RESEARCHES REGARDING THE KNOWLEDGE AND CONTROL OF SPECIFIC PESTS FROM SUNFLOWER CROPS, UNDER THE CENTER OF MOLDOVA CONDITIONS

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Abstract: Worldwide, among the plants that produce cooking oil, the sunflower ranks third within the herbaceous oleifera plants. The fruits of these plants (achenes) contain at the new grown forms over 50% oil, with exceptional food quality (taste, smell and pleasant colour, high nutritional value, caloric value and degree of assimilation near the value of butter cow value) and high degree of conservability. The sunflower productions are reduced with 20 – 30% by a wide range of specific pathogen agents and pests that attack crops from sowing to harvesting. From those over 35 species of pests signalled in sunflower crops of the country, which theoretically reduce the biological potential of the cultivated hybrids, in the Central area of Moldova the production losses are caused by soil pests (*Agriotes* sp., *Tanymecus* sp, *Opatrum sabulosum*, *Crepidodera* sp.) that affect the crops in the phenophases between sowing – germination – emergence – formation of the first 5 – 7 leaves. Within the integrated control system, the most effective method for the protection of seeds from soil in the process of sprouting and of young plants until the phase of 5 – 7 leaves is the seed chemical treatment. In A.R.D.S. Secuieni conditions it was experimented a wide range of insecticides and insecto-fungicides, applied in seed treatment, the effectiveness of which contributed to the obtaining of high quantity and quality productions.

Keywords: *specific pests, sunflower, insecticides, seed treatment.*

INTRODUCTION

Worldwide, among the plants that produce cooking oil, the sunflower ranks third within the herbaceous oleifera plants. The fruits of these plants (achenes) contain at the new grown forms over 50% oil, with exceptional food quality (taste, smell and pleasant color, high nutritional value, caloric value and degree of assimilation near the value of butter cow value) and high degree of conservability.

The sunflower is a valuable plant for food and chemical industries, a forage crop for silage and one of the most appreciated melliferous plant species. From one hectare, in blossom period can be obtain 30-150 kg (15-40 kg per bee family), honey of superior quality.

In terms of plant growing, the sunflower has almost the same value as the corn, with the advantage that this frees the land earlier, leaves it clean of weeds and fewer plant debris, easily shredded and incorporated into the soil, constituting a good preceding plant for the winter wheat (Barbulescu, 2001; Balteanu, 2001; Popov & Barbulescu, 2007).

The sunflower productions are reduced with 20-30% by a wide range of specific pathogen agents and pests that attack crops from sowing to harvesting. The sunflower pests can cause significant production decreases by reducing the plant density, the leaf assimilable area, and some species cause crop losses through seeds quality decrease (Rosca, 2014, 2015; Trotus et al., 1997; Trotus, 2002, 2004, 2007; Trotus & Danila, 2007; Trotus et. al., 2010).

In this paper we present data regarding the structure of the harmful entomofauna of sunflower crop and the effectiveness of some measures, especially of the seed chemical treatment, in reducing the sunflower crop loss, in the Center of Moldova conditions.

MATERIAL AND METHOD

The researches were conducted at A.R.D.S. Secuieni-Neamt during 2010-2014 period, and consisted in ground surveys, determinations and measurements on the harmful entomofauna of sunflower crops.

The collections were made at ten days, starting from sowing to plants harvesting. The collected samples were analyzed in the laboratory at the binocular magnifying glass, determined and separated by species. For each species it was calculated the average density/sqm on the plant entire vegetation period. The results obtained from the collection and determination of the biological material were calculated and interpreted using some ecological parameters such as: abundance (A%), dominance (D%), constancy (C%) and the index of ecological significance (W%), which highlights the characteristics of the recorded biocenosis.

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:

$$D = \frac{AX100}{N}$$

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:

D_1-subrecedent species P<1.0%;
D_2-recedent species P=1.1-2.0%;
D_3-subdominant species P=2.1-5.0%;
D_4 -dominant species P=5.1-10.0%;
D_5 -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:

$$C = \frac{npA}{Np} \text{ X } 100$$

C = species constancy;
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:

C_1 - accidental species (1-25%);
C_2 - accessories species (25.1-50%);
C_3 - constant species (50.1-75%);
C_4 - 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:

$$W = \frac{CXDX100}{10000}$$

C = species constancy;
D = species dominance.

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

W_1 - accidental species (W <1.1%);
W_2 - accessories species (W = 1.1-5.0%);
W_3 - 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).

The experiences regarding the sunflower crops protection were placed in the experimental field of the Plant Protection laboratory, on a typically chernozem cambic soil type, infested with larvae of *Agriotes* genus (popularly known as *wire worms*), whose density was between 6-8 specimens/sqm. The experience placement was according to the randomized block method, in four repetitions. The sowing was done in the optimal epoch, manually, with a single grain (seed) to nest, at a distance of 15 cm between grains per row and 70 cm between rows. Before sowing, the seeds were treated with various products with insecticidal action. The observations were made from emergence until harvesting and consist of:

- the establishing of the percentage of emerged and saved plants at 25 days from the emergence date;
- the assessment of the attack produced by pests by granting grades in accordance with 0-6 scoring scale: 0 -no attack, and 6 -attack between 75-100% per plant.

Based on the given grades it was calculated the frequency, intensity and the attack degree produced by pests as well as the efficacy of the insecticides experimented in seed treatment on the pests.

At harvest, the productions were recorded and analyzed per parcel/repetition, and were statistically calculated by the variance analysis method.

RESULTS AND DISCUSSIONS

The sunflower crops harmful entomofauna from the Center of Moldova was composed of 17 species totalling an annual average density of 194.7 specimens /sqm. The data are presented in table 1. The highest average number of pests was 48 specimens/sqm recorded at the observations in the third decade of April. In the second and third decade of July, the first decade of August and the second and third decade of September there weren't recorded any harmful insects in the sunflower crops (table 1).

Analyzing the collected species from a systematic point of view, it was found that the 17 identified species belonged to the orders: Coleoptera, Lepidoptera and Homoptera (Table 2).

Calculating the orders share depending on the number of species, it was found that the Coleoptera included 12 species and held a share of 70.6%, followed by Lepidoptera which comprised 4 species and a share of 23.5% and Homoptera with only one species and a share of 5.90% (Figure 1).

By the number of collected specimens, it was found that the Coleoptera reached a maximum share of 89.9% and included 175 specimens from the total of 194.7 specimens collected in annual average. In Lepidoptera order, there were 18 specimens with a 9.2% share and the Homoptera order holds a share of 0.9% (Figure 2).

Table 1. The harmful entomofauna from sunflower crops

Secuieni – Neamt (2010 – 2014)

No. crt.	Species	Species density (specimens no.sgm) at the determinations from:																	Annual average density
		April			May			June			July			August			September			
		I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	
1.	*Agriotes sp.*	3	5	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13
2.	*Agrotis segetum*	0	0	1	2	2	1	0	0	0	0	0	0	0	0	0	0	0	0	6
3.	*Amathes C-nigrum*	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	3
4.	*Autographa gamma*	0	0	0	0	1	2	1	0	0	0	0	0	0	0	0	0	0	0	4
5.	*Melolontha melolontha*	0	1	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	5
6.	*Anoxia vilosa*	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
7.	*Pentodon idiota*	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	2
8.	*Lethrus apterus*	0	0	2	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	4
9.	*Potosia hungarica*	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	3
10.	*Opatrum sabulosum*	0	0	5	5	6	4	1	0	0	0	0	0	0	0	0	0	0	0	21
11.	*Tanymecus palliatus*	0	2	3	6	5	0	0	0	0	0	0	0	0	0	0	0	0	0	18
12.	*Tanymecus dilaticollis*	0	0	3	2	4	3	0	0	0	0	0	0	0	0	0	0	0	0	12
13.	*Psalidium maxilosum*	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	3
14.	*Crepidodera feruginea*	0	12	15	17	7	5	3	0	0	0	0	0	0	0	0	0	0	0	59
15.	*Chaetocnema aridula*	0	5	10	9	5	2	1	1	0	0	0	0	0	0	0	0	0	0	33
16.	*Helicoverpa armigera*	0	0	0	0	0	0	0	1	3	0	1	0	0	0	0	0	0	0	5
17.	*Aphis fabae*	0	0	0	0	0	0	0	0	0	0	0	0	0	0.2	1.0	0.5	0	0	1.7 col.
Total specimens		3	25	48	47	36	22	6	2	3	0	1	0	0	0.2	1.0	0.5	0	0	194.7

Table 2. Belonging of the collected species at the systematic orders of the Insecta class, Secuieni-Neamt (2010 – 2014)

No. crt.	Species	No. of specimens collected annually	Order
1.	*Agriotes sp.*	13	Coleoptera
2.	*Melolontha melolontha*	5	Coleoptera
3.	*Anoxia vilosa*	2	Coleoptera
4.	*Pentodon idiota*	2	Coleoptera
5.	*Lethrus apterus*	4	Coleoptera
6.	*Potosia hungarica*	3	Coleoptera
7.	*Opatrum sabulosum*	21	Coleoptera
8.	*Tanymecus palliatus*	18	Coleoptera
9.	*Tanymecus dilaticollis*	12	Coleoptera
10.	*Psalidium maxilosum*	3	Coleoptera
11.	*Crepidodera feruginea*	59	Coleoptera
12.	*Chaetocnema aridula*	33	Coleoptera
13.	*Agrotis segetum*	6	Lepidoptera
14.	*Amathes C-nigrum*	3	Lepidoptera
15.	*Autographa gamma*	4	Lepidoptera
16.	*Helicoverpa armigera*	5	Lepidoptera
17.	*Aphis fabae*	1.7 col.	Homoptera
Total = 17 species		194.7	3 orders

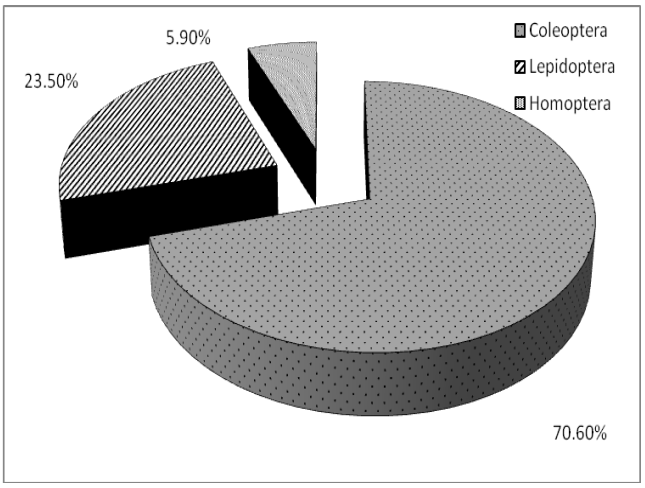

Figure 1. The orders share according to the number of recorded species

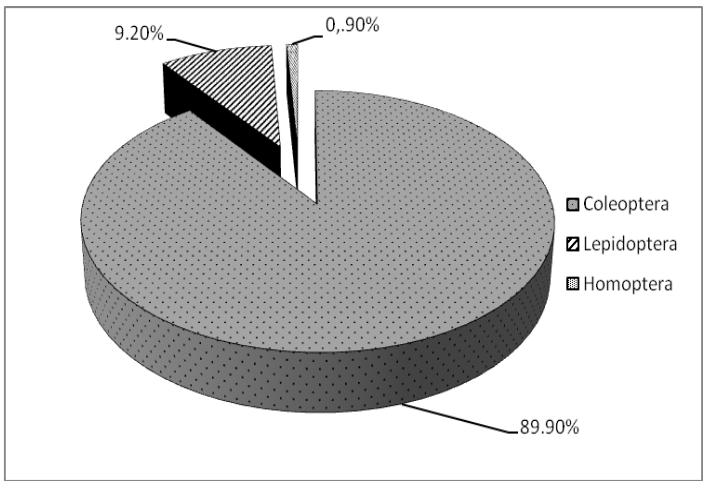

Figure 2. The orders share according to the number of specimens

For the 17 species of insects, the ecological parameters of each species were calculated (Table 2). The highest values of abundance were recorded at the species: *C. feruginea* (59 specimens/sqm), *C. aridula* (33 specimens/sqm), *O. sabulosum* (21 specimens/sqm), *T. palliatus* (18 specimens/sqm), *Agriotes* sp. (12 specimens/sqm). The lowest values of abundance were found at the species: *P. idiota* (2 specimens/sqm), *A. vilosa* (2 specimens/sqm), *A. C-nigrum* (3 specimens/sqm), *P. maxilosum* (3 specimens/sqm). The aphid species *A. fabae* recorded an abundance of 1.7 colonies/ sqm. (Table 2).

Regarding the participation percentage of each species in the total annual collections, represented by calculating the dominance, the values of dominance were between 0.9% (*A. fabae*) and 30.3% (*C. feruginea*). The species were classified in the five classes of dominance as follows:

- 3 species in D_5 class characterized as eudominant species, with values of dominance between 10.8% and 30.3%;
- 3 species in D_4 class characterized as dominant species, the participation values were between 6.2 and 9.2%;
- 4 species, in D_3 class - subdominant species, with the participation percentage between 2.1% and 3.1%;

- 4 species, in D_2 class - recedent species with values between 1.5% and 1.6%;
- 3 species, in D_1 class - subrecedent species, their participation percentage was of 0.9% until 1.0% (table 3).

Through the constancy and ecological significance index calculation it was found that the 17 species of harmful insects are characterized, for sunflower crop as: 2 characteristic species, 4 accessories species and 11 accidental species (table 3).

Table 3. The ecological parameters of the collected species, for Center of Moldova conditions Secuieni – Neamt (2010 – 2014)

No. crt.	Species	Abundance (A)	Dominance		Constancy		Index of ecological significance	
			D%	Class	C%	Class	W%	Class
1.	*Crepidodera feruginea*	39	30.3	D_5	33.3	C_2	10.1	W_3
2.	*Chaetocnema aridula*	33	16.9	D_5	38.8	C_2	6.6	W_3
3.	*Opatrum sabulosum*	21	10.8	D_5	27.7	C_2	3.0	W_2
4.	*Tanymecus palliatus*	18	9.2	D_4	22.2	C_1	2.0	W_2
5.	*Agriotes sp.*	13	6.7	D_4	22.4	C_1	1.5	W_2
6.	*Tanymecus dilaticollis*	12	6.2	D_4	22.4	C_1	1.4	W_2
7.	*Agrotis segetum*	6	3.1	D_3	22.4	C_1	0.7	W_1
8.	*Melolontha melolontha*	5	2.6	D_3	22.4	C_1	0.6	W_1
9.	*Helicoverpa armigera*	5	2.6	D_3	16.7	C_1	0.4	W_1
10.	*Lethrus apterus*	4	2.0	D_2	16.6	C_1	0.3	W_1
11.	*Autographa gamma*	4	2.1	D_3	16.6	C_1	0.3	W_1
12.	*Potosia hungarica*	3	1.5	D_2	16.6	C_1	0.2	W_1
13.	*Psalidium maxilosum*	3	1.5	D_2	16.6	C_1	0.2	W_1
14.	*Amathes C-nigrum*	3	1.6	D_2	16.6	C_1	0.2	W_1
15.	*Anoxia vilosa*	2	1.0	D_1	11.1	C_1	0.1	W_1
16.	*Pentodon idiota*	2	1.0	D_1	11.1	C_1	0.1	W_1
17.	*Aphis fabae*	1.7 col.	0.9	D_1	16.6	C_1	0.1	W_1

The graphs in figures 3, 4 and 5 indicate the share of the dominance, constancy and ecological significance index classes depending on the participation values of each species within the biocenosis of sunflower crop.

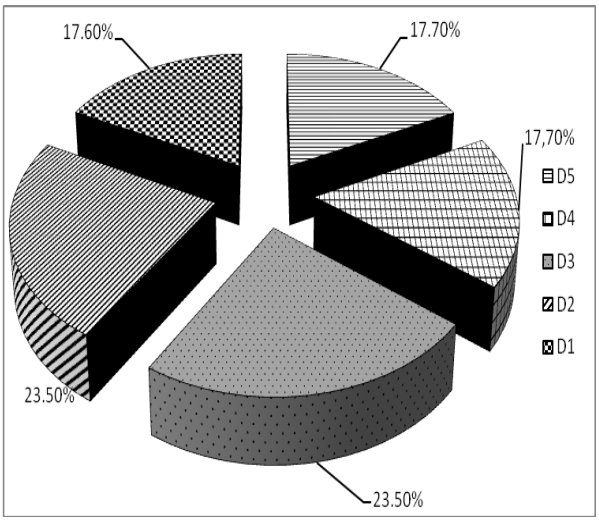

Figure 3. The share of the collected species on dominance classes

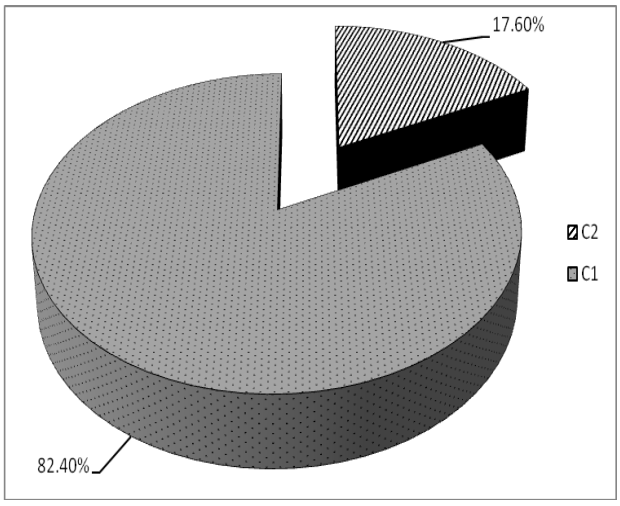

Figure 4. The share of the collected species on constancy classes

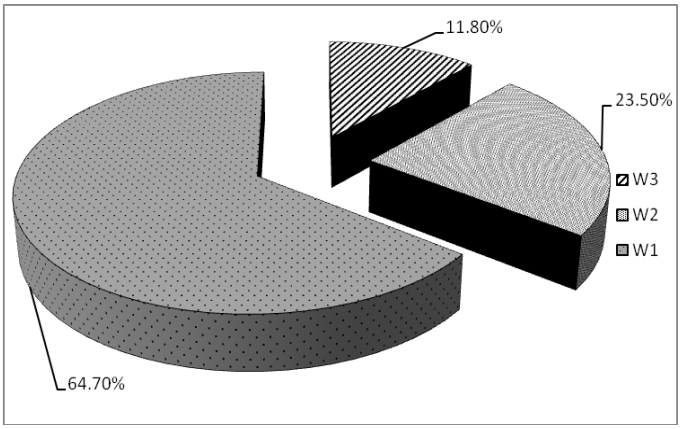

Figure 5. The share of the collected species on classes according to the ecological significance index

Along with the inventory of harmful entomofauna was also followed the attack frequency produced by them at the sunflower plants. The attack frequency had different values from year to year, from 0.1% registered at *A. gamma* species (2010) until 18% produced by *C. feruginea* species (2010, 2013). The average frequency of attack produced by the recorded species, for 2010-2014 period, ranged from 0.1% at *Anoxia vilosa* species to 13.6% at *C. feruginea* species (table 4).

Table 4. The frequency of the attack produced by harmful organisms to the sunflower crops
Secuieni – Neamt (2010 – 2014)

No. crt.	Species	Attack frequency %					The attack average frequency (%)
		2010	2011	2012	2013	2014	
1.	*Crepidodera feruginea*	18.00	14.00	10,00	18.00	8.00	13.60
2.	*Chaetocnema aridula*	16.00	12,00	12.00	16.00	6.00	12.40
3.	*Opatrum sabulosum*	7.00	5.00	5.00	6.00	3.00	5.20
4.	*Tanymecus palliatus*	10.00	11.00	4.70	10.00	3.80	7.90
5.	*Agriotes sp.*	6.20	6.50	15.50	7.50	14.80	10.10
6.	*Tanymecus dilaticollis*	7.50	6.80	5.20	7.20	5.40	6.42
7.	*Agrotis segetum*	2.60	3.80	3.60	4.00	3.60	3.52
8.	*Melolontha melolontha*	0.80	1.20	0.20	0.40	0.20	0.56

9.	*Helicoverpa armigera*	0.30	0.10	0.50	0.80	0.30	0.40
10.	*Lethrus apterus*	0.20	0.12	0.10	0.10	0.20	0.14
11.	*Autographa gamma*	0.10	0.30	0.50	0.30	0.50	0.34
12.	*Potosia hungarica*	0.20	0.15	0.10	0.22	0.16	0.17
13.	*Psalidium maxilosum*	0.80	1.12	0.50	1,50	0.30	0.84
14.	*Amathes C-nigrum*	2.30	2.25	2.60	3.20	5.20	3.11
15.	*Anoxia vilosa*	0.25	0.50	0.12	0.10	0.10	0.21
16.	*Pentodon idiota*	0.12	0.30	0.12	2.15	0.30	0.60
17.	*Aphis fabae*	6.20	5.80	5.00	5.12	5.54	5.53

Analyzing the average density of the inventoried species for each moment of determination it was found that the highest average number of specimens/sqm of 48, 47, 36, 25, respectively 22 specimens/sqm was recorded in the period between the second decade of April and until the third decade of May, period coinciding with the germination - emergence - formation of the first 5 - 8 leaves stage at sunflower (Figure 6).

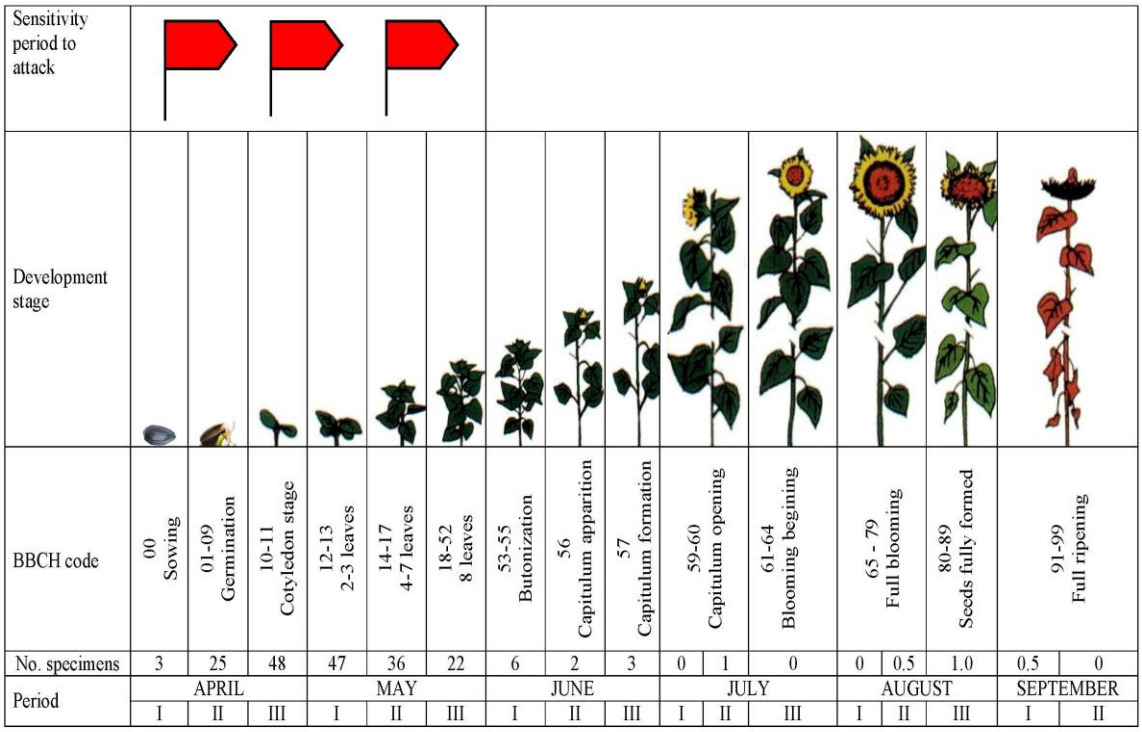

Fig. 6 The average density of pests no/sqm recorded on decades and sunflower development stages

During this period the sunflower crops are most susceptible to the attack, and the species of harmful insects are most voracious, fact which requires the application of special measures for crop protection. Between 2010-2012, in A.R.D.S. Secuieni, a range of systemic insecticides were experienced in the seed chemical treatments, which have provided a good protection of plants against soil pests as follows:

- the percentage of saved plants, at 25 days from emergence, as a result of the genus *Agriotes* larvae attack, was between 83% and 94% at the treated variants compared with 73% as it was at the untreated control;

- the attack degree (AD%) produced by *Tanymecus* sp., ranged between 0.64% and 0.93% at the variants treated with insecticides with systemic action compared with 5.78% registered in the untreated control;
- the frequency attack produced by *O. sabulosum*, *Crepidodera* sp. and *Chaetocnema* sp. species ranged between 0.51% and 3.8% at the treated variants compared with 6.35% and 28.17% at the untreated control (table 5).

Table 5. The influence of some insecticides applied in the sunflower seed treatment on the attack of some specific pests

Secuieni – Neamt (2010 – 2012)

Experimental variant	Dose l, kg/t	Attack produced by the species:				
		Agriotes sp.	Tanymecus sp.	*O. sabulosum*	Crepidodera sp.	Chaetocnema sp.
		P% saved pl.	AD%	F%	F%	F%
Untreated control	-	73	5.78	6.35	28.17	20.15
Poncho 600 FS	9.0	94	0.64	0.51	3.10	2.00
Thiacloprid 400 FS	20,0	93	0.91	0.63	3.54	2.25
Cruiser 350 FS	10,0	93	0.59	0.61	3.60	1.95
Gaucho 600 FS	10.0	94	0.60	0.64	3.12	2.12
Dalila 600 FS	10.0	91	0.93	0.73	3.25	2.56
Nuprid 600 FS	10,0	91	0.85	0.65	3.30	2.58
Nuprid AL 600 FS	10.0	89	0.87	0.64	3.80	2.29
Signal 300 ES	2.0	86	5.26	6.12	26.80	20.12
	DL 5%	1.92%	0.75%	0.51%	3.51%	3.35%
	1%	2.85%	1.64%	0.94%	5.17%	5.01%
	0.1%	4.12%	2.95%	1.71%	8.20%	7.98%

The good protection provided by the insecticides experimented in seed chemical treatment, had positively influenced the sunflower production that ranged between 3580 kg/ha and 3680 kg/ha at the variants treated with insecticides with systemic action as to 2120 kg/ha recorded at the untreated control, the recorded yield differences were statistically ensured as very significant (Table 6).

Table 6. The influence of some insecticides applied in seed treatment on sunflower production

Secuieni – Neamt (2010 – 2012)

No. crt.	Experimental variant	Dose (l, kg/t)	Sunflower production		Diff. untreated control (Kg/ha)	Significance
			Absolute (kg/ha)	Relative (%)		
1.	*Untreated control*	-	2120	100	uc.	uc.
2.	*Poncho 600 FS*	9.0	3680	174	1560	xxx
3.	*Thiacloprid 400FS*	20.0	3594	170	1474	xxx
4.	*Cruiser 350 FS*	10.0	3602	170	1482	xxx
5.	*Gaucho 600 FS*	10.0	3610	170	1490	xxx
6.	*Dalila 600 FS*	10.0	3580	169	1460	xxx
7.	*Nuprid 600 FS*	10.0	3585	169	1465	xxx
8.	*Nuprid AL 600 FS*	10.0	3601	170	1481	xxx
9.	*Signal 300 ES*	2.0	2520	119	400	x

DL 5% = 330 kg/ha
1% = 401
0.1% = 552

By 485/2013 Decision, the European Commission has banned the use in seed chemical treatment, of three insecticides (active substances) from neonicotinoids group, respectively clothianidin, imidacloprid and thiamethoxam. Accordingly at ARDS Secuieni there were experienced, in reducing the attack and diminish the population of insect pests, curative treatments on vegetation using insecticides from pyrethroid group. By applying two treatments, the average frequency of the attack produced by *O. sabulosum*, *Tanymecus* sp., *Crepidodera* sp., *Chaetocnema* sp. and P. *maxilosum* species in 2013 and 2014, had values from 1.27% and 16.1% at the treated variants and between 1.55% and 18.25% at the untreated control. The differences regarding the attack frequency between the treated variants and the untreated control were statistically ensured only at *Crepidodera* sp., *Tanymecus* sp. and *O. sabulosum* species to Karate Zeon - 0.15 l/ha treatment (Table 7).

Table 7. The effectiveness of some insecticides in reducing the attack of some specific pests at sunflower

Secuieni – Neamt (2013, 2014)

No. crt.	Experimental variant	Dose l/ha	Attack F% produced by the species:				
			O. sabulosum	Tanymecus sp.	Crepidodera sp.	Chaetocnema sp.	P. maxilosum
1.	Untreated control	-	6.35	10.30	18.25	17.12	1.55
2.	Karate Zeon	0.15	5.45 x	8.25 xx	15.24 x	16.10	1.32
3.	Decis Mega	0.15	5.65	8.12 xx	15.30 x	15.90	1.27
		DL 5%	0.73%	1.15%	1.94%	1.72%	0.36%
		1%	1.59%	2.01%	3.20%	3.09%	0.59%
		0.1%	2.14%	3.14%	4.95%	4.57%	0.95%

T_1 - at the appearance of pests in culture; T_2 - at 10 -12 days from T_1.

CONCLUSIONS

The harmful entomofauna of sunflower crops from Center of Moldova was composed of 17 species, belonging to Coleoptera, Lepidoptera and Homoptera orders and totalled an annual average 194.7 specimens/sqm.

The species annual average density varied between 2 specimens/sqm (*Anoxia vilosa*, *Pentodon idiota*) and 59 specimens/sqm (*Crepidodera feruginea*).

The Coleoptera order held the maximum share, of 70.9% after the number of species, and of 89.9% after the total number of specimens collected.

According to the ecological parameters (abundance, dominancy, constance and the index of ecological significance), the inventoried species were classified as follows: W_3 - characteristic species (2 species), W_2 - accessories species (4 species) and W_1 - accidental species (11 species).

The highest density of harmful insects was 47.48 specimens/sqm, recorded in the period between plant emergence and the first 3-5 leaves formation.

The sunflower crops protection during the period between seed germination and the first 5-7 leaves formation was achieved through seed chemical treatment with insecticides with systemic action.

The good protection provided by the insecticides experimented in seed treatment have positively influenced the sunflower production.

As an alternative measure of sunflower crop protection against harmful insects, by prohibiting the use of insecticides from neonicotinoids group, could be considered the curative treatments with insecticides from pyrethroid group. After 2 chemical treatments on

vegetation with Decis Mega and Karate Zeon insecticides, the differences between the attack frequencies at the treated variants compared with the untreated control were statistically ensured for the species: *Crepidodera* sp., *Tanymecus* sp. and *Opatrum sabulosum*.

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