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NEW DATA REGARDING THE APPEARANCE, EVOLUTION AND THE ATTACK PRODUCED BY *OSTRINIA NUBILALIS* HBN. SPECIES, AT MAIZE CROP, UNDER THE CENTER OF MOLDAVIA CONDITIONS

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ABSTRACT

Pests are a considerable limiting factor in the production of corn crop. Their knowledge, but also the moment of occurrence and evolution in a certain area, is of particular importance in establishing prevention and control measures in order to limit the population under PED but also the harvest losses.

***Ostrinia nubilalis* Hbn. species was present and caused damage to the maize crop from the Central part of Moldova, for which reason observations and determinations were made regarding the evolution of the species, the mode and the magnitude of the attack.**

Observations and determinations made at the Agricultural Research and Development Station Secuieni, during 1993-2017 have demonstrated that *Ostrinia nubilalis* Hbn. species is characterized as an abundant insect for the studied area, being present in maize, in all 25 years studied.

The total number of adults collected in the light trap was of 8290 specimens, the highest catches per trap of 2818 specimens were recorded between 1993 and 1997 (first stage), followed by 1690 and 1683 specimens in stage II (1998-2002) and III (2003-2007), 1237 specimens in stage V (2013-2017), and the lowest number of 862 specimens/trap was recorded in stage IV (2008-2012).

Based on the data obtained by collecting the insect by means of the light trap, the variability coefficient for the central area of Moldova was calculated and the flight curve made by the adults of the species *Ostrinia nubilalis* Hbn. was established.

Key words: *Ostrinia nubilalis,* pests, flight curve, abundance, attack, protection.

INTRODUCTION

Ostrinia nubilalis Hbn. species, sin. *Botys nubilalis, Micratis nubilalis, Pyrausta nubilalis*, popularly known as corn borer, is a dangerous pest for maize crops (Simionescu, 1983).

In the literature of the last 15 to 20 years, the species is described as a polyphagous insect attacking many plant species. The attack is produced by the larvae, which in maize damage the leaves first, then the panicles, the stalk and the cob.

On panicle, the larvae consume stamens, perforate the ramifications and the peduncle inflorescences, penetrate inside and make galleries. In a high infestation, many broken panicles are easily observable.

On stem the caterpillars make numerous holes, penetrate into the interior and produce galleries.

The attacked strains are easily broken, the plants fall to the ground and the mechanized harvesting of the crops is difficult, resulting in important production losses (Bărbulescu et al., 2000; Balachowski et al., 1972; Camprag, 1973; Perju et al., 1983; Perju et al., 1993; Popov, 2002, 2003, 2004; Trotuş, 2007; Trotuş et al., 2002; Trotuş et al., 2015, 2017; Georgescu et al., 2013).

The larvae attack the maize cobs, eat the grains, then dig the galleys inside the cob, either through its tip or over its entire surface.

The attack produced by larvae favours the emergence and installation of *Fusarium* spp. which produces mycotoxins that degrade the grain quality.

The species is native to Europe, but it is spread throughout the North American, Asian and North African agricultural crops, where it has been reported as harmful to other species such as: sweet corn, pepper, potato, hops, sorghum, wormwood and other cultivated and spontaneous species (Teodorescu et al., 2003).

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In Romania the species is spread in all areas of maize cultivation, production losses are between 1.3% in Dobrogea, 8.5% in Transylvania, 10.5% in Moldova, 11.7% in Baragan and 17.7% in the Western Plain (Popov and Rosca, 2007, quoted by Georgescu et al., 2013).

In this paper we present data on the occurrence, abundance, variability coefficient, flight curve, and flight characteristics of *Ostrinia nubilalis* Hbn. species monitored with a light trap at the Agricultural Research & Development Station Secuieni, Neamt.

MATERIAL AND METHODS

The researches were carried out at ARDS Secuieni, Neamt, between 1993 and 2017 and consisted of:

- collecting and registrating the adults of *O. nubilalis* Hbn. species with the help of a light trap (Ionescu et al., 1985);
- observations and notes on the frequency of attacked plants and how the larvae attack on maize;

The adults collection from the light trap was done daily from the third decade of April until the end of September, annually between 1993 and 2017.

The collected insects were sorted into the laboratory, recorded in the Register of evidence, after which we established:

- the species abundance for the studied area;
- beginning, duration and end of flight;
- the flight intensity and the moment of the flight peak.

The variability coefficient of *O. nubilalis* Hbn. species was calculated using the formula:

$$Cv(s\%)=\frac{s}{x}*100$$

According to the values of the variability coefficient the flight characteristic was set as:

- intense, when $s \geq 20\%$;
- medium, when $s \geq 10\%$;
- low, when $s < 10\%$.

In the field, in the maize crop, observations and notes were made regarding the frequency of attacked plants and how the larvae attack.

RESULTS AND DISCUSSION

Between 1993 and 2017, the total number of adults of *O. nubilalis* Hbn. species, collected in the light trap was of 8290 specimens.

For ease of data interpretation, the 25-year observation period was divided into five stages of five years each.

Analysing the total number of butterflies collected in stages it was found that the largest collection was recorded in the first stage (1993-1997) of 2818 individuals, followed by the second stage (1998-2002) of 1690 specimens, the third stage (2003-2007) of 1683 specimens, the fifth stage (2013-2017) with 1237 specimens and the four stage (2008-2012) of 862 specimens (Table 1).

Table 1. The number of adults of *Ostrinia nubilalis* Hbn. species, collected in the light trap during 1993-2017

Month	Decade	Number of adults collected/ stages					Σ 1993-2017
		Stage I (1993-1997)	Stage II (1998-2002)	Stage III (2003-2007)	Stage IV (2008-2012)	Stage V (2013-2017)	
April	III	0	0	0	0	3	3
May	I	0	0	1	1	3	5
	II	5	22	15	10	4	56
	III	20	60	36	15	31	162
June	I	80	215	77	27	20	419
	II	194	191	201	47	83	716
	III	387	575	331	80	153	1526
July	I	724	165	369	192	209	1659
	II	289	73	238	90	76	766
	III	445	121	139	74	222	1001

August	I	425	114	79	63	110	761
	II	181	89	96	129	167	662
	III	48	48	71	90	92	349
September	I	16	16	15	24	34	105
	II	3	1	4	13	21	42
	III	1	0	11	7	9	28
Total		2818	1690	1683	862	1237	8290

Analyzing the number of insects collected in the light trap, decadal from April to the end of September, between 1993 and 2017, we found that the species flight was continuous from the third decade of April or the first and second decades of May to the end of the third decade of September (Table 1). Flight curve made by adults of *O. nubilalis* Hbn. species both on stages and on average for 1993-2017 period, was continuous, the flight started at the end of April - the beginning of May and continued uninterrupted until the end of September, the insect made a flight curve with the maximum flight peak in the third decade of June and the first decade of July (Figure 1).

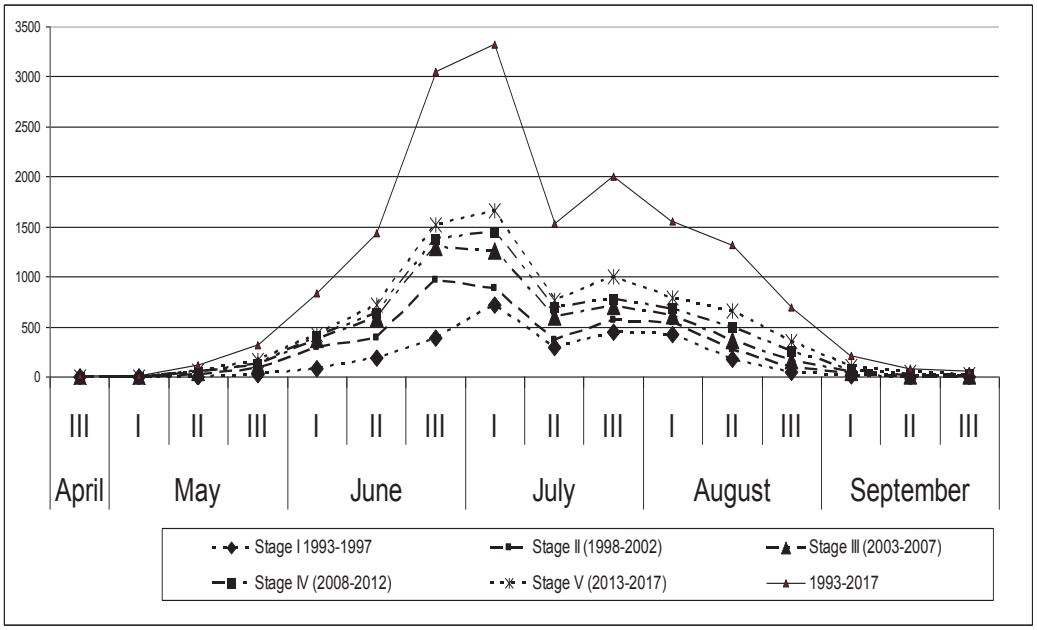

Figure 1. The flight curve made by *Ostrinia nubilalis* Hbn. species during 1993-2017

From the analysis of the catches recorded between 1993 and 2017 the *O. nubilalis* Hbn. insect was present in the studied area in every year of the 25 of observation, the species abundance ranging between 23 specimens/trap in 2011 and up to 837 specimens/trap in 1997, the average value of abundance was of 331.6 specimens/trap (Table 2).

The species variability coefficient (CV%) ranged between 1.3% (2011) and 50.48% (1997) being on average for 1993-2017 period, of 20.01% under the conditions of an average annual temperature for the analysed range of 9.3°C and the average rainfall of 540.5 mm (Table 2). Between the annual abundance of *Ostrinia nubilalis* Hbn. species and the annual variability coefficient there is a direct correlation, the correlation coefficient is of 0.999 (Figure 2).

Following the influence of the climatic conditions of the year on the abundance of the species, we found that, in terms of temperature, the highest sum of insects collected, of 3992 specimens, we recorded in the years characterized as warm, followed by 2710 specimens in the years characterized as normal and 1588 specimens in the cool years.

Table 2. The variability coefficient of *Ostrinia nubilalis* Hbn. species for Secuieni – Neamţ conditions, during 1993-2017

No.	Observation year	Species abundance	Variability coefficient CV%	CV% difference vs. average	Climate characterization	
					Average annual temp. °C	Annual Σ of raifall (mm)
1	1993	407	24.55	4.54	7.8	552.2
2	1994	557	33.59	13.58	10.0	423.7
3	1995	673	40.59	20.58	8.9	476.1
4	1996	344	20.75	0.74	7.8	646.2
5	1997	837	50.48	30.47	8.1	572.1
6	1998	559	33.72	13.71	8.6	638.1
7	1999	441	26.60	6.59	9.8	511.8
8	2000	355	21.41	1.4	10.4	509.6
9	2001	169	10.19	- 9.82	9.3	656.4
10	2002	166	10.11	- 9.9	9.6	512.8
11	2003	363	21.89	1.88	8.9	458.6
12	2004	404	24.51	4.55	9.8	507.1
13	2005	471	28.41	8.4	9.1	753.3
14	2006	32	1.93	- 18.08	9.0	560.3
15	2007	413	24.91	4.9	10.3	530.3
16	2008	121	7.30	- 12.71	9.8	505.2
17	2009	324	19.54	- 0.42	8.7	449.6
18	2010	265	15.98	- 4.03	8.9	683.4
19	2011	23	1.39	- 18.62	8.8	425.5
20	2012	129	7.78	- 12.23	9.3	455.2
21	2013	161	9.71	- 10.3	9.6	538.0
22	2014	413	24.91	4.9	9.6	556.6
23	2015	213	12.84	- 7.17	10.7	334.0
24	2016	283	17.07	- 2.94	10.9	575.8
25	2017	168	10.07	- 9.94	9.4	681.1
Σ 1993-2017		829.0	500.23	-	-	-
Average		331	20.01	-	9.3°C	540.5 mm

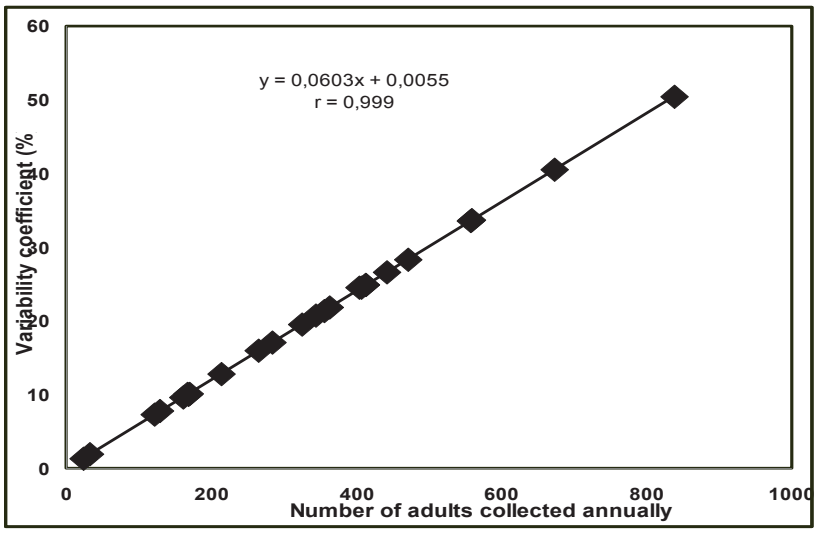

Figure 2. The correlation between the number of adults collected annually and the variability coefficient at *Ostrinia nubilalis* Hbn species

If we compare the conditions of years with the percentage of collected insects, we find that in the years characterized as warm, with a share of 56% of the total observation period, the percentage of collected insects was of 48%, in years characterized as normal, whose share was of 32%, the percentage of insects was of 33%, and in the cool years, with a share of 12%, the insect percentage was of 19% (Figure 3).

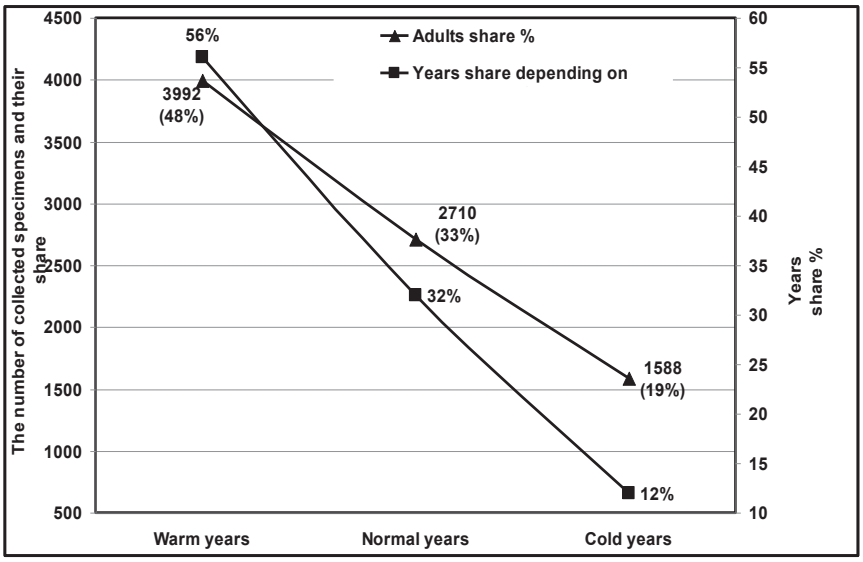

Figure 3. The adults flight variation of *Ostrinia nubilalis* Hbn. species depending on the average annual temperature

Regarding the precipitations, the greatest number of insects we collected in the years characterized as normal, of 4033 specimens, followed by 2282 specimens in the years characterized as dry and 1975 specimens in the years characterized as rainy (Figure 4).

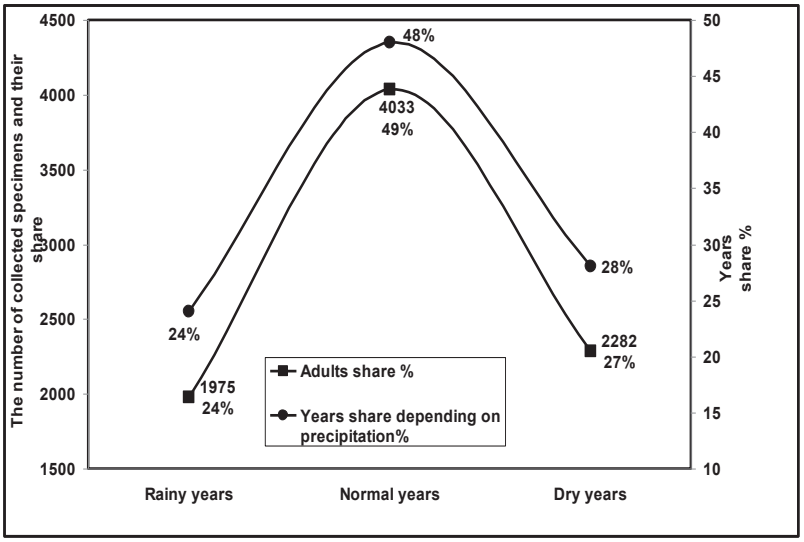

Figure 4. The adults flight variation of *Ostrinia nubilalis* Hbn. Species depending on the rainfall regime

Analyzing the adults flight of *O. nubilalis* Hbn. species, according to the variability coefficient value, the following were found:

- the average value of the variability coefficient for the analysed period (1993-2017) was of 20.01%, which fits the species into the group of abundant insects for the studied area;

- of the 25 analysed years, the species variability coefficient was higher than the multiannual average of 20.01% in 13 years of observation, the variability coefficient values were between 20.75% and 50.48%, the flight being characterized as „intense", in seven years the variability coefficient had values of more (>) than 10% and less (<) than 20%, the flight was characterized as „medium", and in five years, the variability coefficient was less (<) than 10%, the species flight being „reduced" (Table 3).

Table 3. The flight characterization of *Ostrinia nubilalis* Hbn. species, depending on the variability coefficient

No.	Observation years	The variability coefficient (CV%)	Flight characterization depending on CV%
1	1997	50.48	s > 20% Intense flight
2	1995	40.59	
3	1998	33.72	
4	1994	33.59	
5	2005	28.41	
6	1999	26.60	
7	2007	24.91	
8	2014	24.91	
9	1993	24.55	
10	2004	24.51	
11	2003	21.81	
12	2000	21.41	
13	1996	20.75	
14	2009	19.54	s> 10 % Medium flight
15	2016	17.07	
16	2010	15.98	
17	2015	12.84	
18	2001	10.19	
19	2002	10.11	
20	2017	10.07	
21	2013	9.71	s< 10% low flight
22	2012	7.78	
23	2008	7.30	
24	2006	1.93	
25	2011	1.39	
Average 1993-2017		20.01	Intense flight

By calculating the years share, depending on the intensity of the flight, we found that the species had an intense flight in 52% (13 years) of the analysed period, in 28% (7 years) the flight of the species was medium and in 20% (5 years) of the period the flight was reduced (Figure 5).

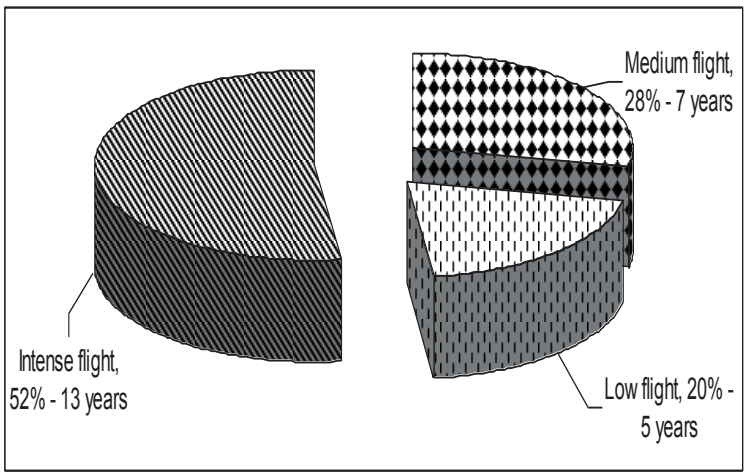

Figure 5. The years share according to flight characteristics

The average larval density per plant had a minimum of 0.4 specimens/plant and 1.7 specimens/plant, while the maximum values were between 1.8 specimens/plant and 3.6 specimens/plant and the average frequency of attacked plants ranged between 15% and 52.6% of the minimum and maximum limits for the 1993-2017 period (Table 4).

Table 4. The density of *O. nubilalis* Hbn. species and the attack produced by larvae in maize

Observation period	Larvae density specimens/plant			Attack frequency (%)		
	minimum	maximum	average	minimum	maximum	average
Stage I 1993-1997	1.3	3.0	2.46	20	100	50.6
Stage II 1998-2002	0.5	2.5	1.34	10	38	24.0
Stage III 2003-2007	1.2	2.2	1.47	18	42	27.8
Stage IV 2008-2012	0.4	1.8	1.12	12	48	23.8
Stage V 2013-2017	1.7	3.6	2.65	15	35	25.2
Average 1993-2017	1.02	2.62	1.81	15	52,6	30.28

Analyzing the frequency of the attack and the larval density per plant, we found that there was no direct correlation between them, the correlation coefficient r = 0.538 showing that the frequency of the attack was also influenced by the larval voracity (Figure 6).

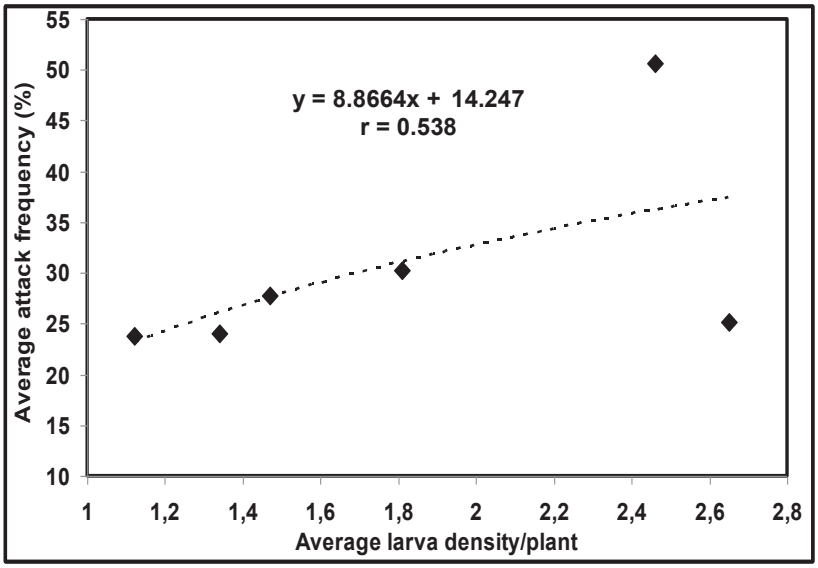

Figure 6. The correlation between average larvae density/plant and attack frequency of *Ostrinia nubilalis* Hbn.

CONCLUSIONS

Ostrinia nubilalis Hbn. species is characterized as an abundant insect for the center of Moldova conditions.

O. nubilalis Hbn. species was present in the area every year of the 25 years of observation (1993-2017). The total number of adults collected during 1993-2017 in the light trap was of 8290 specimens.

From the five stages, in which the 1993-2017 period was divided, the highest catches were recorded in the first stage (2818 specimens), followed by the second stage with 1690 specimens, the third stage with 1683 specimens and the fifth stage with 1237 specimens.

The variability coefficient of *O. nubilalis* Hbn. species was on average of 20.01%, fitting the species into the group of abundant insects for the area.

By the value of the annual variability coefficient, the species flight was characterized as intense in 13 years of observation, medium in seven years and low in five years.

The average larval density was between 0.4 specimens per plant and 1.7 specimens per plant.

The average frequency of plants attacked by larvae ranged from 15 to 52.6%.

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