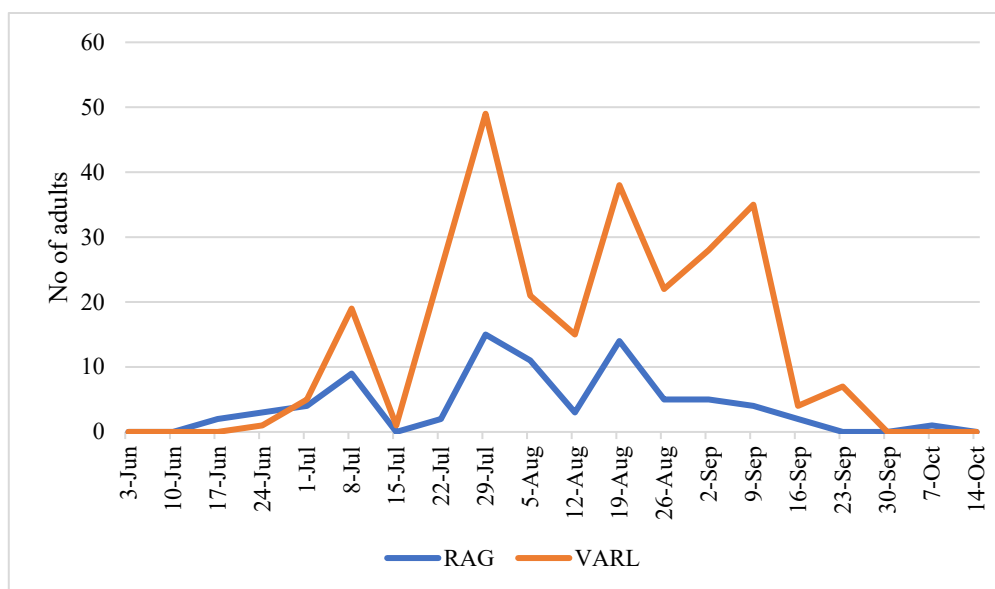


Figure 2. Flight dynamics of *H. armigera* – 2024

Season 2024

In 2024, a total of 350 male adults of *H. armigera* were caught using both traps. The active flight period lasted 16 weeks, starting from June 17 and ending on October 7. In the second half of June, the flight intensity was weaker, gradually increasing with the highest catch occurring in the first week of July, after which the flight declined. The decline lasted for one week, after which another increase in flight activity was observed. The highest flight intensity lasted for 9 weeks, from the second half of July to the second decade of September. During this period, 298 adults were caught, making up 85% of the total catch. In October, only one adult was caught.

The RAG pheromone trap caught a total of 80 moths, or 23% of the total catch for the season. This trap recorded an active flight period of 16 weeks, with the last catch recorded on October 7. The highest number of adults caught in a one-week period was 15, from July 22 to 29 (Figure 2).

The VARL trap recorded an active period of 13 weeks. The first moths were caught on June 24, and the last ones on September 23. The total number of adults caught was 270, or 77% of the total catch. The highest number of adults caught in a one-week period was 49, which occurred in the last week of July (Figure 2).

2023 vs 2024

In 2023, the flight intensity was weaker compared to 2024, which can be determined by comparing the total number of adults caught in each season. There are also differences in the results obtained from the same type of traps, as well as in the maximum

results of adults caught in both types of traps. In 2023, the start of the flight was one week earlier compared to 2024, and the same trend is followed by the peaks during the season. This clearly shows that the dynamics of the flight are similar in both seasons

Table 1. Captured male adults with pheromone traps in 2023 and 2024

Date	2023		2024	
	RAG	VARL	RAG	VARL
3-Jun	-	-	-	-
10-Jun	2	-	-	-
17-Jun	5	1	2	-
24-Jun	5	4	3	1
1-Jul	2	1	4	5
8-Jul	5	6	9	19
15-Jul	2	2	-	1
22-Jul	2	2	2	25
29-Jul	-	7	15	49
5-Aug	8	36	11	21
12-Aug	5	30	3	15
19-Aug	-	3	14	38
26-Aug	2	24	5	22
2-Sep	3	29	5	28
9-Sep	5	18	4	35
16-Sep	6	34	2	4
23-Sep	5	14	-	7
30-Sep	2	1	-	-
7-Oct	-	-	1	-
14-Oct	-	-	-	-
Total	59	212	80	270

From the beginning of April until the end of the first half of June, no activity of *H. armigera* adults was registered in either season. These results match the results of Krsteska (2022), where in a pheromone trap set at the beginning of June in 2019, the first

catch occurred on July 4, while in 2020, the first catch was recorded on July 12. According to Vasilev (1989), using a pheromone trap set in the Prilep region, the first male adults were caught at the end of June. Similar results are reported by

Karakasis et al. (2021) in central Greece, in cotton field, where active flight occurred between June 13 and September 29.

Based on the data from the *H. armigera* catches in both seasons, it can be observed from Figures 1 and 2 that the RAG pheromone trap shows a consistent and relatively stable catch. In both seasons, it starts one week earlier than the VARL traps. In the first 2 to 3 weeks of the flight period in both production seasons, the RAG trap catches a greater number of adults.

The VARL trap records a shorter active flight period compared to the RAG trap in both seasons. With the increased flight intensity in the second part of the vegetation, the VARL trap catches 3 to 4 times more adults.

Both traps caught only male adults. According to Krsteska (2022), sticky sex-pheromone traps (RAG, Csalomon®) capture

only male moths. According to Tóth et al. (2020), Csalomon® VARL also catches only males.

The highest percentage of captured males occurs in the second half of the vegetation period, throughout both seasons, with over 80% of the total individuals captured. Karakasis et al. (2021) observed a remarkable increase in captures across all traps within cotton fields during the period from late August to mid-September. Each of the traps successfully registers the periods of mass flight. The RAG trap is more sensitive at the beginning of the flight period when only a small number of individuals are active. The VARL trap is better at detecting the peaks during the mass flight period, which can be seen in Table 1.

CONCLUSIONS

Both traps find practical use in monitoring *H. armigera*. Based on the results presented so far, we can clearly conclude that, for the Prilep region, there is no need to set up pheromone traps in the months of April and May. The RAG trap is used when the focus is on the beginning of the adult flight, while the VARL trap determines the mass flight of the moths more precisely and reliably. A drawback of the RAG trap is that it needs to

be checked frequently, especially during the mass flight period when the entire sticky surface is covered with caught adults, and it needs to be replaced. A disadvantage of the VARL trap is that some individuals may escape through the opening of the trap. According to the conducted research, the best monitoring method is the combined use of both types of traps.

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