THE ROLE OF COCCINELLIDS IN CONTROLLING PESTS IN WESTERN ROMANIA WINTER WHEAT CROPS

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Abstract . *The insect predator complex in winter wheat crops was studied in order to understand the ecological role played by polyphagous predator in intensive farming system. Is well known that coccinellid beetles (Coleoptera: Coccinellidae) are voracious predators of many insect pest, amoung which can mention winter wheat pests (aphids, thrips). Amoung 5000 species described worldwide, only 23 species are reported in Romania (ANDRIEV & CHIMIȘLIU, 2003). Taking into account the lack of information on this family of extremely important predators, an extensive faunal survey was conducted in winter wheat crop in Timiș County, Romania. The aimed of this paper is to assess the species richness and distribution of coccinellid in 5 winter wheat varieties. Coccinellids were collected from mid April to late July, 2016 – 2017. The monitoring of coccinellids adults and larvae was made using colored sticky traps and direct field counts. Coccinellidae familiy form the most abundent family of predators – compresing 38, 04%. During the investigation 11 species of predatory coccinellids were collected from winter wheat crops from western part of Romania, namely: Chilocorus bipustulatus, Adalia bipunctata, Adalia decimpunctata, Calvia quatordecimguttata, Coccinella septempunctata, Harmonia axyridis, Adonia variegata, Hippodamia tredecimpunctata, Propylaea quatordecimpunctata, Psyllobora vigintiduopunctata and Scymnus frontalis. Adults and larvae of Coccinella septempunctata were the most abundent species found in the study.*

Keywords*: coccinelids, pests, winter wheat, Western Romania, crops*

INTRODUCTION

The insects fauna of winter wheat crops has been studied very intensively. Several recent scientific papers regarding coccinellids, consider them to be important natural enemies of insect pests, especially for cereal aphids (HAGEN & VAN DEN BOSCH, 1968; RICE & WILDE, 1988; HODEK & HODEK, 1996). Lady beetles (Coccinelidae: Coleoptera) are important components of biological control in winter wheat crop (OBRYCKI & KRING, 1998; WRIGHT & DEVRIES, 2000)

European literature points out the presence of coccinellides in winter wheat crops, as follow: in Czech Republic - three major species of coccinelide were dominant: *Coccinella septempunctata, Propylaea quatordecimpunctata* and *Coccinella quinquepuncta* (HONEK, 1979, 1982, 1983); in Germany – two species *Coccinella quinquepuncta* and *Propylaea quatordecimpunctata*, were the main species of winter wheat (BODE, 1980; STORCK – WEYHERMŰLLER, 1988); the two mentioned species were also dominant in England, together with *Adalia bipunctata* (CHAMBERS ET AL., 1983); in Ukraine – the most important species was *Adonia variegata*, followed by *Coccinella septempunctata* and *Scymnus frontalis* (DYADECHKO, 1954); in Russian Federation, eight species of coccinellids were found in winter wheat, four of them beeing dominant: *Coccinella septempunctata, Coccinula quatordecimpustulata, Hippodamia tredecimpunctata* and *Propylaea quatordecimpunctata* (KULIKOVA, 1984). In north american literature: in winter wheat filds from South Dakota - six species of coccinellids are mention, from wich four were dominant: *Hippodamia convergens, Hippodamia tredecimpunctata, Hippodamia paranthesis* and *Coleomegilla maculata* (ELLIOT & KIECKHEFER, 1990, 1991); in Minesota – three species are mentioned: *Coleomegilla*

maculata, *Hippodamia convergens* and *Hippodamia tredecimpunctata* (EWART & CHIANG, 1966); in Oklahoma – nine species were collected, only three of them being dominant: *Harmonia axyridis*, *Hippodamia convergens* and *Scymnus spp.* (GILES ET AL., 1994, 2003); Texas – seven species, two are dominant: *Hippodamia convergens* and *Hippodamia sinuata* (MICHELS & MATIS, 2008); Nebraska – six species were colected, the most common species were: *Hippodamia convergens*, follow by *Coleomegilla maculata* (WRIGHT & DEVRIES, 2000)

MATERIAL AND METHODS

Study site

The experiment was conducted during 2016 and 2017 in Jimbolia (45°47′30″N 20°43′20″E), which is an intensive agricultural production area in the western region of Romania.

The climate in this area is temperate, with an average annual temperature of 10,7°C (min -1,5°C and max. 21,4°C); the mean annual rainfall was 570 mm and was uniformly distributed across both years. The soil on which the research was carried out was a soil of good quality, a typical cadmic chernozem soil, mollic horizons are rich in organic matter, highly saturated with bases, react neutrally in terms of soil pH and high humus reserve.

5 varieties of winter wheat were selected for their agronomic proprieties of higher quality: Exotic, Cubus, Sobbel, Renan, and Apache. The Apache variety was the testifier, the monoculture cropping system being used for it. Each variant had three replication per site, with plots arranged in a completely randomized design, haveing a distance between replication of 2 m, and between the variants of 0,25 m.

Sampling methods

Sampling of coccinellids started when the flag leaf just visible (GS 37 – mid - April) and ended at harvesting (late July).

The method of colored sticky traps and direct field counts were used to monitored the coccinellids present in winter wheat crop. Three traps per plot were used. The cards were placed on wooden stakes, the trap height being continuously adjusted so that it was always 10 cm above the wheat plants. The traps were changed in every month, with a collecting periodicity at each 7 days.

The sample unit for direct field counts, for each plot, consist of 50 plants, chosen randomly, avoidind edges. The observation were carried out when wheat is in flowering stage (GS 65) and milky stage (GS 73). For each plant we covered the ears with plastic bags, shook of and after, the biological material was transported by specific methods in the Entomology laboratory at the Faculty of Agriculture Timisoara, for identification and counting.

RESULTS AND DISCUSSIONS

A rich fauna o coccinellids species is found within winter wheat fields in western part of Romania. However, recent populations of three coccinellids species are declining due to the presence of a new invasive species, *Harmonia axyridis*. These three native coccinellids: *Chilocorus bipustulatus*, *Hippodamia tredecimpunctata*, *Scymnus frontalis* and a fourth species, *Adalia decimpunctata* were collected from winter wheat filds in low number in past three years (VÎRTEIU ET AL., 2015), providing futher evidence that these previously common coccinellids are in decline in western part of Romania.

The predator families collected from winter wheat filds during 2016 – 2017 period, are presented in table 1. After analyzing the data collected from fields, we may conclude that *Coccinellidae* form the most abundent family of predators – compresing 38,04 precentage, followed by *Nabidae* – 19,67% and *Anthocoridae* - 12,99%. Families poorly represented in

winter wheat crops from western part of Romania, were *Chrysopidae* – compresing 4,4%, followed by *Staphylinidae* – 4,24% and *Carabidae* – 3,95%. We believe that the reduced number of specimens of those families is due to the used method for sampling. Sampling by colored sticky traps helps us to collect only the terrestrial species, and not those on the soil.

Table 1.

The families of predator sampled from winter wheat crop, in 2016 – 2017 period

Predator families	Sampling periods					Total number of specimens	%
	1	2	3	4	5		
Formicidae	23	37	19	32	0	111	10,45
Anthocoridae	24	36	13	31	34	138	12,99
Nabidae	23	41	36	49	60	209	19,67
Carabidae	2	16	4	8	12	42	3,95
Staphylinidae	7	6	3	14	15	45	4,24
Coccinellidae	95	40	75	83	111	404	38,04
Chrysopidae	10	3	4	18	12	47	4,4
Syrphidae	8	14	21	13	10	66	6,21
					Total	**1062**	

During the investigation 11 species of predatory coccinellids were collected from winter wheat crops from western part of Romania, namely: *Chilocorus bipustulatus, Adalia bipunctata, Adalia decimpunctata, Calvia quatordecimguttata, Coccinella septempunctata, Harmonia axyridis, Adonia variegata, Hippodamia tredecimpunctata, Propylaea quatordecimpunctata, Psyllobora vigintiduopunctata*, *Scymnus frontalis*, belonging to 4 tribes and 3 subfamilies.

Table 2.

The distribution of coccinellid species to different winter wheat varieties

No. indiv./species	**Variety**										**Total**	
	Exotic		Cubus		Sobbel		Renan		Apache			
	A	L	A	L	A	L	A	L	A	L	A	L
Chilocorus bipustulatus	-	-	-	-	-	-	1	-	2	-	3	-
Adalia bipunctata	7	1	4	-	6	-	11	4	7	2	35	7
Adalia decimpunctata	-	-	4	-	2	1	5	1	2	-	13	2
Calvia quatordecimguttata	-	2	6	1	5	1	5	-	5	2	21	6
Coccinella septempunctata	10	4	9	3	12	5	21	11	15	10	67	33
Harmonia axyridis	1	2	-	-	8	2	15	6	17	3	41	13
Adonia variegata	11	2	6	3	8	6	13	1	15	3	53	15
Hippodamia tredecimpunctata	1	-	-	-	-	-	-	-	-	-	1	-
Propylaea quatordecimpunctata	11	3	7	4	9	2	13	7	19	7	59	23
Psyllobora vigintiduopunctata	1	-	-	-	-	-	1	-	7	-	9	-
Scymnus frontalis	-	-	-	-	-	-	3	-	-	-	3	-
										Total	305	99
											404	

*A – adult; L - larvae

A total of 305 adult coccinellids and 99 larvae were collected from the research fields (table 2). More adults then larvae were collected in the sampling period. Five native species: *Coccinella septempunctata*, *Propylaea quatordecimpunctata*, *Adonia variegata*, *Adalia bipunctata*, *Calvia quatordecimguttata* and one invasive species *Harmonia axyridis* together comprising over 69 percent of all coccinellids collected.

Analyzed samples, revealed that adults and larvae of *Coccinella septempunctata* were the most abundent species found in the study, compresing 24,75%, being folowed by *Propylaea quatordecimpunctata* (adults and larvae) – representing 20,30% and *Adonia variegata* (adults and larvae) – representing 16,83% from the total number of collected coccinellids.

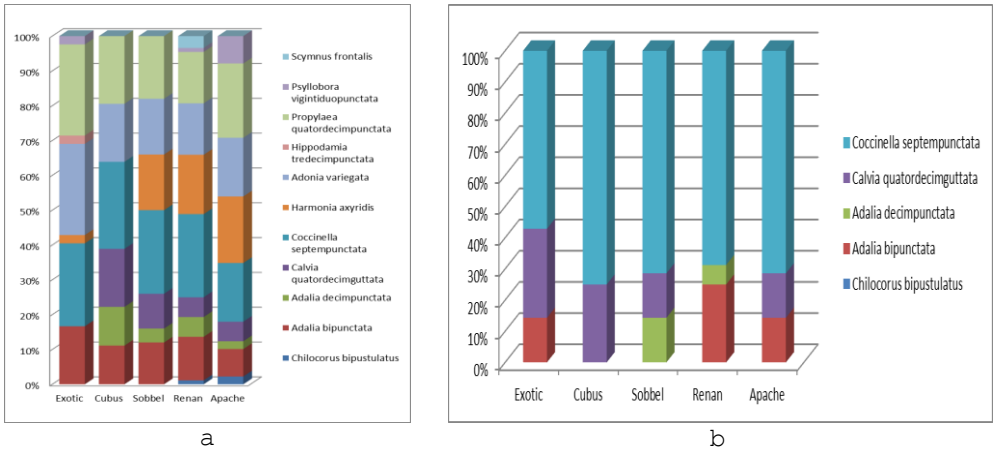
An additional four native coccinellids - *Chilocorus bipustulatus*, *Hippodamia tredecimpunctata*, *Psyllobora vigintiduopunctata* and *Scymnus frontalis* – were collected occasionally from winter wheat crops, but only as adults.

Comparing the data with those existing in literature (ELLIOTT & KIECKHEFER, 1990; ELLIOTT ET AL., 1991; ELLIOTT & MICHELS JR, 1997), we can say that we are expecting such a large number of coccinellids adult species collected. This is primarily due to the method used for collecting, namely the method of colored sticky traps, this being more efficient in sampling adults than larvae.

The sampling of a very low number of adults specimens (7) in native species: *Chilocorus bipustulatus*, *Hippodamia tredecimpunctata* and *Scymnus frontalis*, which in the past were frequent in cereal crops, is due to the establishment, in the area in late 2014, of the invasive species *Harmonia axyridis.* It is possible that larvae of *Chilocorus bipustulatus, Hippodamia tredecimpunctata* and *Scymnus frontalis* were collected, but we were unable to identify them, because identification keys for coccinellids larvae have not yet been published.

In general, our results are corroborated with those noted by HARMON ET AL. (2007) and highlight the decline of native coccinellids species in favor of invasive one.

Regarding to the distribution of coccinellid species to different winter wheat varieties, we can affirm that larvae and adults of *Coccinella septempunctata* and *Propylaea quatordecimpunctata*, the most abundent species, were frequently found on Renan and Apache varieties, indicating that these varieties are important for these coccinellids species (figure 1 a, b).



a b

Figure 1. The percentage distribution of coccinellid species to different winter wheat varieties, in 2016 – 2017 period: a – adults distribution; b – larvae distribution

Also, *Chilocorus bipustulatus, Adalia bipunctata, Harmonia axyridis* and *Adonia variegata* were common species found on Renan and Apache varieties, while *Adalia decimpunctata* prefer Renan and Cubus varieties, *Calvia quatordecimguttata* prefer Cubus and Apache varieties and *Psyllobora vigintiduopunctata* prefer just Apache varieties.

This results suggests that those species can be used as predator species to control aphids. The collecting data are similar whit those found in scientific literature, described by ELLIOTT ET AL., 1991; EVANS & YOUSSEF, 1992; HONĚK, 1982, 1983, 1985.

CONCLUSIONS

1. A total of 11 species of predatory coccinellids were identified in winter wheat crops from western part of Romania, belonging to 4 tribes and 3 subfamilies.
2. A total of 305 adult coccinellids and 99 larvae were collected from the research fields.
3. Adults and larvae of *Coccinella septempunctata* were the most abundent species found in the study.
4. The populations of three coccinellids species: *Chilocorus bipustulatus, Hippodamia tredecimpunctata, Scymnus frontalis* are declining due to the recent establishment in western part of Romania, of a new invasive species, *Harmonia axyridis.*
5. As a final conclusion, we can point out that these researches represent the first step for future research to determine the predatory potential of these coccinellids against different insects' pest and to the development of a complex biological control strategy.

BIBLIOGRAPHY

ANDRIEV SORINA OCTAVIA, CHIMIȘLIU CORNELIA, 2003 – Catalogul Familiei Coccinellidae (Insecta: Coleoptera) din colectiile Muzeului Olteniei din Craiova (I). Oltenia. Studii și comunicări. Științele Naturii. 19: 129–133

BODE E., 1980 - Aphids in winter wheat: abundance and limiting factors from 1976 to 1979. Bulletin SROP. 3(4):49–57

CHAMBERS, R. J.; SUDERLAND, K. D.; WYATT, I. J. AND VICKERMAN, G. P., 1983 - Effects of predator exclusion and caging on cereal Aphid in winter wheat. J. Appl. Ecol., 2 0 (1):209-224(Cited in Rev. of Appl. Ento., 71(6):505 1983)

DYADECHKO, N.P., 1954 - Coccinellidae of the Ukrainian SSR. Kiev, Academy of Sciences of USSR

ELLIOTT N.C., KIECKHEFER R.W., 1990 - Dynamics of aphidophagous coccinellid assemblages in small grain fields in eastern South Dakota. Environ. Entomol. 19: 1320-1329.

ELLIOTT N.C., KIECKHEFER R.W., KAUFFMAN W.C., 1991 - Estimating adult coccinellid populations in wheat fields by removal, sweepnet, and visual count sampling. Canadian Entomologist 123:13–22.

ELLIOTT N. C. AND MICHELS JR. G. J., 1997 - Estimating aphidophagous coccinellid populations in alfalfa. Biol. Control 8: 43-51

EVANS E.W. AND YOUSSEF N.N., 1992 - Numerical responses of aphid predators to varying prey density among Utah alfalfa fields. J. Kans. Entomol. Soc. 65: 30-38.

EWERT M.A., CHIANG H.C., 1966 – Dispersal of three species of coccinellids in corn fields. Can. Entomol. 98: 999 – 1001

GILES K.L., OBRYCKI J.J., DEGOOYER T.A., 1994 – Prevalence of predatots associated with *Acyrthosiphon pisum* (Homoptera: Aphididae) and *Hypera postica* (Coleoptera: Curculionidae) during growth of the first crop of alfalfa. Biol. Control, 4:170 – 177

GILES K., JONES D.B., ROYER T.A., ELLIOTT N.C., KINDLER S.D., 2003 - Development of a sampling plan in winter wheat that estimates ceral aphid parasitism levels and predicts population suppression. Journal of Economic Entomology 96:975–982

HARMON J.P., STEPHENS E., LOSEY J., 2007 - The decline of native coccinellids (Coleoptera: Coccinellidae) in the United States and Canada, Journal of Insect Conservation 11: 85-94

HAGEN K.S., VAN DEN BOSCH R., 1968 - Impact of pathogens, parasites, and predators on aphids. Annu. Rev. Entomol. 13: 325 – 84

HODEK, I. & HONEK, A., 1996 - Ecology of Coccinellidae. Kluwer Academic Publishers Dordrecht, pp. 464.

HONEK A.,1979 - Plant density and occurrence of *Coccinella septempunctata* and *Propylea quatuordecimpunctata* (Coleoptera: Coccinellidae) in cereals. Acta Entomol. Bohemoslov. 76, 308–312.

HONEK A.,1982 - Factors which determine the composition of field communities of adult aphidophagous Coccinellidae (Coleoptera). Z. Angew. Entomol. 94, 157–168

HONEK A., 1983 - Factors affecting the distribution of larvae of aphid predators (Col., Coccinellidae and Dipt., Syrphidae) in cereal stands. Z. Angew. Entomol. 95, 336–343.

HONEK A., 1985 - Habitat preferences of aphidophagous coccinellids. Entomophaga 30: 253-264.

KULIKOVA L.S., 1984 - Changes of insect fauna on cereals on newly established arable soils in Prirnorsk:ii krai. In: Fauna i Ekologia Dalnego Vostoka (Vrediteli i Entomofagi). Dalnevostochnii Nauchnii Center Akademii Nauk SSSR. Vladivostok. Pp. 37-42.

MICHELS G.J., MATIS J.H., 2008 - Corn leaf aphid, *Rhopalosiphum maidis* (Hemiptera: Aphididae), is a key to greenbug, *Schizaphis graminum* (Hemiptera: Aphididae), biological control in grain sorghum, *Sorghum bicolor*, Eur. J. Entomol., 105: 513 - 520

OBRYCKI J.J. AND KRING T.J., 1998 – Predaceous Coccinellidae in biological control. Annual Review of Entomology, 43: 295 – 321

RICE M.E., WILDE G.E., 1988 - Experimental evaluation of predators and parasitoids in suppressing greenbugs (Homoptera: Aphididae) in sorghum and wheat. Environ. Entomol. 17: 836 – 841

STORCK-WEYHERMÜLLER S., 1988 - Einfluss natürlicher Feinde auf die Populationsdynamik der Getreideblattläuse im Winterweizen Mittelhessens (Homoptera: Aphididae). Entomol Gen 13: 189–206

VIRTEIU ANA – MARIA, GROZEA IOANA, STEF RAMONA, VLAD MIHAI AND DOBRIN IONELA, 2015 - Faunistic Study Of Ladybirds (Coleoptera: Coccinellidae) In The Banat Region, Romania, Bulletin of University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca. Agriculture, 72(2): 576 – 581

WRIGHT R.J., DEVRIES T.A., 2000 – Species composition and relative abundance of Coccinellidae (Coleoptera) in South Central Nebraska field crops. Journal of the Kansas Entomological Society, 73(2): 103 – 111