



ENTOMOLOGICAL MONITORING IN ECOLOGICAL CROP ROTATION

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Abstract. During the period 2011–2013 a monitoring of entomofauna was performed in environmentally justified crop rotation including alternation of legumes (field beans, forage peas) with cereals (wheat, malting barley). Conventional entomological methods were used for identification of species and population density of harmful insects and their entomophaga. The results were processed according to the crops. In no one of the four crops, pests in density over Economic Injury Level were detected. Diversity of entomophaga was explained via the favorable ecological environmental conditions and namely by the presence of the trophic factor and the absence of chemical treatments with insecticides.

Keyword: entomofauna, monitoring, ecological crop rotation.

Introduction

Cereals and legumes are significant structure-defining crops.

Because of their wide spread in agriculture, their pests and the chemicals for control were studies in details [DONCHEV, 1961; DERIMANOV, 1962; KRUSTEVA, 1995; YANKOVA *et al.*, 2004; NIKOLOVA and KERTIKOV, 2008; DIMITROV, 2008; BUTNARIU *et al.*, 2015 RASHED and BUTNARIU, 2014a].

But one-sided and long-term application of the conventional plant protection leads too many negative subsequences, as violation of the biological balance in agrocenosis is one of them. Integrated plant protection and organic farming are alternatives of the chemical method [KAROV, 1999; IANCULOV *et al.*, 2004; BARBAT, *et al.*, 2013; BUTNARIU, 2015a; CAUNII *et al.*, 2015a].

The organic farming becomes more popular because of the contemporary requirements for protecting of human and animal health and environment.

In the system of the organic farming it is relied on application of appropriate crop rotation, organic fertilizers, biological and agro technical pest control [STANCHEVA, 2003; STOICHEV, 2004; CIOPEC *et al.*, 2015; BUTNARIU and BUTU, 2015a; CAUNII *et al.*, 2015a; RASHED and BUTNARIU, 2014b].

The objective of the study was species and population density of harmful and useful entomofauna to be identified in ecologically justified crop rotation, including legumes in rotation with cereals under conditions of organic farming.

Material and methods

The study was conducted during the period 2011–2013 at the experimental field of Institute of agriculture and seed science "Obraztsov chiflik"–Rousse in four-pole crop rotation, including growing and rotation of the crops–field beans, wheat, forage peas and malting barley under conditions of organic farming.

The trial started after the Block method in four replications, harvesting plot being 52.5 m².

The growing of crops was according to the requirements of Ordinance N 22/04.07.2001 of MAF about organic plant production.

In order species composition of harmful and useful entomofauna to be determined during the vegetation of crops, a monitoring was performed every seven days in clear and calm weather from early May to harvesting.

A conventional cutting method was used with a standard entomological sack (0.3 x 0.7 x 1.0 m)–25 slopes = 5 m², as insects caught were killed and identified by type.

The perambulating method was used for complete monitoring of the study.

The results were processed according to the crop.

The classification of species was made after Boichev [BOICHEV, 1975; BUTNARIU, *et*



al., 2014; SAMFIRA et al., 2015; RASHED and BUTNARIU, 2014], according which: the dominant species showed over 15 % participation, subdominant—from 5 to 15 %, the secondary—from 1 to 5 %.

Results and discussion

As a result of the study it was found:

1. Wheat (table 1)

In 2012 green cicada /*Cicadella viridis* L./ dominated, aphid /*Sitobion avenae* L./ was the subdominant species.

Pentatomid eurygaster /*Eurygaster integriceps* Put./ and *Aelia acuminata* L. were secondary species. Of useful insects, 7–spotted ladybug /*Coccinella septempunctata* L./ and nabis /genus *Nabis*/ were most commonly found.

Table 1.

Spreading of insects by order and year in wheat

Order	Number		
	2011	2012	2013
<i>Coleoptera</i>	–	13	39
<i>Heteroptera</i>	–	39	37
<i>Homoptera</i>	–	169	35
<i>Diptera</i>	–	4	–
<i>Hymenoptera</i>	–	9	8
<i>Lepidoptera</i>	–	1	17
<i>Orthoptera</i>	–	1	4
<i>Thysanoptera</i>	–	–	58
Total number of insects	–	355	199

In 2013 thrips /*Haplothrips tritici* Kurdjumov/ dominated.

Pentatomid eurygaster /*Eurygaster integriceps* Put. and *Aelia acuminata* L./, green cicada /*Cicadella viridis* L./ and aphid /*Sitobion avenae* L./ were subdominant species.

Secondary species were large green grasshopper /*Tettigonia viridissima*

L./ and common wheat leech /*Lema melanopa* L./.

7–spotted ladybug /*Coccinella septempunctata* L./ and nabis /*Nabis* genus/ were the useful insects, most commonly found.

2. Field beans (table 2).

Table 2.

Spreading of insects by order and year in field beans

Order	Number		
	2011	2012	2013
<i>Coleoptera</i>	240	58	93
<i>Diptera</i>	30	–	11
<i>Heteroptera</i>	6	3	36
<i>Homoptera</i>	156	89	92
<i>Orthoptera</i>	26	2	1
<i>Hymenoptera</i>	–	1	15
<i>Lepidoptera</i>	–	1	2
<i>Thysanoptera</i>	–	5	–
<i>Neuroptera</i>	–	–	3
Total number of insects	458	159	253

In 2011 green cicada /*Cicadella viridis* L./ and garden fleahopper of g. *Phyllotreta* dominated. Subdominant species were sitona beetles of g. *Sitona* and large green grasshopper /*Tettigonia viridissima* L./.

The most commonly found useful species were: 7–spotted ladybug /*Coccinella septempunctata* L./, 14–spotted ladybug /*Propylea quatuordecimpunctata* L./ and *Cantharis*

sp. In 2012 green cicada /*Cicadella viridis* L./ dominated. Subdominant species was cereal aphid–*Aphis fabae* Scop, The most commonly found useful species were: 7–spotted ladybug /*Coccinella septempunctata* L./, and 14–spotted ladybug /*Propylea quatuordecimpunctata* L./, In 2013 green cicada /*Cicadella viridis* L./ was again dominant.



Subdominant species was tarnished plant bug of g. *Lygus*.

Secondary species were: flea beetle */Phyllotreta atra F./*, cabbage bug */Eurydema ornata L./*, bean weevil */Bruchus rufimanus Boheman/* and pea aphid */Acyrtosiphon pisum Harr./*

The most commonly found useful species were: 7-spotted ladybug */Coccinella septempunctata L./* and 14-vesicular ladybug */Coccinula quatuordecimpustulata L./*.

3. Malting barley (table 3).

Table 3.

Spreading of insects by order and year in malting barley

Order	Number		
	2011	2012	2013
<i>Coleoptera</i>	–	42	34
<i>Heteroptera</i>	–	30	39
<i>Homoptera</i>	–	102	48
<i>Diptera</i>	–	3	1
<i>Hymenoptera</i>	–	60	5
<i>Orthoptera</i>	–	–	3
<i>Lepidoptera</i>	–	–	1
<i>Thysanoptera</i>	–	–	27
<i>Neuroptera</i>	–	–	1
Total number of insects	–	249	159

In 2012 green cicada */Cicadella viridis L./* and aphid */Sitobion avenae L./* were dominant. Subdominant species—pentatomid eurygaster */Eurygaster integriceps Put./*. Secondary species were: caspid grain bug */Aelia acuminata L./* and wide-striped garden fleahopper */Phyllotreta armoracia Koch./* The most commonly found useful species were: 7-spotted ladybug */Coccinella septempunctata L./* and nabis /g. *Nabis/*.

In 2013 green cicada */Cicadella viridis L./* and wheat thrips */Haplothrips tritici Kurdjumov/* dominated. Subdominant species—caspid grain bug */Eurygaster integriceps Put./* and tarnished plant bug of g. *Lygus*. Nabis /g. *Nabis/* was the most common of useful species.

4. Forage peas (table 4).

Table 4.

Spreading of insects by order and year in forage peas

Order	Number		
	2011	2012	2013
<i>Coleoptera</i>	30	20	131
<i>Diptera</i>	22	–	–
<i>Hymenoptera</i>	12	–	10
<i>Homoptera</i>	72	52	40
<i>Lepidoptera</i>	2	–	–
<i>Heteroptera</i>	–	5	36
Total number of insects	138	77	217

In 2011 pea weevil */Bruchus pisi L./* and beet aphid */Aphis fabae Scop./* dominated. Subdominant species was green cicada */Cicadella viridis L./*. In 2012 pea aphid */Acyrtosiphon pisi Kalt/* dominated. Subdominant specie—lucerne weevil */Tychius quinquepunctatus L./*. In 2013 pea aphid */Acyrtosiphon pisi, Kalt./* dominated. Subdominant species—tarnished plant bug of g. *Lygus*, pea weevil */Bruchus pisi L./* and flea beetle */Phyllotreta atra F./*. Secondary species—

lucerne weevil */Tychius quinquepunctatus L./*, sitona beetle of g. *Sitona* and bean weevil */Bruchus rufimanus, Boheman/*. The most common of useful species were: 7-spotted ladybug */Coccinella septempunctata L./* and predatory bugs of g. *Nabis*. As a result of that study, insects belonging to Coleoptera, Diptera, Heteroptera, Homoptera, Hymenoptera, Lepidoptera, Neuroptera, Thysanoptera and Orthoptera orders were identified.



The number of the representatives of Lepidoptera and Neuroptera was insignificant. Share of orders, to which insect species belonged, caught during the three years of study, in the four crops, varied. In cereals in the second year of the study, a greater number of insects was identified, compared to the third year.

In legumes, the lowest number of insects were identified in the second year of study. In field beans the most insects were identified in the first year, and in forage peas—in the third year of study [BUTNARIU, 2015b; BUTNARIU 2015c; PENTEA, et al., 2015].

In cereals, the most frequently identified harmful species were: cicadas, thrips, aphids, and pentatomid eurygasters; in legumes—cicadas, aphids, sitona beetles and pea weevils [BUTNARIU and BUTU, 2015b; BUTNARIU, 2015d; BUTNARIU and SAMFIRA 2014].

In none of the four crops during all the three years of study, pests in density above the Economic Injury Level were identified. The great number of entomophaga—ladybugs, nabises, cantarises, etc. was explained by the favorable environmental conditions, and more precisely, by the presence of trophic factor, and the absence of chemical treatments with insecticides.

Conclusions

As a result of the study, conducted during the period 2011–2013 in an ecologically justified crop rotation involving alternation of legumes /field beans, forage peas/ with cereals /wheat, malting barley/ under conditions of biological system of agriculture, the following has been concluded:

1. Differences in species of the entomofauna in the three years of study
2. Quantitative differences in insects during the three years of study
3. In all crops included in crop rotation, the registered pests were in density below the economic injury level (EIL)

Species and population density of the useful insects were adequate and appropriate system of control of harmful insects below the Economic Injury Level.

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