Wheat pest entomofauna in climatic changes conditions of central Transylvania

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Abstract

Elaborated in 1989-2006 at Agricultural Research Station Turda (Romanian Academy of Agriculture and Forestry Sciences), in central Transylvania, the paper presents agroecological study on the population dynamics and attack evolution of wheat pests entomofauna: Diptera, Homoptera, Thysanoptera, Coleoptera, Heteroptera etc., in the climatic changes conditions of cereal agroecosystems and biotechnological experiments on the adequate integrated pest control methods, enclosing insecticides efficiency, cultural measures and entomophagous predators.

The results on the integrated pests control strategy were obtained with the use of optimal zone crop technology. The high efficiency on the control of main dangerous pests and the achieved increasing yields are experimental results which recommend the integrated pest management and modern insecticides pest control. Used on field treatments, at optimal application moment, such insecticides like: tiachloprid, thiametoxam, fipronil, bensultap, acetamiprid, dimethoate, chlorpirifos-metil, deltametrin, lambdacihalotrin, novaluron, lufenuron, fenitrotion with fenvalerat, oxidemeton metil with beta-ciflutrin, chlorpirifos with cypermetrin, dimethoate with cypermetrin etc., had a very good efficiency in pests control, especially in cereal flies, leafhopper, aphids, trips, cereal leaf beetle control, realizing the increasing of grain yields average with 7-24 % and had protected useful arthropod fauna.

Intersting research regarding the importance of useful arthropod populations was carried out, too. The well-known systematic groups of enthomophagous predators: Aranea; Dermaptera; Thysanoptera (Aeolothripidae); Heteroptera (Nabidae etc.); Coleoptera (Carabidae, Cicindelidae, Staphylinidae, Sylphidae, Coccinellidae, Cantharidae, Malachiidae); Diptera (Syrphidae, Scatophagidae, Empididae etc.); Hymenoptera (Formicidae etc.); Neuroptera (Chrysopidae) were represented in the structure of arthropod fauna.

Key words: wheat flies, cereal leaf beetle, aphids, leafhoppers, trips, insecticides, entomophagous predators

Introduction

The research regarding the populations dynamics, attack evolution and the control of wheat pests was carried out at Agricultural Research and Development Station Turda, in Central Transylvania, in the special conditions of 1989-2006 period. The paper presents the main wheat pests - Diptera, Homoptera, Thysanoptera, Coleoptera-Chrysomelidae, insecticides efficiency, cultural measures and entomophagous predators involved in the actual adequate strategy of integrated pests control, as part of agroecological technological system for sustainable development of wheat crop in Transylvania (MALSCHI & MUSTEA 1992, MALSCHI 1999, 2004, 2006, 2007).

Under the conditions of actual agro-ecological changes, yielded by climatic warming and dryness and new technological and economic conditions of zone agricultural exploitations, the original research was pointed aut the increasing attack of main wheat pests: wheat flies, leafhoppers, aphids, trips, bugs, cereal leaf beetle etc. and the oportunity of insecticide control.

Material and methods

The data related to the composition of species, biology, evolution of the attack level and experimental control of wheat pests were obtained by researches performed in cereal agroecosystems and were statistically processed using correlation, variance analysis methods. The samplings were achieved by capturing insects pests and useful entomophagous predators, by means of pitfall soil traps, white adhesive sticky traps and 100 double sweep net catches. According to the natural agroentomocoenotic model, studies on prey compositions and feeding rate of predators were made in laboratory trials with pests.

Results and discusions

The paper presents data on the pests and useful arthropod fauna, biological and agroecological aspects, experimental field trials for pest control and preventive measures, in order to achieve the integrated control system of the main species damaging wheat crops (BANIȚĂ 1999, BAICU 1996, BĂRBULESCU 1997, MALSCHI & MUSTEA 1992, WETZEL 1995).

In the last years, the increase of pest density in some crops and some unexpected attacks (table 1) have been produced by specific zonal factors such as the continuous annual increase of biological reserve of pests, the increase of arid microclimate and the attack aggressions of pest, the decrease of the grain crops area, the exploitation farming system with incomplete or incorrect crop technologies of wheat crops in Central Transylvania (Malschi & Mustea, 1992, 1995, 1997, 1998, 1999).

The natural predators play an important role in decreasing the wheat pest abundance (Basedow 1990, Baniţa & all.1999, Malschi, Mustea, 1995, 1996, 1997, 1998, 1999. Malschi, 2003, Rupert, Molthan 1991, Wetzel, 1995, Welling 1990). The well-known systematic groups of enthomophagous predators: Aranea; Dermaptera; Thysanoptera (Aeolothripidae); Heteroptera (Nabidae etc.); Coleoptera (Carabidae, Cicindelidae, Staphylinidae, Sylphidae, Coccinellidae, Cantharidae, Malachiidae); Diptera (Syrphidae, Scatophagidae, Empididae etc.); Hymenoptera (Formicidae etc.); Neuroptera (Chrysopidae) were represented in the structure of arthropod fauna (table 2).

The spring months of the last years 2000–2006 (table 3), was characterized by an increased warming, heating and dryness periods, causing the increasing of pests abundance and damages on wheat crops, in Transylvania (Malschi 2000, 2001, 2004, 2005, 2006, 2007).

It was remarked (tables 4 and 5) a reduction of species diversity and an increasing

abundance of the species with a single generation by year: *Delia coarctata* Fallén 1794*, Opomyza florum* Fabricius, 1794*, Phorbia penicillifera* Jermy, 1952*, Oulema melanopus* Linnaeus, 1758*, Chaetocnema aridula* Gyllenhal, 1827*, Eurygaster maura* Linnaeus, 1758*, Aelia acuminate* Linnaeus 1758*, Haplothrips tritici* Kurdjumov, 1912*, Zabrus tenebrioides* Goeze, 1777, and of the other species of chloropids (*Oscinella frit* Linnaeus, 1758, *Oscinella pusilla* Meigen, 1830, *Elachiptera cornuta* Fallen, 1820, *Meromyza nigriventris* Macquart, 1835, *Chlorops pumilionis* Bjerkander, 1778, *Lasiosina cinctipes* Meigen, 1830), anthomyiids (*Phorbia securis* Tiensuu, 1936*, Delia platura* Meigen, *1826, Delia liturata* Meigen, *1838*), cecidomyiids (*Mayetiola destructor* Say, 1817), leafhoppers (*Psammotettix alienus* Dahlbom, 1850, *Macrosteles laevis* Ribaut, 1927, *Macrosteles sexnotatus* Fallen, 1806, *Javesella pellucida* Fabricius, 1794), aphids (*Schizaphis graminum* Rondani, 1847, *Macrosiphum (Sitobion) avenae* Fabricius, 1775, *Rhopalosiphum padi* Linnaeus, 1758, *Metopolophium dirhodum* Walker, 1849) etc., well favored by consecutive wheat crops and zone cereal ecosystems presence (tables 6 and 7) .

The attack critical moments of the different species were registered with 3–4 weeks earlier and superposed. The insecticide treatments were imposed at the end of tillering phase in April and at the spike appearance phase, in middle of May.

The paper point out the extension risk of wheat pests attack with an increasing potential, affecting the wheat crops yields and causing possible crops damages or carried at compromise of the specially sowing fields of consecutive wheat crop and of early sowing, in September and the importance of the elaboration of agro-ecological integrated control strategy (ICS). The attack reduction methods of the ICS are: **a-agro-technical methods:**_avoid early planting in the autumn to minimize the incidence of insect vectors and diptera species, destroy volunteer wheat, adequate fertility, use good seed quality, the weeds, main pests and diseases control, conservation and use of biological factors: tolerant varieties, entomophagous limiters; **b-application of selective insecticides,** with economic and ecological efficiency, at two different selective moments. Usual insecticides treatments (pirethroids, neonicotinoids, fipronil, acetamiprid, organo-phosphorics etc.) were tested and efficient used in the two different selective moments of application: 1 - on the control of wheat flies larvae *(Delia coarctata, Opomyza florum, Phorbia securis, Ph. penicillifera, Oscinella frit etc.)*, in April, at the end of tillering phase (13-33 DC stage), controlling other pests of wheat, too; 2 - on the wheat thrips (*Haplothrips tritici*) adults control at spike appearance phase in 45-59 DC stage, in the period of May 15th-25th, the treatments being efficient in controlling all dangerous pests of wheat.

Integrated pests control strategy is an important section of agrotechnological system for wheat crops sustainable development. High insecticides efficiency and the achieved increasing yields with 7-24 % were experimental results recommending an adequate technological system and modern insecticides pest control strategy.

Laboratory tests and investigation regarding the role of the main species of predatory entomophagues as regulators of pest populations in cereal agro-ecosystems, demonstrated that various species feed preferentially on wheat flies, cereal aphids, trips, bugs, *Oulema* etc**.** (table 8). The results of laboratory feeding trials with cereal pests regarding feeding habits of predators, prey composition and feeding rate per day and individual pre-

Table 1

Evolution of the attack potential of wheat pests, in 1989-2005, at ARDSTurda

Pests	1989-1999 period	2000-2002 period	2003-2005 vegetation year	Economic density threshold/ vegetative stage
Cereal flies-diptera : Delia coarctata, Opomyza florum, Phorbia penicillifera, Phorbia securis, Oscinella frit, Meromyza nigriventris	22 April	10 March-20 April	15-30 April	Tillering
	16 % plants 6 % tillers	26 % plants 11 % tillers	30 % plants 11 % tillers	5-10% plants
	10-28 May	4-10 May	12-22 May	End of tillering
	17 % plants 12% tillers 65 tillers/m^2	28 % plants 23 % tillers 186 tillers/m^2	66-87 % plants 62-72 % tillers 321 tillers/m^2	10-15 % plants
Cereal leaf beetle: Oulema melanopus	8-15 June	28 May-17 May	6-24 May	Flag leaf-heading
	265 larvae /m^2	317 larvae/m^2	13 adults/m^2 350 larvae/m^2	10 adults/m^2 250 larvae/m^2
Wheat thrips - adults : Haplothrips tritici	25 May	15-17 May	12-22 May	Heading
	6 adults/ear	12 adults/ear	12 adults/ear 20 adults/m^2	8 adults/ear 5 adults/m^2
Wheat thrips - larvae Haplothrips tritici	10-25 June	10-25 June	12 June	Milky- ripening
	13 larvae/ear	22 larvae/ear	11 larvae/ear	10-40 larvae /ear
Cereal bugs Eurygaster maura, Aelia acuminata	10-25 June	15-25 May	22 May-10 June	Heading-ripening
	1-2 adults/m^2 2-3 larvae/m^2	1-3,3 adults/m^2 3 ears/m^2	3-6 adults /m^2 4,4 % ears	3-4 adults/m^2 3-5 larvae/m^2
Aphides: Sitobion avenae, Schizaphis graminum, Rhopalosiphum padi, Metopolophium dirhodum	25 June	10-24 June	10 June	Milky- ripening
	12 aphides/ear	32 aphides/ear	1,3 aphides/ear	25 aphides/ear
			14.11. 2002	2-3 leaves
			4-6 aphides/pl. 80% plants	5 afide/plant
Cicadae: Psammotettix aliaenus Javesella pellucida Macrosteles laevis ş.a.	5-14 July	20 June -5 July	10 May-10 June	Emergence
	9,9 /m^2/10/ sweep net catches	2,5-5 cicadae /m^2/ 10 sweep net catches	7-10 cicadae/m^2	5 cicadae/m^2/10 sweep net catches
			14 Nov. 2002 6 cicadae/m^2	

Table 2

Structure of enthomophagous predators in cereals agro-ecosistems, at ARDS Turda

1. Ord. Dermaptera	Fam. Forficulidae: Forficula auricularia L.
2. Ord. Heteroptera	Fam. Nabidae: Nabis ferus L. Fam. Anthocoridae: Anthocoris nemorum L. Fam Miridae: Daraeocoris ruber L.
3. Ord. Thysanoptera	Fam. Aeolothripidae: Aeolothrips intermedius Bagn.
4. Ord Coleoptera	Fam. Carabidae: Poecilus cupreus L., Amara aenea De Geer., Pterostichus melanarius Ill., P. macer Marsh., Harpalus distinguendus Duft., H. rufipes De Geer., H. aeneus L., H.affinis Sch., Brachinus explodens Duft., Loricera pilicornis F., Platynus dorsalis Pont., Dolichus halensis Schall., Agonum muelleri Hbst., Carabus coriaceus L., Carabus nemoralis Mull. Fam. Cicindelidae: Cicindela campestris L. Fam. Staphylinidae: Tachyporus hypnorum L., Staphylinus sp. Fam. Sylphidae: Sylpha obscura L., Necrophorus vespillo L. Fam. Cantharidae: Cantharis fusca L. Fam. Malachiidae: Malachius bipustulatus L. Fam. Coccinellidae:Coccinella septempunctata L.,Propylaea quatuordecimpunctata L., Adalia bipunctata L., Anattis occellata L., Hippodamia tridecimpunctata L., Adonia variegata Goeze., Chilocorus bipustulatus L.
5. Ord. Hymenoptera	Fam. Formicidae etc.
6. Ord. Planipennia	Fam. Chrysopidae: Chrysopa carnea Stephn.

7. Ord. Diptera	Fam. Empididae: Platypalpus sp. Fam. Dolichopodidae: Medetera sp. Fam. Scatophagidae: Scatophaga stercoraria L. Fam. Tachinidae: Lydella sp. Fam. Syrphidae: Episyrphus balteatus Dg., Metasyrphus corollae Fabr.

Table 3

Average temperatures and sum of rainfall zone conditions by month, from March to September and by vegetation year, in 1989-2006, by comparison with normal annual conditions, at ARDSTurda

Average temperatures °C	Mar.	Apr.	Mai	Iun.	Iul.	Aug.	Sept.	Annual average /vegetation year
2006	3.4	10.8	14.3	17.6	21.2	18.5	15.8	8.9
2005	1.5	9.8	15.7	17.2	19.7	19	16.1	9.0
2004	4.7	10.7	14	18.3	19.3	19.3	14.1	9,1
2003	2.4	8.4	19.5	21.1	20.3	21.9	15.9	9,4
2000-2002	6.0	11.2	16.9	18.4	20.5	20.4	14.3	9,76
1989-1999	4.3	9.8	14.7	18.3	19.9	19.8	14.5	9,09
Normal	3.9	9.4	14.5	17.4	18.5	18.5	15.0	8,6
Rainfall sum (mm)	Mar.	Apr.	Mai	Iun.	Iul.	Aug.	Sept.	Annual average /vegetation year
2006	45.3	70.8	77.9	118.2	16.5	148.6	32.6	589,0
2005	33.3	81.5	54.9	95.4	131.6	180.8	62.4	798,5
2004	28.8	49.4	15.2	85	160.1	111.9	76.6	527,2
2003	13.9	17.9	26.6	21.9	151.3	1.3	28.3	406,9
2000-2002	26.1	30.6	46.8	65	77.2	37.5	66.5	442,7
1989-1999	14.1	44.1	60.5	102.8	58.4	53.6	44.8	487.1
Normal	24.2	48.2	71.3	75.7	70.8	55.5	34.5	509,2

Table 4

Dynamics of cereal pests, in 2003-2005, ARDS Turda

Sampling data	**21.04.**	**06.05.**	**12.05.**	**22.05.**	**26.05.**	**30.05.**	**10.06.**	**12.06.**	**18.06.**	**29.06.**
Oulema melanopus		58	1	7		4	1		4	1
Chaetocnema aridula	2	78	5				10	19	3	5
Phorbia securis	25	11	2							
Oscinella frit	3	6	40	1	2	3	6		6	3
Elachiptera cornuta		2	8	1	1					
Meromyza nigriventris		25	68	1	1	2	3	1	5	6
Lasiosina cinctipes		46	8	1	1	2				
Opomyza florum							6	4	3	
Delia coarctata		4	4	1			6	8		3
Haplothrips tritici		14	160	200	140	180	32	66	37	10
Aphids			2	6	3	5	51	62	36	8
Cicades	4	44	68	7	2	5	46	27	68	33
Eurygaster, Aelia etc.		6	3	27	15	3	58	11	20	7

Table 5

Dynamics of cereal useful entomophagous arthropod fauna, in 2003-2005, ARDS Turda

Sampling data	21.04.	06.05.	12.05.	22.05	26.05.	30.05.	10.06.	12.06.	18.06.	29.06.
Aranea	3	37	29	16	3	7	58	32	16	15
Hymenoptera		15	6	3	3	6	9	2	1	2
Chrysopa carnea			2		2			2	2	
Aeolothrips intermedius			8		3	26			6	
Nabis ferus		7	1	8	2	4	55	31		
Coccinella 7- punctata		2	2	1	1	2	2	2		4
Propylaea 14-punctata		4	5							
Malachius bipustulatus			1	3	4	2	1		1	
Cantaris fusca			3			15				
Carabidae	13	17	2	2						
Platypalpus sp		2	3	2						

Sampling data	21.04.	06.05.	12.05.	22.05	26.05.	30.05.	10.06.	12.06.	18.06.	29.06.
Thaumatomyia glabra		3			1	2	1			
Syrphidae				3	1	1				

Table 6

Structure of cereal pests in 2003-2005, ARDS Turda

Cereal pest species	In winter wheat	In spring barley
Haplothrips tritici	35,1%	4,0%
Oulema melanopus	3,2%	80,1%
Chaetocnema aridula	15,2%	1,7
Phylotreta sp.	5,1%	0,4%
Cereal flies	13,7%	7,1%
Cicades	12,7%	6,1%
Aphids	7,2%	0,4%
Cereal bugs	6,4%	0,1%
Other pests	1,4%	0,1%

Table 7

Structure of pest larvae damaging in wheat tillers, in the spring: 10 -20.05.2003-2005, ARDS Turda

Species	In consecutive wheat crop	In wheat with bean precursory crop
Phorbia securis	38,0 %	19,7 %
Phorbia penicillifera	26,0 %	12,5 %
Delia coarctata	12,0 %	4,2 %
Opomyza florum	4,0 %	4,2 %
***Chloropidae-Oscinella frit* etc.**	4,0 %	9,0 %
Chaetocnema aridula	16,0 %	50,0 %

Tabel 8

Prey composition and feeding rate of main predators with cereal pests in laboratory trials

Entomophagous predators	1	2	3	4	5	6	7	8	9	10	11
Chrysopa carnea (larva)	10	5	10	40	30	50	10	3	1	2	-
Nabis ferus (adult)	8	5	-	42	60	25	-	3	4	3	4
Nabis ferus (larva)	-	-	-	30	25	17	-	-	-	-	-
Coccinella 7-punctata	10	3	-	35	50	25	16	5	7	5	7
Propylaea 14-punctata	7	3	-	20	40	25	-	-	2	-	-
Malachius bipustulatus	-	10	15	30	40	-	-	-	-	3	-
Cantharis fusca	6	-	15	-	40	-	-	2	-	4	-
Staphylinus spp.	10	-	-	-	30	15	-	1	-	4	4
Tachyporus hypnorum	8	-	-	-	-	25	-	1	-	1	-
Poecilus cupreus	9	6	-	-	60	50	10	5	10	5	7
Pseudophonus pubescens	8	9	-	-	60	50	10	1	-	2	1
Harpalus distinguendus	8	3	-	-	-	50	-	-	-	2	2
Harpalus aeneus	5	4	-	-	-	50	-	-	2	4	2
Amara aenea	9	5	-	-	-	50	10	-	-	8	-
Brachinus explodens	-	5	-	-	25	30	-	-	-	-	-
Sylpha obscura	14	3	-	-	-	-	10	1	4	2	4
Episyrphus balteatus	-	-	10	-	25	-	-	-	-	-	-

1-*Oulema melanopus* eggs and **2**-larvae, **3**-*Haplothrips tritici* adults and **4**- larvae, **5**- *Sitobion avenae*, **6**- *Rhopalosiphum padi*, **7**- *Eurygaster maura* (eggs), **8**- *Opomyza florum* larvae and **9**- pupae, **10**- *Phorbia securis* larvae, **11**-pupae.

sented the importance of dominant predatory species (MALSCHI, MUSTEA, 1995, 1996, 1997, 1998, 1999. MALSCHI DANA, 2003).

Coccinella septempunctata L. (Coccinellidae) is able to eat eggs and larvae of *Oulema melanopus* L., larvae and pupae of diptera (*Opomyza florum* F., *Phorbia securis Tiensu*, *Delia coarctata* Fll.), eggs of *Eurygaster maura* L., larvae of *Haplothrips tritici* Kurdj., aphids (*Sitobion avenae* Fabr., *Rhopalosiphum padi* L.) etc., *Malachius bipustulatus* L.(*Malachiidae*) consumed larvae of *Oulema*, aphids, adults and larvae of *Haplothrips tritici*. *Cantharis fusca* L. (*Cantharidae*), was capable of destroyng *Oulema* eggs, aphids, adults of Haplothrips, larvae and pupae of diptera (*Opomyza*). *Episyrphus balteatus* Dg.(*Syrphidae*) consumed especially aphids and trips. *Chrysopa carnea Stephn. (Chrysopidae*) and *Nabis* spp. (*Nabidae*) could kill eggs and larvae of *Oulema*, aphids, trips, eggs of *Eurygaster* etc. *Sylpha obscura (Sylphidae)* consumed larvae and eggs of *Oulema*, eggs, larvae, pupae of diptera (*Phorbia*); *Tachyporus hypnorum* L., *Staphylinus* spp. (*Staphylinidae*) and *Poecilus cupreus* L., *Harpalus rufipes* De Geer, *Brachinus explodens* Duft., *Amara aenea* De Geer (*Carabidae*) consumed aphids, eggs of Eurygaster, eggs and larvae of *Oulema*, larvae and pupae of diptera etc.

Diptera pest species. The increase of damages produced by diptera larvae was registered in zonal cereal crops, intensely affected by climatic unfavorable conditions and by the exploitation agro-ecosystems. The recorded diptera species are present in their geographical area and possess a high biological reserve (Malschi & Mustea 1992, Malschi 1997, 1998, 2006).

The early sowing of crops in September provokes the dangerous autumn attack of *Oscinella frit* L., *Mayetiola destructor* Say and *Phorbia securis* Tiensuu. The biological potential and the early spring attack of *Delia coarctata* Fall. and *Opomyza florum* F. increase very much when the emergence of wheat takes place in October. But, the late emergence of crops in November determined the preferential attack of *Phorbia penicillifera* Jermy and *Ph. securis* in the spring and the development of populations. The most important attack of diptera took place at the beginning of spring. The experimental results suggest the following preventive control measures: late sowing data (in the first half of October); zonal adequate agrotechnological measures for wheat crops, ensuring a good development of plants and for a productive compensatory tillering effect of attacked plants; cultivation of wheat varieties with high compensatory capacity after the diptera attack (consisting in 70-80% at Transylvania, Turda 95, Arieşan, Apulum varieties). The grain yield losses for every attacked plant were registered at: the level of 0.92-1.47 g/plant for *Delia coarctata*; 0.57-1.22 g for *Opomyza florum*, in April and 0.93-1.27 g for *Phorbia securis*, in May. This means: 516; 397 and 478 kg/ha average grain yield losses, under optimum zonal wheat crop conditions, with a density of 450 wheat plants/m^2 and 10% attacked plants.

Preventive seed and field treatments with insecticides have only a partial efficiency (50-75% larval mortality) because of the life cycle of different species and the feeding behavior of larvae within wheat tillers. Special chemical control should be related to the economic damage threshold, the insecticides biological efficiency, the side-effect of insecticides on the useful entomophagous fauna, especially predators (Carabidae, Staphylinidae, Sylphidae, Coccinellidae, Nabidae, Aranea etc.) involved in diptera pest population levels. The results of field tests concerning the side - effects of insecticides showed the slightly harmful toxicity on the auxiliary entomophagous predators, in the early spring applications of insecticides.

The optimal moment of spring treatment application is at the first larval stage of *Opomyza florum* and *Delia coarctata* and at the adult flying of *Phorbia* species, simultaneously. The biological effect of applied insecticides was significantly on the increasing wheat yields with 7-21 % when dimethoate, chlorpyriphos-etil, chlorpyriphos-metil, bensultap, fipronil, acetamiprid, lufenuron, thiachloprid, thiametoxam, different complex insecticides as fenitrotion with esfenvalerat; oxidemeton metil with betaciflutrin were used (Table 9 and 10).

Cereal leaf beetles (*Oulema melanopus* L.). In the last years the biological reserve and the attack potential of the cereal leaf beetle have exceeded the economic damaging threshold, being higher than 10 adults/m^2 and 250 larvae/m^2 (Malschi 2000, 2005). The increase of pest density and attack in certain crops was due especially to the arid microclimate in early spring and in May-June period which caused the increase of the attack aggressions of adults and larvae for the establishment of their favorable nourishment conditions.

The pest larvae damaging potential is reduced by the predators activity and by climate conditions as abundant rains and low temperatures, which are unfavorable for the eggs and larvae of the pest first age. Chemical control is recommended after the limitative activity of the natural factors has been developed, at the massive apparition of the first age larvae and it is applied in the attack areas identified. The insecticide control of *Oulema* had more than 85% efficiency.

The laboratory tests have established the importance of the auxiliary entomophagous predator species (*Chrysopa carnea* Stephn, *Nabis ferus* L., *Coccinella septempunctata* L., *Propylaea quatuordecimpunctata* L., *Malachius bipustulatus* L., *Cantharis fusca* L., *Tachyporus hypnorum* L., *Aleochara bilineata* Gyll., *Poecilus cupreus* L., *Pterostichus mellanarius* Ill., *Pseudophonus pubescens* De Geer., *Harpalus distinguendus* L., *H. aeneus* L., *Amara aenea* De Geer., *Brachinus explodens* Duft., *Sylpha obscura* L.), involved in pest natural biological control, pointing out the active predatory species which have a high predatory capacity, eating between 5 and 39 eggs/ day/individual and between 3 and 40 larvae of *Oulema*/day/ individual predator.

Table 9

Efficiency of seed insecticides for wheat diptera pest control, in 2001-2006, A.R.D.S. Turda

Varianta	Doza p.c./t	Efficiency (%)	Kg/ha (%)
COSMOS 250 FS (fipronil)	2,5 l	40	115
YUNTA 246 FS (imidacloprid)	2,0 l	44	111
CRUISER 350 ST(thiametoxam)	1,5 l	19	116
CRUISER 350 ST	3,0 l	25	117
TEFLUTHRIN 300	0,17 l	47	107
TEFLUTHRIN 300	0,33 l	42	112
TONIC (tefluthrin 200)	0,5 l	42	109
TONIC	1,0 l	35	108
Check (163 larvae/m^2)	-		100 (3964 kg/ha)

Table 10

Efficiency of insecticides for wheat diptera-larvae-pest control, in April, 2000-2002, A.R.D.S. Turda

Insecticides	Product and dose/ha	Efficiency %	Grain yield		
			Kg/ha	%	Difference
Bensultap	Victenon 50 WP (400 g)	43	4635	106.7	291*
Fipronil	Regent 200 SC (90 ml)	45	4778	110.0	434***
Acetamiprid	Mospilan 20 SP (100 g)	56	4778	110.0	434***
Thiacloprid	Calypso 480 EC (100 ml)	29	4735	109.0	391**
Thiametoxam	Actara 25 WG (60 g)	45	4661	107.3	317**
Lufenuron	Match 050 EC (300 ml)	58	4844	111.5	500***
Oxidemeton metil-betaciflutrin	Enduro 258 EC (1000 ml)	41	4722	108.7	378***
Fenitrotion-fenvalerat	Alpha-Combi (500 ml)	47	4865	112.0	521***
Clorpirifos-etil	Pyrinex 25EC (3500 ml)	50	4952	114.0	608***
Clorpirifos metil	Reldan 40 EC (1250 ml)	44	5039	116.0	695***
Dimetoat	Dimezil 40 EC (2000 ml)	47	5256	121.0	912***
Check (186 larvae/m^2)		-	4343	100.0	-
F=5.1* (3.05); LSD 5% - 225 kg; LSD 1% - 303 kg; LSD 0.1% - 404 kg					

Wheat trips (*Haplothrips tritici* Kurdj.) is an important pest, the adults and larvae causing damages by feeding on wheat ears (Baniță 1999, Malschi 2001, 2005). Larvae cause the greatest damage at the end of June and beginning of July. In the last years the increase of *H. tritici* populations at average values of 12.5-22.0 larvae/ear has been favoured by the agro-ecological conditions especially by warming microclimate and by constant wheat cultivation in the zone.

One of the most important factors for limitation of pest development is represented by the activity of natural entomophagous predators which destroy the trips adults, eggs and larvae. At the beginning of spike appearance, the economic damaging threshold (EDT) of 5 adults/m^2 (or 5 adults/10 sweeps with net catches) is surpassed, but in the next vegetation stages, at the kernel formation and ripening, the EDT values of 8 adults/ear or 10-40 larves/ear are no more attained, due to predators activity. The maximum activity of predators involved in natural limitation of wheat thrips is attained at flowering and milky stage, in half of June. The studies on the destructive ability of predators against wheat thrips *H. tritici* their individual pray ratio/day in laboratory feeding trials have demonstrated that 10-15 adults of thrips/day/individual of *Chrysopa, Episyrphus, Malachius* or *Cantharis* have been destroyed and also 10-42 thrips larvae per day and per individual of *Chrysopa* and *Epishyrphus* and adults and larvae of *Nabis* and *Coccinella* of *Propylaea, Malachius, Pseudophonus pubescens.*

Some insecticides efficiency in the larvae control and the influence on wheat yield were tested in the period of 15-25 May 2001-2002, at heading-spike appearance phase (in 45-59 DC stage) (Table 11) in order to protect and use the beneficial predators peak activity, too The treatments with adequate insecticides: chlorpirifos-metil, dimetoat, deltametrin, tiacloprid, thiametoxam, acetamiprid, fipronil, bensultap, fenitrotion-fenvalerat, oxidemetonmetil-betaciflutrin, chlorpirifos - cipermetrin etc. provided statistically significant grain yields amounting to 10 to 23 % and high thrips control efficiency to 70 on 90%.

Homoptera (Aphidina, Cicadina). The main Homoptera species: *Schizaphis graminum* Rond., *Macrosiphum avenae* Fabr., *Rhopalosiphum padi* L., *Metopolophium dirhodum* Walk. (Aphididae) and *Psammotettix alienus* Dahlb., *Macrosteles lae-*

vis Rib., *M. sexnotatus* Fall. (Cicadellidae), *Javesella pellucida* Fabr. (Delphacidae) were find out with an important populations abundance (Malschi & Mustea 1992, Malschi, Perju, 1999, Malschi & all. 2006). Because of agro-ecoclimatic conditions and because of the predator activity the populations level is limited at an average of 12-32 aphides/ear (in June) and only 5-10 cicades/m^2 or /10 sweep net catches (in July). These levels can overpass the economic density thresholds in some favorable years for the development of aphids and cicades.

In laboratory feeding trials with *M. avenae* and *R. padi*, the achieved daily feeding rate by individual predator species were studied, as follows: for *Nabis ferus* L., adult (60 aphids) and for *Nabis* larvae (17 and 25 aphids/day/individual), for *Chrysopa carnea* Stephn.(30 aphids), for *Episyrphus balteatus* Dg. (25 aphids), *Coccinella septempunctata* L. (25-50 aphides), *Propylaea quatuordecimpunctata* L. (25-40 aphides), *Cantharis fusca* L. (40 aphids), *Tachyporus hypnorum* L. (25 aphids), *Poecilus cupreus* L. (60 aphides), *Harpalus rufipes* De Geer. *(Pseudophonus pubescens* Műll.) (50-60 aphids), *H. distinguendus* Duft. and *H. aeneus* L. (50 aphids) and for *Brachibus explodens* Duft. (25-30 aphids).

Conclusions

On 1989-2006 period, the study on wheat pests: Diptera, Homoptera, Thysanoptera, Heteroptera, Coleoptera-Chrysomelidae, their attack and actual strategy of integrated pests management, as part of agro-ecological technological system for sustainable development of wheat crop in Transylvania, were performed at ARDS Turda.

Under natural conditions of years with arid microclimate, with excessive dryness and warming, the insecticide control is necessary, due to the increasing attack of the main wheat pests (flies, aphids, leafhoppers, trips, bugs, cereal leaf beetle etc.). The study performed insecticides effect, the biological efficiency and selective moment of treatments, with the aim to a real integrated pest control and forecast of losses, to protect and to use the natural reservoir of entomophagous in cereal agro-ecosystems. The high efficiency on the insecticides control of main dangerous pests and the achieved increasing yields with 7-24% were experimental results recommending the integrated pest management, with an adequate technology and modern insecticides pest control strategy. Usual insecticides treatments (organophosphorics, pirethroids, neonicotinoids, fipronil, acetamiprid etc.) were tested in different selective moments of application: 1 - for the wheat flies *(Delia coarctata, Opomyza florum, Phorbia penicillifera, Ph. securis, Oscinella frit etc.)* larvae-pest control, in April, at the end of tillering phase (13-33 DC stage); 2 - for the wheat thrips (*Haplothrips tritici* Kurdj.) adults control at spike appearance phase in 45-59 DC stage, in the period of May, 15th-25th, the treatments being efficient in controlling all dangerous pests of wheat crops.

The study proved the important role of entomophagous natural predators, its efficiency on the decreasing of wheat pests abundance, in normal condition. Cereals agro-ecosystem of central Transylvania are rich in beneficial entomophagous arthropod fauna. On the last years with excessive dryness and warming it was necessary to apply the insecticide treatments, because the development of pest population exceeds the adjusting capacity of entomophagous arthropod fauna, on the cereal agroecosystem in open field area.

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