

ECOLOGICAL PARAMETERS FOR THE HARMFUL ENTOMOFAUNA FROM FOR THE MILK THISTLE CROPS (*Silybum marianum* L) UNDER CENTER OF MOLDOVA CONDITION

Elena TROTUȘ^{1,2}, Paula-Lucelia URSACHE²

Abstract. *Silybum marianum* L is grown for its fruit (*Fructus cardui* material) containing a specific compound, insoluble in water, with hepatoprotective properties (2.5). The average yield of seeds (fruits) is between 6-12 q/ha, if the harvest is done when 80% of the inflorescences are dry, delaying the harvest involves loss of seeds, which spread easily due to the presence of pappus. Loss of seeds are produced frequently and by a large range of specific and polyphagous pests (3,4,6,7,8,9). It was found that the dangerous entomofauna for the *Silybum marianum* L crops was composed of 28 species of insects that totaled averaged over the entire period between sowing and harvesting (April-July) a total of 702 specimens/sqm. The average density of collected species ranged from 3 specimens/sqm which as totaled at *Anomala solida*, *Decticus verrucivorus*, *Tettigonia viridissima* species and up to 377 specimens/leaf at *Tetranychus urticae*. It was found that 11 species belong to the *Coleoptera* order, six species to *Lepidoptera* order, four species to *Orthoptera* order, three species to *Heteroptera* and *Homoptera* and 1 species to *Acari* order.

Key words: insect, pests, *Silybum marianum*, species.

Introduction

Milk thistle (*Silybum marianum*) is an annual species, herbaceous, with erect stem, hairless leaves, shiny, with a green with white mosaic, sessile and amplexicaule, with terminal veins at the margin ending in spines.

The fruit is a cylindrical achene which ends with a pappus. The species has its origins in the Asian Basin of Mediterranean Sea, where it grows in the spontaneous flora. It is cultivated in Italy, France, Hungary, Poland and others European countries. In our country the most favorable areas for growing are the

¹ Academy of Romania Scientists, Splaiul Independenței 54, 050094, Bucharest, Romania.
Academy of Agriculture and Silviculture Sciences, CS Idr. ing. Stațiunea de Cercetare Dezvoltare Agricolă Secuieni. etrotus@yahoo.com

² As.cercet ing., Stațiunea de Cercetare Dezvoltare Agricolă Secuieni.

Romanian Plain, Timis Plain, Jijiei and Bahlui Plain and in central area of Central Moldavian plateau (2,13).

Silybum marianum L is grown for its fruit (*Fructus cardui material*) containing a specific compound, insoluble in water, with hepatoprotective properties (3,5).

The average yields seed (fruits) are between 6-12 q/ha, if the harvest is done when 80% of the inflorescences are dry, delaying the harvest involves loss of seeds, which spread easily due to the presence of pappus. Loss of seeds are produced frequently and by a large range of specific and polyphagous pests (1,4,6,7,8,9,10,11,12).

The aim of this scientific paper it is to present data regarding the identification of harmful entomofauna from the milk thistle (*Silybum marianum*), under the Central Moldova's condition.

Material and method

The researches were conducted at Secuieni-Neamt unit, located in the Southeast of Neamț County, between the geographical coordinates 26°5' east longitude, 46°5' latitude and at an altitude of 205.7 m above the sea level.

The A.R.D.S Secuieni-Neamț is located in an area characterized with a temperate-continental climate, with the multi-annual average temperature of 8.8°C and the average amount of precipitation of 547 mm.

The milk thistle crops (*Silybum marianum*) were sowed within the Medicinal and Aromatic Plants Laboratory, under conditions of ecological agriculture, and were conducted observation and determination for establishment of the harmful entomofauna.

The biological material gathering was conducted with the help of Barber traps, ground surveys using metric frame 25/25 cm and mowing using entomological net. The collections and determinations were conducted at every ten day, starting from the plant rising phenophase until the harvest phenophase. The collected samples were analyzed in the laboratory at the binocular magnifying glass, determined and separated by species.

For each species were calculated the average density/sqm for the entire plant vegetation period (April-August) and the ecological parameters representative like: **abundance (A)**, **constancy (C)**, **dominance (D)** and **ecological significance index (W)**.

The **abundance** of species (**A%**) represents the number of individuals of a species from the catch in a certain place at a certain time.

The **dominance (D%)** shows the participation percentage of each species in the total catches. It is calculated using the formula.

$$D = \frac{Ax100}{N}$$

D=dominance

A=species abundance

N=the total number of individuals of all species

Depending on the obtained values, the species fall within the following classes of dominance:

D1-subrecedent species $P < 1,0\%$;

D2-recedent species $P = 1,1-2,0\%$;

D3-subdominant species $P = 2,1-5,0\%$;

D4-dominant species $P = 5,1-10,0\%$;

D5-eudominant species $P > 10,1\%$.

The **constancy (C%)** represents the species participation proportion in the realization of the biocenosis structure. It is calculated using the formula:

$$CA = \frac{npA}{Np} \times 100$$

CA=constancy species;

npaA= number of samples in which the A species occurs

Np= total number of collected samples.

Depending on the constancy value, the species are classified as follows.

C1- accidental species(1-25%)

C2- accessories species(25,1-50%)

C3- constant species(50,1-75%)

C4- euconstant species(75,1-100%)

The **index of ecological significance (W%)** represents the relationship between the structural indicator (C) and the productive indicator (D) and is calculated using the formula:

$$W = \frac{Cx Dx 100}{10000}$$

C= species constancy;

D= species dominance.

By the value of the ecological significance index (W), the species fall into three classes, as follows.

W1- accidental species ($W < 10,1\%$)

W2- accessories species ($W = 1,1-5,0\%$)

W3- characteristic species ($W > 5,1\%$)

The ecological parameters of the collected and determined species were calculated and interpreted after the methods presented and published by Simionescu (1983) and Stan (1994).

Results and discussions

After conducting the observations and determinations was found that the dangerous entomofauna for the *Silybum marianum L* crops was composed of 28 species of insects that totaled averaged over the entire period between sowing and harvesting (April-July) a total of 702 specimens/sqm (table1).

The average density of collected species ranged from 3 specimens/sqm which totaled at *Anomala solida*, *Decticus verrucivorus*, *Tettigonia viridissima* species and up to 377 specimens/leaf to *Tetranychus urticae*. (Table 1).

Table 1. The harmful entomofauna from the milk thistle crops (*Silybum marianum L*), under condition of ecological agriculture, Secuieni-Neamț, 2014-2016

	Species	Order	Months/sample/specimens/sqm												Total avr
			April			May			June			July			
			I	II	III	I	II	III	I	II	III	I	II	III	
1	<i>Agriotes ustulatus</i>	<i>Coleoptera</i>	2	3	5	1	0	0	2	1	2	1	0	0	17
2	<i>Agriotes obscurus</i>	<i>Coleoptera</i>	0	1	1	0	0	0	0	1	1	1	0	0	5
3	<i>Agriotes lineatus</i>	<i>Coleoptera</i>	0	2	2	2	0	0	0	0	1	1	0	0	8
4	<i>Melolontha melolontha</i>	<i>Coleoptera</i>	2	1	2	5	4	5	0	0	0	0	0	0	19
5	<i>Gryllotalpa gryllotalpa</i>	<i>Orthoptera</i>	1	3	1	0	0	0	0	0	0	0	0	0	5
6	<i>Opatrum sabulosum</i>	<i>Coleoptera</i>	0	0	2	3	3	4	1	0	0	0	0	0	13
7	<i>Agrotis segetum</i>	<i>Lepidoptera</i>	1	1	2	0	0	0	0	0	0	0	0	0	4
8	<i>Anomala solida</i>	<i>Coleoptera</i>	1	1	1	0	0	0	0	0	0	0	0	0	3
9	<i>Pollyphylla fullo</i>	<i>Coleoptera</i>	0	2	2	0	0	0	0	0	0	0	0	0	4
10	<i>Amathes c-nigrum</i>	<i>Lepidoptera</i>	0	0	0	0	0	3	5	3	1	0	0	0	12
11	<i>Autographa gamma</i>	<i>Lepidoptera</i>	0	0	0	0	2	2	1	3	0	0	0	0	8
12	<i>Vanessa cardui</i>	<i>Lepidoptera</i>	0	0	0	0	0	0	2	1	0	1	2	2	8
13	<i>Loxostege stititalis</i>	<i>Lepidoptera</i>	0	0	0	0	2	3	0	0	0	0	0	0	5
14	<i>Mamestra brassicae</i>	<i>Lepidoptera</i>	0	0	0	0	0	0	0	3	5	2	0	0	10
15	<i>Phyllotreta nemorum</i>	<i>Coleoptera</i>	0	3	12	15	10	3	1	0	0	0	0	0	44

Table 1. (continued)

	Species	Order	Months/sample/specimens/sqm												Total avr
			April			May			June			July			
			I	II	III	I	II	III	I	II	III	I	II	III	
16	<i>Phyllotreta atra</i>	<i>Coleoptera</i>	0	0	5	3	7	2	0	0	0	0	0	0	17
17	<i>Epicometis hirta</i>	<i>Coleoptera</i>	0	0	0	0	0	0	0	0	11	15	7	7	40
18	<i>Lytta vesicatoria</i>	<i>Coleoptera</i>	0	0	0	0	1	2	1	0	0	0	0	0	4
19	<i>Aphis fabae</i>	<i>Homoptera</i>	0	0	0	0	0	0	0	1*	1*	0	0	0	2*
20	<i>Macrosiphoniella sanborni</i>	<i>Homoptera</i>	0	0	0	0	0	0	0	0	1*	1*	0	0	2*
21	<i>Graphosoma lineatum</i>	<i>Heteroptera</i>	0	1	1	0	0	0	0	3	5	4	0	0	14
22	<i>Lygus rugulipennis</i>	<i>Heteroptera</i>	0	0	2	3	0	0	3	4	0	0	0	0	12
23	<i>Eurydema ornata</i>	<i>Heteroptera</i>	0	3	5	7	3	1	0	0	0	0	0	0	19
24	<i>Decticus verrucivorus</i>	<i>Orthoptera</i>	0	0	0	2	1	0	0	0	0	0	0	0	3
25	<i>Tettigonia viridissima</i>	<i>Orthoptera</i>	0	0	0	0	0	0	2	1	0	0	0	0	3
26	<i>Polysarcus denticaudus</i>	<i>Orthoptera</i>	0	0	0	0	0	0	0	5	2	0	3	1	11
27	<i>Macrosteles sexnotatus</i>	<i>Homoptera</i>	0	0	0	0	4	5	3	1	2	7	9	7	38
28	<i>Tetranychus urticae</i>	<i>Acari</i>	0	0	0	0	0	56	64	72	79	84	12	10	377
Total			7	21	41	41	36	86	83	99	111	117	33	27	702

*colony

Following the appearance and evolution of the harmful insects depending on the milk thistle's phenophase, it was noticed that the average density for the period between sowing-emergence phenophase totaled 110 specimens/sqm, followed by 122 specimens/sqm in the leaf rosette formation phenophase, 293 specimens/sqm in the stem elongation – blossom phenophase and 150 specimens in the blooming-seeds formation phenophase (Fig.1).

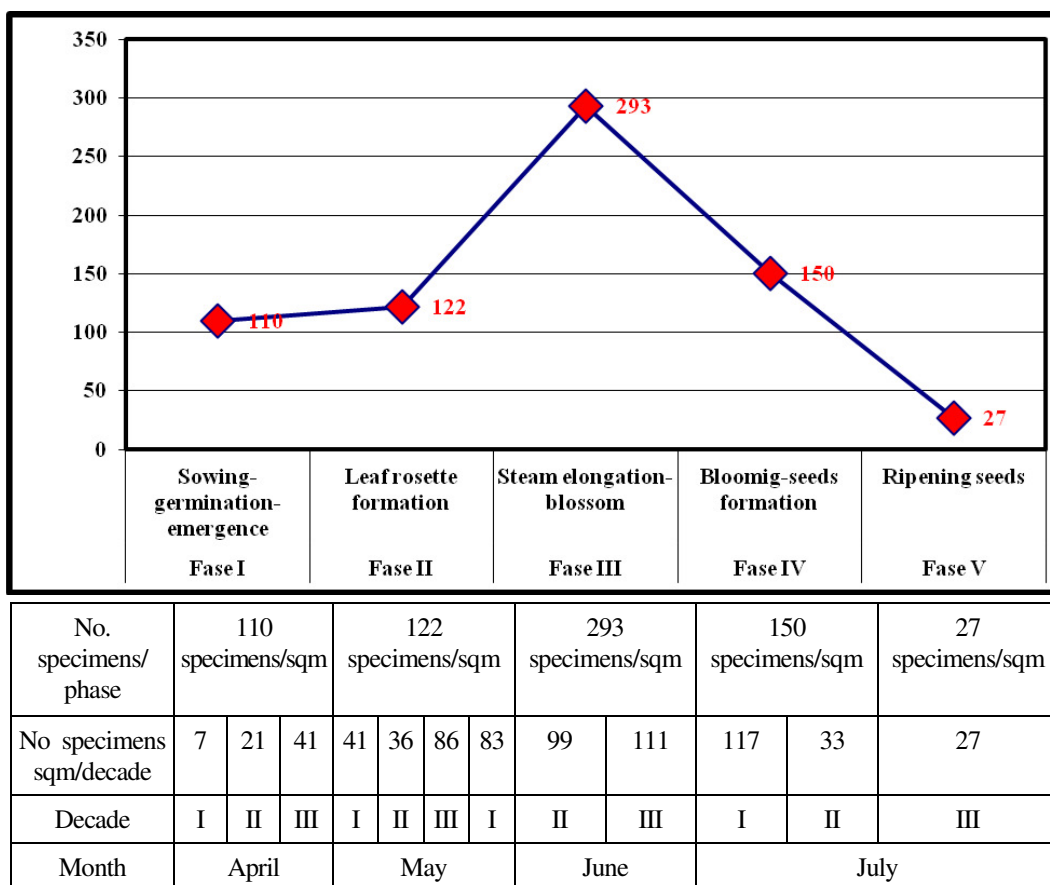


Fig. 1 – The evolution of the harmful entomofauna depending of the milk thistle phenophase

Analyzing the species collected and determined regarding the systematic inclusion in orders was found that 11 species belong to the *Coleoptera* order, six species to the *Lepidoptera* order, four species to the *Orthoptera* order, three species to the *Heteroptera* and *Homoptera* order and 1 species to the *Acari* order (Table 2).

Table 2 - The collected species belonging to the systemic orders of the Insecta class

crt crt.	Order/number specimens/species											
	<i>Coleoptera</i>		<i>Lepidoptera</i>		<i>Orthoptera</i>		<i>Heteroptera</i>		<i>Homptera</i>		<i>Acari</i>	
	Species	Sp/sqm	Species	sp/sqm	Species	sp/sqm	Species	sp/sqm	Species	Col ex/sqm	Species	sp/leaf
1	<i>Agriotes ustulatus</i>	17	<i>Agrotis segetum</i>	4	<i>Gryllotalpa gryllotalpa</i>	5	<i>Graphosoma lineatum</i>	14	<i>Aphis fabae</i>	2	<i>Tetranychus urticae</i>	377
2	<i>Agriotes obscurus</i>	5	<i>Amathes c-nigrum</i>	12	<i>Decticus verrucivorus</i>	3	<i>Lygus rugulipennis</i>	12	<i>Macrosiphoniella sanborni</i>	2		

3	<i>Agriotes lineatus</i>	8	<i>Autographa gamma</i>	8	<i>Tettigonia viridissima</i>	3	<i>Eurydema ornata</i>	19	<i>Macrosteles sexnotatus</i>	38		
4	<i>Melolontha melolontha</i>	19	<i>Vanessa cardui</i>	8	<i>Polysarcus denticaudus</i>	11						
5	<i>Opatrum sabulosum</i>	13	<i>Loxostege sticticalis</i>	5								
6	<i>Anomala solida</i>	3	<i>Mamaestra brassicae</i>	10								
7	<i>Pollyphylla fullo</i>	4										
8	<i>Phyllotreta nemorum</i>	44										
9	<i>Phyllotreta atra</i>	17										
10	<i>Epicometis hirta</i>	40										
11	<i>Lytta vesicatoria</i>	4										
Total	11 species	174	6 species	47	4 species	22	3 species	45	3 species	4 col, 38 sp/sqm	1 species	377

Calculating the share of the collected species, it was found that the *Coleoptera* order reached a maximum share of 39.3% and it was represented by 11 species of harmful insects and the minimum share of 3.6% it is hold by order *Acari* represented by the *Tetranychus urticae* species (Fig 2).

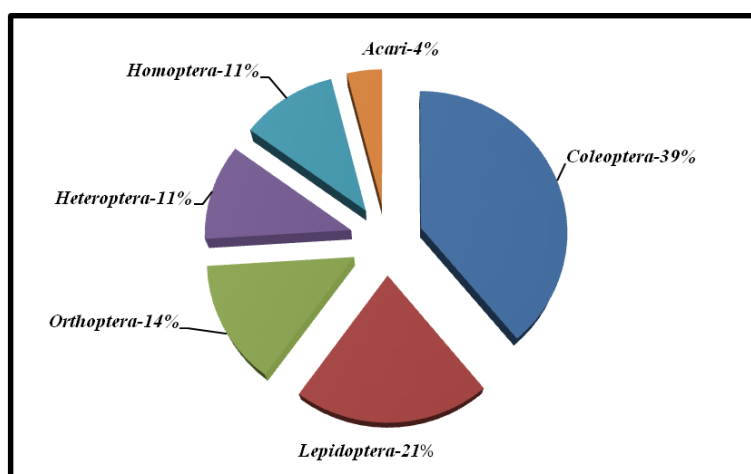


Fig. 2. The order share according to the number of recorded species

Analyzing the number of collected insects, the maximum share of 53.7% it is held by the *Acari* order, with a total number of 377 specimens/leaf and the minimum share of 2.7% it is held by the *Orthoptera* order with 22 specimens/sqm (Fig 3):

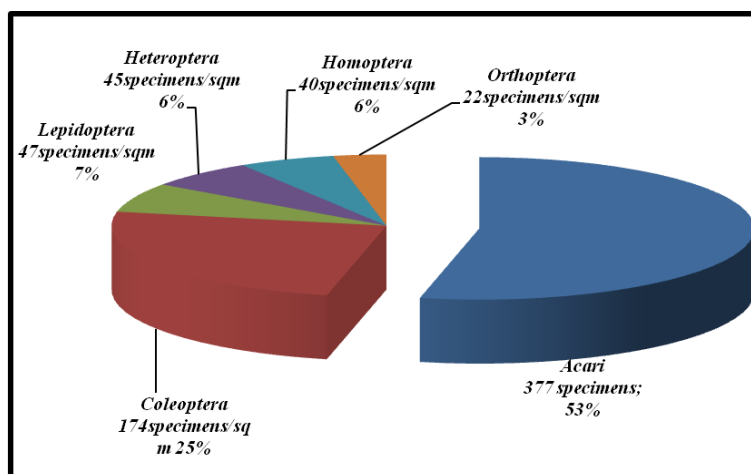


Fig. 3. The orders share according to the number of specimens

By calculating the parameters for the species collected was found that:

- **Abundance (A)** ranged between 3 specimens/sqm (*Anomala solida*, *Decticus verrucivorus*, *Tettigonia viridissima*) to 377 specimens/leaf (*Tetranychus urticae*) (Table 3).
- **Dominance (D)** of the collected species ranged from 0.28% (*Aphis fabae*, *Macrosiphoniella sanborni*) to 53.13% (*Tetranychus urticae*) (Table 3).
- The **constancy (C)** index that expresses the continuity of the species occurrence in the analyzed habitat ranged from 16.6% at *Polyphylla fullo*, *Loxostege stitcalis*, *Aphis fabae*, *Macrosiphoniella sanborni*, *Decticus verrucivorus*, *Tettigonia viridissima* species to 66,6% at *Agriotes ustulatus*, *Macrosteles sexnatatus* species;

- **Ecological significance index (W)** which represent the relationship between structural and productive indicator it ranged between 0.05% at the *Macrosiphoniella sanborni*, *Aphis fabae* species and 30.9% at the *Tetranychus urticae* species (table 3).

Table 3.The ecological parameters of the collected species identified in the milk thistle crops (*Silybum marianum* L)

Nr. crt.	Species	Abundance (A)	Dominance (D)	Constancy (C)	Ecological significance index (W)
1	<i>Agriotes ustulatus</i>	17	2.4	66.6	1.6
2	<i>Agriotes obscurus</i>	5	0.7	41.6	0.3
3	<i>Agriotes lineatus</i>	8	1.14	41.6	0.5
4	<i>Melolontha melolontha</i>	19	2.7	50	1.4
5	<i>Gryllotalpa gryllotalpa</i>	5	0.7	25	0.2
6	<i>Opatrum sabulosum</i>	13	1.85	41.6	0.8
7	<i>Agrotis segetum</i>	4	0.57	25.0	0.2
8	<i>Anomala solida</i>	3	0.43	25.0	0.1
9	<i>Pollyphylla fullo</i>	4	0.57	16.6	0.1
10	<i>Amathes c-nigrum</i>	12	1.7	33.3	0.6
11	<i>Autographa gamma</i>	8	1.14	33.3	0.4
12	<i>Vanessa cardui</i>	8	1.14	41.6	0.5
13	<i>Loxostege stiticialis</i>	5	0.7	16.6	0.1
14	<i>Mamaestra brassicae</i>	10	1.40	25.0	0.4
15	<i>Phyllotreta nemorum</i>	44	6.26	50.0	3.13
16	<i>Phyllotreta atra</i>	17	2.42	33.3	0.8
17	<i>Epicomites hirta</i>	40	5.7	33.3	1.9
18	<i>Lytta vesicatoria</i>	4	0.57	25.0	0.1
19	<i>Aphis fabae</i>	2	0.28	16.6	0.05
20	<i>Macrosiphoniella sanborni</i>	2	0.28	16.6	0.05
21	<i>Graphosoma lineatum</i>	14	1.99	41.6	0.83
22	<i>Lygus rugulipennis</i>	12	1.7	33.3	0.6
23	<i>Eurydema ornata</i>	19	2.7	41.6	1.12
24	<i>Decticus verrucivorus</i>	3	0.43	16.6	0.07
25	<i>Tettigonia viridissima</i>	3	0.43	16.6	0.07
26	<i>Polysarcus denticaudus</i>	11	1.56	33.3	0.52
27	<i>Macrosteles sexnotatus</i>	38	5.41	66.6	3.6
28	<i>Tetranychus urticae</i>	377	53.13	58.3	30.9
Total		702	100%	-	-

Regarding the participation percentage of each species in the collected entomofauna at the (calculated after the dominance value) the species collected were classified in the five class of dominance as follows:

- 11 species recorded the participation percentage lower than 1.1% and were classified as subrecedent species;
- 9 species were classified as recedent species;

- 4 species characterized as subdominant species;
- 3 species characterized as dominant species;
- one species belonging to the eudominant class (table 4).

Table 4. Belonging of the collected specie according to the dominance class

No. Crt.	DOMINANCE CLASS				
	Subrecurrent species P < 1.1 %	Recedent species P= 1.2 – 2.0%	Subdominant species P=2.1 – 5.0%	Dominant species P=5.1 - 10%	Eudominant species P> 10.1%
1	<i>Agriotes obscurus</i>	<i>Agriotes lineatus</i>	<i>Agriotes ustulatus</i>	<i>Phyllotreta nemorum</i>	<i>Tetranychus urticae</i>
2	<i>Gryllotalpa gryllotalpa</i>	<i>Opatrum sabulosum</i>	<i>Melolontha melolontha</i>	<i>Epicometis hirta</i>	
3	<i>Agrotis segetum</i>	<i>Amathes c-nigrum</i>	<i>Phyllotreta atra</i>	<i>Macrosteles sexnatatus</i>	
4	<i>Loxostege stiticalis</i>	<i>Autographa gamma</i>	<i>Eurydema ornata</i>		
5	<i>Lytta vesicatoria</i>	<i>Vanessa cardui</i>			
6	<i>Aphis fabae</i>	<i>Mamaestra brassicae</i>			
7	<i>Macrosiphoniella sanborni</i>	<i>Graphosoma lineatum</i>			
8	<i>Decticus verrucivorus</i>	<i>Lygus rugulipennis</i>			
9	<i>Tettigonia viridissima</i>	<i>Polysarcus denticaudus</i>			
10	<i>Anomala solida</i>				
11	<i>Pollyphylla fullo</i>				
Total	11 species	9 species	4 species	3 species	1 species

Regarding the constancy (C), the collected species were characterized as: 11 accidental species, 15 accessories species, 2 constant species (table 5), and depending the ecological significance index, 21 species were characterized as accidental species, six species as accessories species and one species as characteristic species (Table 6).

Table 5. The harmful entomofauna distribution regarding the constancy class

No. crt.	CONSTANCY CLASS			
	C1 - Accidental species P= 1-25%	C2 –Accessories species P=25.1-50%	C3 – Constant species P= 50.1-75 %	C4 – Euconstant species P= 75.1-100%
1	<i>Gryllotalpa gryllotalpa</i>	<i>Agriotes obscurus</i>	<i>Agriotes ustulatus</i>	-
2	<i>Agrotis segetum</i>	<i>Agriotes lineatus</i>	<i>Tetranychus urticae</i>	-
3	<i>Anomala solida</i>	<i>Melolontha melolontha</i>	-	-
4	<i>Pollyphylla fullo</i>	<i>Gryllotalpa gryllotalpa</i>	-	-
5	<i>Loxostege stiticalis</i>	<i>Opatrum sabulosum</i>	-	-
6	<i>Mamestra brassicae</i>	<i>Amathes c-nigrum</i>	-	--
7	<i>Lytta vesicatoria</i>	<i>Autographa gamma</i>	-	-
8	<i>Aphis fabae</i>	<i>Vanessa cardui</i>	-	-
9	<i>Macrosiphoniella sanborni</i>	<i>Phyllotreta nemorum</i>	-	-
10	<i>Decticus verrucivorus</i>	<i>Phyllotreta atra</i>	-	-
11	<i>Tettigonia viridissima</i>	<i>Epicometis hirta</i>	-	-
12	-	<i>Graphosoma lineatum</i>	-	-
13	-	<i>Lygus rugulipennis</i>	-	-
14	-	<i>Eurydema ornata</i>	-	-
15	-	<i>Polysarcus denticaudus</i>	-	-
Total	11 species	15 species	2 species	0 species

Table 6. Belonging of the harmful entomofauna according to the value of ecological significance index (W)

No.crt.	Accidental species W < 1.0%	Accessories species W=1.1 < 5.0%	Characteristic species W 5 > 10%
1	<i>Agriotes obscurus</i>	<i>Agriotes ustulatus</i>	<i>Tetranychus urticae</i>
2	<i>Agriotes lineatus</i>	<i>Melolontha melolontha</i>	

3	<i>Gryllotalpa gryllotalpa</i>	<i>Phyllotreta nemorum</i>	
4	<i>Opatrum sabulosum</i>	<i>Epicometis hirta</i>	
5	<i>Agrotis segetum</i>	<i>Eurydema ornata</i>	
6	<i>Anomala solida</i>	<i>Macrosteles sexnotatus</i>	
7	<i>Pollyphylla fullo</i>		
8	<i>Amathes c-nigrum</i>		
9	<i>Autographa gamma</i>		
10	<i>Vanessa cardui</i>		
11	<i>Loxostege sticticalis</i>		
12	<i>Mamestra brassicae</i>		
13	<i>Phyllotreta atra</i>		
14	<i>Lytta vesicatoria</i>		
15	<i>Aphis fabae</i>		
16	<i>Macrosiphoniella sanborni</i>		
17	<i>Graphosoma lineatum</i>		
18	<i>Lygus rugulipennis</i>		
19	<i>Decticus verrucivorus</i>		
20	<i>Tettigonia viridissima</i>		
21	<i>Polysarcus denticaudus</i>		
Total	21 species	6 species	1 species

Conclusions

- (1) The harmful entomofauna from *Silybum marianum* L. crops is consisted of 28 species that totalized 702 specimens/ sqm for the entire vegetation period.
- (2) The highest density of insects, 293 specimens/sqm was recorded in the stem elongation – blossom phenophases.
- (3) The insects collected were placed in the systematic orders: *Coleoptera*, *Lepidoptera*, *Orthoptera*, *Heteroptera*, *Homoptera* and *Acari*.
- (4) After the number of species, the *Coleoptera* order held the maximum share of 39.3%, and after the number of specimens collected, the maximum share was held by the *Acari* order of 53.7%.
- (5) Depending on the ecological parameters value, the 28 species of collected insects were classified in five dominance class and three constancy class.

(6) Depending on the ecological significance index, 21 species were characterized as accidental species, six species as accessories species and one species as characteristic species.

References

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