RESEARCH CONCERNING THE BIOLOGY OF THE PEST *HELICOVERPA ARMIGERA* HBN. IN MAIZE CROPS IN THE WESTERN PLAIN CONDITIONS

CERCETĂRI PRIVIND BIOLOGIA DĂUNĂTORULUI *HELICOVERPA ARMIGERA* HBN. ÎN CULTURA DE PORUMB ÎN CONDIȚIILE CÂMPIEI DE VEST

PĂLĂGEŞIU I., NARCISA CRISTA

Agricultural and Veterinary University of the Banat, Timişoara, Romania

Abstract: *In Europe, the species Helicoverpa armigera Hbn. has the status of "invasive foreign species". Taking into account the fact that in the last years there has been significant damage in numerous crops both in Romania and in its neighbouring countries (Hungary, Serbia, Bulgaria, Ukraine, etc.), we thought it proper to choose this research topic. Research carried out aimed at completing the knowledge of the biology and ecology of the species Helicoverpa armigera Hbn. in the conditions of our country, monitoring the appearance and flight of the adults, the appearance and succession of larvae generations in the maize crop in the year 2007, as well as the duration of the development cycle in laboratory conditions.*

Rezumat: *În Europa, specia Helicoverpa armigera Hbn. are statutul de "specie străină invazivă". Având în vedere faptul că în ultimii ani au fost semnalate daune semnificative provocate de larvele acestui dăunător la numeroase culturi, atât în ţara noastră cât şi în ţările europene şi cele vecine: Ungaria, Serbia, Bulgaria, Ucraina etc., am considerat oportună alegerea acestei teme de cercetare. Cercetările efectuate au avut drept scop completarea cunoştinţelor privind biologia şi ecologia speciei Helicoverpa armigera Hbn. în condiţiile concrete din ţara noastră, urmărindu-se în acest sens apariţia şi zborul adulţilor, apariţia şi succesiunea generaţiilor larvare în cultura de porumb în anul 2007, precum şi durata ciclul de dezvoltare în condiţii de laborator.*

***Key words*:** *Noctuidae, Lepidoptera, Helicoverpa armigera Hbn., life cycle*
Cuvinte cheie: *Noctuidae, Lepidoptera, Helicoverpa armigera Hbn., ciclu de dezvoltare*

INTRODUCTION

The status of "pest" is conferred to the species *Helicoverpa armigera* Hbn .by a few of its features, such as: mobility – the butterfly migrates from one area to another flying over large distances, polyphagy – it attacks over 250 species of crops and spontaneous plants, high reproductivity – a characteristic of insects in general, and diapause – that makes it particularly adaptable and allows it to use for a short time the habitats developed by man in agro-ecosystems.

Thus, research of this pest's biology and ecology, together with the study of its morphology constitute the fundament necessary to develop the most efficient strategies of integrated control of this pest in maize crops.

MATERIALS AND METHOD

Monitoring adults was done with the help of pheromone traps of the Csalomon VARL+ type, recording the first signs, the dynamics of the butterfly flight, and the last signs. Readings were done at intervals of 3-4 days.

Monitoring the pest's larvae populations was done by periodically visiting the trial field at the Didactic Station in Timişoara as well as other maize fields in the county. To do so, we inspected maize plants entirely: stems, leaves, cobs, and panicle.

The life cycle of the pest *Helicoverpa armigera* Hbn. in laboratory conditions was studied on larvae collected from the field. Larvae were bred in the laboratory in vases on the bottom of which we laid an earth layer, and they were fed with silk and milky grains. Newly born larvae were bred in Petri boxes individually to avoid the appearance of the cannibal behaviour, and were fed with silk and milk grains. We monitored the duration of the larval stage, the duration of the pupal stage, and the duration of the egg stage.

RESULTS AND DISCUSSION

In the year 2007, we recorded the following data concerning the appearance and number of butterflies of *Helicoverpa armigera* Hbn. captured with pheromone traps at the Didactic Station in Timişoara (Table 1).

Table 1

Helicoverpa armigera Hbn. adults' flight curve at the Didactic Station in Timişoara (2007)

Time of reading	Number of butterflies in Trap 1	Number of butterflies in Trap 2	Total	Time of reading	Number of butterflies in Trap 1	Number of butterflies in Trap 2	Total
8.05.07	-	-	-	17.07.07	18	6	24
11.05.07	2	-	**2**	23.07.07	-	-	-
16.05.07	-	-	-	**27.07.07**	126	198	**324**
19.05.07	2	-	2	**4.08.07**	192	154	**346**
24. 05.07	3	2	5	8.08.07	28	68	98
28.05.07	-	-	-	12.08.07	104	72	176
31. 05.07	1	3	4	17.08.07	96	71	167
8. 06.07	2	-	2	21.08.07	14	26	40
11.06.07	-	-	-	**24.08.07**	53	92	**145**
15.06.07	-	2	2	**27.08.07**	126	148	**274**
20.06.07	2	11	13	1.09.07	7	-	7
24.06.07	2	3	5	4.09.07	54	8	62
29.06.07	-	7	7	8.09.07	32	9	41
3.07.07	4	17	21	11.09.07	11	-	11
8.07.07	-	17	17	14.09.07	4	-	4
12.07.07	8	6	14	**18.09.07**		2	**2**

Adults' flight curve developed with pheromone traps of the Csalomon VARL + type pointed out the fact that butterflies' flight started on May 11, 2007 and lasted until September 18, 2007, with a peak between July 27 and August, 4, i.e. a total of 324 adults on July 27, 2007, and 346 adults on August 4, 2007 (Figure 1).

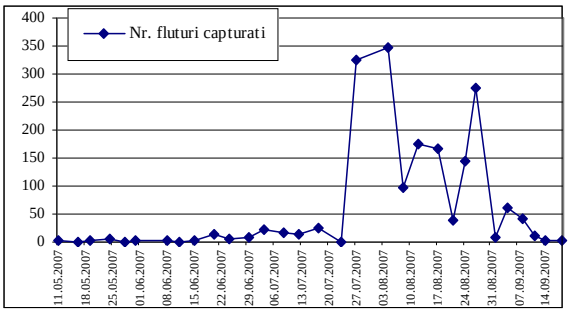

Figure 1. Adults' flight curve of *Helicoverpa armigera* Hbn., SD Timişoara 2007,

From a climate point of view, the period April-August of the year 2007 can be characterised by large and relatively sudden variations of temperature and precipitations, from one week to another and even from one day to another. The month of April 2007 was characterised by a deficit of precipitations and an excess of temperature, which favoured the appearance of butterflies from hibernating pupae earlier than in previous years. Thus, at the beginning of May there were signs of the first butterflies. The months of June and July were characterised by a deficit of precipitations and an excess of temperature, which favoured some flight peaks in the butterfly flight curve between July 27 and August 8, 2007. The last signs of adults were recorded on September 18, 2007, because of some temperatures below the mean, and accompanied by abundant rainfalls. In the year 2007, we captured in the month of May 13 butterflies, in June – 29 butterflies, in July – 400 butterflies, in August – 1246 butterflies, and in September – 189 butterflies (Figure 2).

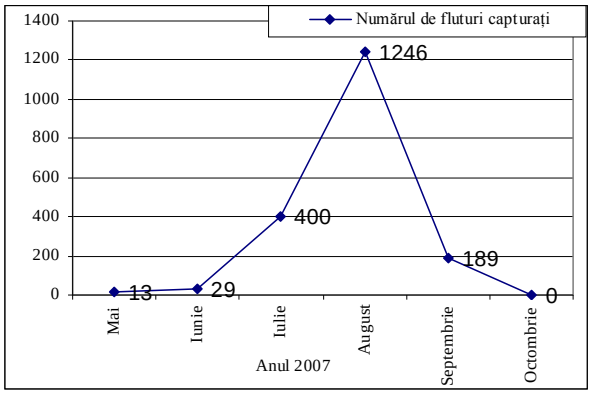

Figure 2. The evolution of moth number captured in 2007 year by month

Table 2

Period of development of *Helicoverpa armigera* Hbn. larvae on maize (2007)

Generation	First sign	Maxim	Last sign
G1	24VI	14-20 VII	24 VII
G2	29 VII	9-16 VIII	23 VIII
G3	16 VIII	23 IX	3 IX

Since females lay eggs gradually, there is a superposition of the larval generations, because the first larvae of the second generation appear simultaneously with the eggs laid in the last days of egg-laying (table 2).

Biology and ecology studies carried out in laboratory conditions in the year 2007 pointed out the duration of the egg stage, of the larva and pupa stage in *Helicoverpa armigera* Hbn. From larvae caught in the field we obtained in laboratory conditions pupae and then butterflies, that laid eggs on July 30, 2007. A female laid 366 eggs that hatched, within 3-4 days, as follows: 40 larvae after 3 days and 120 larvae after 4 days. Newly hatched larvae were fed with milk grains until they pupated, with a total of 49 pupae within 16-25 days. The duration of the pupal stage was 10-14 days, 49 of the pupae obtained in the laboratory producing 47 adults, 1 died, and 1 continued its pupal stage until October 27, 2007 with a total of 58 days. 17 of the pupae harvested from the field resulted in 17 adults, with a total of 66

adults. The duration of the entire development cycle of *Helicoverpa armigera* Hbn. in laboratory conditions was 26-39 days, from July 30 to August 8, 2007.

During its embryo stage, the eggs changes its colour passing through several phases: a white egg is a freshly laid egg, clear, bright, with a slight creamy hue; later the egg's colour changes, with a brown circle around it indicating its viability first followed by a light brown colouration of the entire egg; then there is a "black point" phase in which you can see through the egg's chorion the black head capsule of the larva developing inside the egg.

Egg hatching in laboratory conditions took place between 1-2 minutes and 6 minutes. Right after hatching, newly hatched larvae start eating the egg shell, and then they hide among the maize silk threads and start feeding. Their growth is rapid during this time therefore the factor feed is essential for little age larvae survival. We could see that newly hatched larvae fed only on cob silk had a lower growth rate than that of larvae fed on both silk and milk grains. After they started feeding on maize, the larvae growth rate increased considerably. A rather frequent phenomenon among larvae bred in laboratory conditions is their cannibal behaviour they show for each other, particularly medium age and old ones to younger ones because of lack of space and struggle for survival.

Figure 3. Neonate larva eating the eggs shelter (original)

Upon hatching, newly hatched larvae are 1.8-2 mm long, white-yellowish, white-greyish, with a remarkable head capsule, and dark coloured legs and hairs. After 2 days, larvae are 2.8-3 mm long, and after 4 days they are double as long. At 6 days larvae are over 6 mm long, at 10 days they are over 20 mm long, and after 14 days they are 30-40 mm long. Larvae fully developed enter pre-pupal phase that lasts 2-3 days and that can be identified because of the colour turning reddish and the larva turning less mobile.

CONCLUSIONS

Monitoring *Helicoverpa armigera* Hbn. adults supplies useful information necessary for short-term warning and prognosis activities. We can see that butterflies captured in May and June are relatively small in number compared to the butterflies captured in July, August, and September, which shows that the butterfly generation emerging from hibernating pupae (G1) is smaller, while the larger number of butterflies in July, August, and September, i.e. adults from the generations G2 and G3 develop on maize crops and some of the captured butterflies might come from migration. Migration is, therefore, as mentioned in literature, more intense in summer and autumn, when the butterflies fly large distances in search for food.

Analysing results obtained in 2007, when we monitored the flight of the adults of *Helicoverpa armigera*, we can conclude that the emergence of the butterflies from pupae in spring takes place in May-June, and that butterfly flight is influenced by the climate conditions of the periods.

In field conditions, the egg is very vulnerable and it is exposed to unfavourable climate conditions, i.e. speedy winds and quick rainfalls that can considerably contribute to diminishing the number of the eggs in the field. As a result of observations of maize plants, we could see that eggs easily fall from the sub-stratum on which they were laid, particularly if they are laid on cob leaves or on the leaves, and less if they are laid on silk. Small larvae are vulnerable, their survival depending on the quality of the food available, on climate conditions (strong rainfalls and variations of temperature), on predators, and on parasites. It is so that we can explain the small number of larvae found on maize plants compared to the large number of eggs laid.

The appearance of larval populations of the pest *Helicoverpa armigera* Hbn. from the first generation during the studied period of time took place starting with the third decade of May, with a peak between the second and third decades of July, the last appearances being in the last decade of July (Table 2).

Larval populations of the second generation appeared at the end of the last decade of July, with a peak between the first and the second decades of August, the last ones being at the end of the second decade of August.

In the third larval generation, the first signs were starting with the second decade of August, with a peak in the third decade of September, the last signs being in the first decade of September.

We can consider that the periods in which larval populations appeared are determined largely by the climate conditions of each year, which can favour or not the early appearance of the butterflies and the development of the larval populations earlier or later on maize crops.

The second and third generations are the generations that cause damage on maize crops, the second generation being more important since it appears the moment maize is in the milk stage.

This is why prevention measures and, if necessary, control measures should aim particularly the larval populations of the second generation.

Climate conditions have a big impact not only on the pest's biology, but also on plant growth and development, both cultivated and spontaneous that represents a food source for the butterflies of the first generation and, thus, act indirectly on the pest population growth and multiplication.

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