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INSECT FAUNA ASSOCIATED WITH SUNFLOWER CULTIVATED IN SYSTEM WITH BLACK LOCUST WINDBREAKS

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Abstract: A study was performed in 2018, to evaluate the Entomofauna in a sunflower crop in system with black locust windbreaks in the field of SC SPORT AGRA SRL Amzacea, Constanța County, the eastern part of Romania. Insects were collected on yellow sticky traps inside the windbreaks and in two parallel planes in the sunflower crop of 100 ha at two distances from the windbreaks (50 and 300 m). Five traps per site were used changed every two weeks from mid-June to early August. The results showed that the number of species inside the black locust windbreaks was 22 with a total of 3595 specimens, in the sunflower plane near the windbreaks were 19 species with a total of 3817 specimens and in the distant sunflower plane were 17 species which totalled 3570 specimens. The composition of the beneficial fauna was represented by 12 species in the windbreaks, 8 in sunflower plane 1 and 6 in sunflower plane 2. Percentage ratio of beneficial and harmful species from the two sunflower planes and from the black locust windbreaks was calculated as well as the ecological parameters (abundance, dominance, constancy and ecological significance).

Key words: *beneficial insects, insect pests, biodiversity, sunflower*

INTRODUCTION

The sunflower represents one of the most important oilseed crops in the world. In 2017, sunflower seeds accounted for 50 million tons worldwide with a percentage of 8.7% of the total oil seed production in the world (Popescu, 2018). As different pests and phytopathogens attack sunflower crop annually, phytosanitary protection is mandatory and various integrated management systems needed to be implemented (Trotuș & Buburuz, 2015). The presence of windbreaks around a crop is a good alternative to protect it against pests and climatic factors such as drought, wind and extreme temperatures. The early studies (Naegeli, 1941; Andersen, 1943) as well as recent ones (Brandle & Finch, 1991; Cleugh, 1998, Brandle et al., 2004; Tyndall & Colletti, 2007) have reported results regarding the positive effects of windbreaks on the windbreak-crop systems: windbreaks mainly modify the microclimate in a favourably way for crops, improve biodiversity at the crops level, decrease soil erosion caused by wind and water, provide shelters for livestock and wildlife, reduce the chemicals impact and increase the crops yield. A more complex windbreak structure leads to a greater diversity of microhabitats and species; vegetative diversity of windbreaks not only creates new microhabitats but also offers new sources of hosts, prey, pollen and nectar for local fauna (Pasek, 1988).

The purpose of this work was to evaluate the range and structure of pest and useful entomofauna in a sunflower crop in system with black locust windbreaks in the field of SC SPORT AGRA SRL Amzacea, Constanța County from the eastern part of Romania.

MATERIALS AND METHODS

The study has been conducted in 2018 in a 100 ha sunflower culture in system with black locust windbreaks in the field of SC SPORT AGRA SRL Amzacea. The evaluation of useful and harmful insect fauna was carried out in two parallel planes in the sunflower crop, at 50 meters respectively 300 meters distance from the edge of the black locust windbreaks and in the black locust windbreaks surrounding the crop. Insects were trapped on yellow sticky traps, 5 traps/collecting site, replaced every two weeks from mid-June to early August. A total of 15 traps per site were used. Each trap was fixed along row between two sunflower plants and directly on black locust branches at approximately 1.5 meters above ground.

The trapped insects have been identified under a stereomicroscope SZ 61 following the morphological characteristics and illustrations in the literature which describe adult specimens. The percentage ratio of useful and harmful species, as well as the ecological parameters abundance (A), dominance (D%), constancy (C%) and ecological significance (W%) were calculated. The methods published by Simionescu (1983) and Stan (1994) were used to calculate the ecological parameters.

According to dominance values, species were classified as subreceding species (D1 <1%), receding species (D2= 1-2%), subdominant species (D3= 2-5%), dominant species (D4= 5-10%) and eudominant species (D5 >10%). Depending on the constancy values, species were grouped in accidental species (C1= 1-25%), accessory species (C2= 25-50%), constant species (C3= 50-75%), and euconstant species (C4= 75-100%). As for the ecological significance, species were grouped in accidental species (W1 <1%), accessory species (W2= 1-5%) and characteristic species (W3 >5%).

RESULTS AND DISCUSSION

Altogether 10982 insect specimens (harmful and beneficial) were collected on the yellow sticky traps in the three collecting planes in 2018, of which the pest fauna counted 9153 specimens and the useful one 1829 specimens (Table 1 and 2). In sunflower plane 1, there were identified 19 species of insects with a total of 3817 specimens belonging to six orders, Thysanoptera, Hemiptera, Hymenoptera, Coleoptera, Diptera and Neuroptera. In sunflower plane 2, 17 species were recorded counting 3570 specimens belonging to five orders, Thysanoptera, Hemiptera, Coleoptera, Diptera and Neuroptera. The number of species in black locust Windbreaks was 22 with a total of 3595 specimens belonging to Thysanoptera, Hemiptera, Hymenoptera, Coleoptera, Diptera and Neuroptera orders (Table 1 and 2).

Table 1. Pest insects collected on yellow sticky traps in 2018

Order/family/subfamily/species	Sunflower plane 1	Sunflower plane 2	Black locust windbreaks	Total
Ord. THYSANOPTERA	1225	951	1058	3234
Ord. HEMIPTERA	1832	1993	808	4633
Aphrophoridae /Aphrophorinae	1	1	20	22
Philaenus spumarius L., 1758	1	1	20	22
Membracidae /Smiliinae	0	1	0	1
Stictocephala bisonia Kopp &Yonke, 1977	0	1	0	1
Cixiidae/Cixinae	96	119	3	218
Hyalesthes obsoletus Signoret, 1865	8	9	0	17
Cixius wagneri China, 1942	5	11	2	18
Reptalus quinquecostatus Dufour, 1833	83	99	1	183
Delphacidae/Delphacinae	1	0	0	1
Javesella pellucida Fabricius, 1794	1	0	0	1
Cicadellidae/Agalliinae	33	68	0	101
Anaceratagallia sp Zachvatkin, 1946	33	68	0	101

Cicadellidae/ Deltocephalinae	1140	1336	493	2969
Allygus modestus Scott, 1876	76	47	492	615
Macrosteles sp Fieber, 1866	1064	1289	1	2354
Cicadellidae /Macropsinae	0	4	0	4
Macropsis fuscula Zetterstedt 1828	0	4	0	4
Cicadellidae/ Typhlocybinae	561	464	292	1317
Empoasca sp Walsh, 1862	561	464	292	1317
Ord. HYMENOPTERA	1	0	36	37
Tenthredinidae/Allantinae	1	0	36	37
Athalia rosae L., 1758	1	0	36	37
Ord. COLEOPTERA	5	4	1237	1246
Chrysomelidae/Alticinae	0	0	1219	1219
Altica oleracea L., 1758	0	0	1219	1219
Chrysomelidae/Criocerinae	0	0	4	4
Oulema melanopus L., 1758	0	0	4	4
Chrysomelidae/Chrysomelinae	0	0	12	12
Chrysolina sp Motschulsky, 1860	0	0	12	12
Cerambycidae	0	1	0	1
Curculionidae	5	3	2	10
Total	3064 (34%)	2950 (32%)	3139 (34%)	9153 (100)

Table 2. Beneficial insects collected on yellow sticky traps in 2018

Order/suborder/family/subfamily/species	Sunflower plane 1	Sunflower plane 2	Black locust windbreaks	Total
Ord. HEMIPTERA	2	0	0	2
Subord. Heteroptera	2	0	0	2
Anthocoridae/Anthocorinae	2	0	0	2
Orius sp Wolff, 1811	2	0	0	2
Ord. COLEOPTERA	335	244	167	746
Carabidae/Harpalinae	0	0	8	8
Anchomenus sp Bonelli, 1810	0	0	1	1
Harpalus rufipes Degeer, 1774	0	0	7	7
Coccinellidae/Coccinellinae	4	9	10	23
Coccinella septempunctata L., 1758	1	2	1	4
Psyllobora vigintiduopunctata L., 1758	3	7	9	19
Cantharidae/Cantharinae	331	235	144	710
Cantharis fusca L., 1758	331	235	117	683
Cantharis livida L., 1758	0	0	26	26
Cantharis rufa L., 1758	0	0	1	1
Mordellidae/Mordellinae	0	0	4	4
Mordella aculeata L., 1758	0	0	4	4
Oedemeridae/Odemerinae	0	0	1	1
Oedemera podagrariae L., 1767	0	0	1	1
Ord. DIPTERA	371	273	245	889
Syrphidae/Syrphinae	371	273	245	889
Episyrphus balteatus De Geer, 1776	301	229	172	702
Syrphus ribesii L., 1758	70	44	73	187
Ord. NEUROPTERA	45	103	44	192
Chrysopidae/Chrysopinae	45	103	44	192
Chrysoperla carnea Stephens, 1836	45	103	44	192
Total	753 (41%)	620 (34%)	456 (25%)	1829 (100%)

The pest insects belonged to 10 species inside the windbreaks and 11 species in each of sunflower plane. The beneficial insects comprised 12 species inside the windbreaks, 8 in sunflower plane 1 and 6 in sunflower plane 2.

Within the total harmful entomofauna, the thrips were the most abundant group (3234 specimens) and were present inside the sunflower crop and the black locust windbreaks as well.

As for the species, the leafhopper *Allygus modestus* (Cicadellidae) and the coleopter *Altica oleracea* (Chrysomelidae) were trapped in the highest number, 615 and 1219 specimens, respectively. *A. modestus* is present in most European countries, including Romania. It prefers open woodlands, especially moist habitats. In the present study, 80% of individuals were inside the black locust windbreaks. *A. oleracea* is a phytophagous species of leaf beetle feeding on various flowering plants, especially from the Onagraceae and Rosaceae families. Its all specimens in this study were found on traps inside the black locust windbreaks.

Hemipterans from the Auchenorrhyncha group totalled 4636 specimens distributed on five families, Aphrophoridae, Membracidae, Cixiidae, Delphacidae and Cicadellidae.

Within the Cicadellidae family, two genera were the most abundant, *Macrosteles* (2354 specimens) and *Empoasca* (1317 specimens). Both genera include sucking insect pests of agricultural importance. Species from *Macrosteles* genus feed on xylem sap and many of them are vectors of economically important plant diseases that include viruses, bacteria and fungi (Brčak, 1979). Almost all specimens in this investigation were collected inside the sunflower crop, only one specimen inside the windbreaks.

The genus *Empoasca* contains cosmopolitan leafhoppers, most of them being serious pests of cultivated plants. They are usually very polyphagous and can also transmit phytoplasmas to various plants species (Pastore et al., 2004). In this study, the most numerous specimens were found inside the sunflower crop.

Other numerically relevant species in the Auchenorrhyncha group were the cixid *Reptalus quinquecostatus* (183 specimens) and the cicadellid *Anaceratagallia* sp. (101 specimens). *R. quinquecostatus* and other two planthoppers in Cixiidae family like *Hyalesthes obsoletus* and *Cixius wagneri* are polyphagous planthopper on weeds manly bindweed (*Convolvulus arvensis*) in the crops and nearby, they being involved in spreading of infectious diseases such stolbur (*Candidatus phytoplasma solani*) to grapevine, solanaceous plants and other crops (Danet et al., 2003, 2004; Trivellone et al., 2005; Chuche et al., 2016).

Among the pest coleopterans identified in this study belonged to Chrysomelidae, Cerambycidae and Curculionidae families. Some unidentified beetles from the families Cerambycidae and Curculionidae were also found in the sticky traps.

The total beneficial fauna included 1829 specimens in the Hemiptera, Coleoptera, Diptera and Neuroptera orders. The most specimens belonged to *Episyrphus balteatus* (702 specimens) and *Cantharis fusca* (683 specimens). Both species are frequently reported in agriculture crops in Romania and are considered efficient natural control agents of the pests (Tălmaciu et al., 2018; Malschi et al., 2018; Stavrescu-Bedivan et al., 2018, Herea et al., 2019). *E. balteatus* is reported as the most abundant aphidophagous predator in crops (Colignon et al., 2001). The genus *Cantharis* contains species of soldier beetles that feed mainly on soft-bodied arthropods (Lukasiewicz, 1996). *Chrysoperla carnea* (192 specimens) and *S. ribesii* (187 specimens) were also noted; both are reported as important predators in agriculture crops (Sauciuc & Roșca, 2010; Nechita & Roșca 2010).

Other beneficial insects collected in this study were *Psyllobora vigintiduopunctata*, *Coccinella septempunctata*, *Harpalus rufipes*, *Anchomenus sp.*, *Cantharis livida*, *Mordella aculeate*, *Anchomenus sp*., *Orius sp.* and *Oedemera podagrariae*.

Of the total number of insects, proportion of the pests were quite similar in the two sunflower planes and in the windbreaks, while the beneficial insects dominated in the sunflower plane 1, with a percentage of 41%.

The ecological parameters calculated for harmful and beneficial species collected in the three investigated sites are presented in the Tables 4 and 5.

Dominance (D%) values for each species trapped in windbreaks and the two sunflower planes ranged from 0.03% to 43.96%, corresponding to the D1-D5 classes. Within pest fauna, two eudominant species were found in the sunflower culture, *Empoasca sp.* (18.31%) in plane 1 and *Macrosteles sp.* (43.69%) in plane 2 and two eudominant species, *Allygus modestus* (15.67%) and *Altica oleracea* (38.83%) inside the black locust windbreaks. The eudominant beneficial insect species were *Cantharis fusca* (43.96%) and *Episyrphus balteatus* (39.97%) in all the three evaluated planes in sunflower and black locust windbreaks, to which are added *Chrysoperla carnea* (16.61%) in sunflower plane 2 and *Episyrphus balteatus* (37.72%) inside the windbreaks.

Regarding the species constancy in samples (C%), in the case of the pests in the sunflower culture, two euconstant species were classified: *Macrosteles sp.* (80%) in plane 1 and (86.66%) in plane 2 and *Empoasca sp.* (100%) in both planes. Two constant species were found, namely *Reptalus quinquecostatus* (73.33%) in plane 1 and *Allygus modestus* (66.66%) in plane 1. In the windbreaks, *Empoasca sp.* (93.33%) was the only euconstant harmful species identified and two constant harmful species, *Allygus modestus* (73.33%), and *Altica oleracea* (73.33%). Thrips represented 66.66% in plane 1 and 100% in plane 2 and in the windbreaks.

The constant beneficial insects were *Cantharis fusca* (66.66%) in both planes of sunflower and (53.33%) in the windbreaks and *Episyrphus balteatus* (60%) in sunflower plane 2.

In terms of ecological significance regarding the insect pests (W%), values over 5% were obtained for *Macrosteles sp.* and *Empoasca sp.* in the sunflower culture and for *Allygus modestus*, *Empoasca sp.* and *Altica oleracea* in the black locust windbreaks. Also thrips reached values over 5%. All these species corresponded to the category of characteristic species (W3).

Among the beneficial species, values over 5% were for *Cantharis fusca*, *Episyrphus balteatus* and *Chrysoperla carnea* in the sunflower culture and *Cantharis fusca*, *Episyrphus balteatus* and *Syrphus ribesii* in the black locust windbreaks.

Table 3. Ecological parameters of pest insects

	Sunflower plane 1			Sunflower plane 2			Windbreaks		
Philaenus spumarius	D1	C1	W1	D1	C1	W1	D1	C1	W1
Stictocephala bisonia	0	0	0	D1	C1	W1	0	0	0
Hyalesthes obsoletus	D1	C2	W1	D1	C1	W1	0	0	0
Cixius wagneri	D1	C1	W1	D1	C1	W1	D1	C1	W1
Reptalus quinquecostatus	D3	C3	W2	D3	C3	W2	D1	C1	W1
Javesella pellucida	D1	C1	W1	0	0	0	0	0	0
Anaceratagallia sp.	D2	C2	W1	D3	C2	W1	0	0	0
Allygus modestus	D3	C3	W2	D2	C2	W1	D5	C3	W3
Macrosteles sp.	D5	C4	W3	D5	C4	W3	D1	C1	W1
Macropsis fuscula	0	0	0	D1	C1	W1	0	0	0
Empoasca sp.	D5	C4	W3	D5	C4	W3	D4	C4	W3
Athalia rosae	D1	C1	W1	0	0	0	D2	C2	W1
Altica oleracea	0	0	0	0	0	0	D5	C3	W3
Oulema melanopus	0	0	0	0	0	0	D1	C1	W1
Chrysolina sp.	0	0	0	0	0	0	D1	C1	W1
Cerambycidae	0	0	0	D1	C1	W1	0	0	0
Curculionidae	D1	C1	W1	D1	C1	W1	D1	C1	W1

Table 4. Ecological parameters of beneficial insects

	Sunflower plane 1			Sunflower plane 2			Windbreaks		
Orius sp.	D1	C1	W1	0	0	0	0	0	0
Anchomenus sp.	0	0	0	0	0	0	D1	C1	W1
Harpalus rufipes	0	0	0	0	0	0	D2	C1	W1
Coccinella septempunctata	D1	C1	W1	D1	C1	W1	D1	C1	W1
Psyllobora vigintiduopunctata	D1	C1	W1	D2	C1	W1	D2	C1	W1
Cantharis fusca	D5	C3	W3	D5	C3	W3	D5	C3	W3
Cantharis livida	0	0	0	0	0	0	D4	C2	W2
Cantharis rufa	0	0	0	0	0	0	D1	C1	W1
Mordella aculeata	0	0	0	0	0	0	D1	C1	W1
Oedemera podagrariae	0	0	0	0	0	0	D1	C1	W1
Episyrphus balteatus	D5	C2	W3	D5	C3	W3	D5	C2	W3
Syrphus ribesii	D4	C2	W2	D4	C2	W2	D5	C2	W3
Chrysoperla carnea	D4	C2	W2	D5	C2	W3	D4	C2	W2

CONCLUSIONS

The positioning of the black locust windbreaks on the edge of the sunflower culture has contributed to the increase of the local biodiversity. The windbreaks represent a reservoir of microhabitats and contain various species of insects.

The number of species and the abundance of entomofauna were higher inside the black locust windbreaks and in the sunflower plot near this than in the sunflower plot at a distance from the black locust windbreaks.

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