RESEARCH ON THE INTEGRATED WHEAT PESTS CONTROL
(Actual strategy of integrated pests management as part of agroecological system for sustainable development of wheat crop, in Transylvania)

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ABSTRACT

Under special conditions of 1989-2003 period, the attack of the main wheat pests (diptera, aphides, cicades, thrips etc.) increased. The research regarding the control of main dangerous pests was carried out at Agricultural Research and Deve-lopment Station Turda, in Central Transylvania. The results 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 modern 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, aphides, thrips, cereal leaf beetle control, realizing the increasing of grain yields average with 7-24 % and had protected the activity of useful entomophagous arthropod fauna. Since 1991, comparative research regarding useful arthropod populations in cereal field crops rotation, including winter wheat, spring barley, soybeans, maize and marginal herbs, was carried out in two agroecosystems, in an open field area at Turda and in the farm with a network of forestry belts for soil erosion control, founded in 1952, at Cean-Bolduþ. The abundance of auxiliary entomophagous species was superior in the farming system with protective forestry belts and marginal herbs, as compared to the farming system in open field. The well-known systematic groups of predators: *Araneae; Dermaptera; Thysanoptera (Aeolothripidae); Heteroptera (Nabidae* etc.); *Coleoptera (Sylphidae, Coccinellidae, Carabidae, Cicindelidae, Staphylinidae, Cantharidae, Malachiidae); Diptera (Syrphidae, Scatophagidae, Empididae* etc.); *Hymenoptera (Formicidae* etc.); *Neuroptera (Chrysopidae)* were represented in the structure of arthropod fauna. They developed an intensive and efficient destructive activity of phytophagous in cereal field crops and maintained the pests below the economic damaging threshold of population levels, in the agroecosystem with protective forestry belts.

Key words: cereal flies-diptera, leafhoppers, aphides, thrips, cereal leaf beetle, biological natural control and insecticides wheat pests control, entomophagous predator arthropods, protective agro forestry belts.

INTRODUCTION

Elaborated in 1989-2003 period, at Turda, the paper presents the main wheat pests - *Diptera*, *Homoptera*, *Thysanoptera*, *Coleoptera*, *Chrysomelidae* and insecticides efficiency, cultural measures and entomophagous natural 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.

MATERIAL AND METHODS

The data related to the composition of species, biology and experimental control of wheat pests were obtained by comparative researches performed in cereal agroecosystems in two farms : the farm in open field area, at Turda, and the farm with protective forestry belts at Cean-Boldut. The data were statistically processed using regression, correlation, variance analysis methods. The samplings were achieved by capturing insects pests and useful entomophagous predators, by means of complex traps/field plot, including: pitfall soil traps, white adhesive sticky traps and 100 double sweep net catches, in 3 samplings for each control site. According to the natural agroentomocenotic model, studies on prey compositions and feeding rate per day and per predator individual were made in feeding trials with cereals pests, under laboratory conditions.

RESULTS AND DISCUSSION

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Pests	1989-1999 period	2000-2002 period	2002-2003 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: *Lema melanopa*	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 8 ears/m^2	12 adults/ear 20 adults/m^2 9% ears	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 75% ears	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 s.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 November 2002 6 cicadae/m^2	

This paper presents data on the 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 in Central Transylvania. In the last years, the increase of pest density in some crops and some unexpected hard attacks (Table 1) have been produced by specific zonal factors such as the continuous multiannual 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 (Malschi, Mustea, 1992, 1995, 1997, 1998, 1999).

Diptera pest species. The increase of damages produced by diptera larvae was registered in zonal cereal crops, intensely affected by climatic unfavourable conditions and by the exploitation agrosystem. The recorded diptera species are present in their geographical area and possess a high biological reserve. The early sowing of crops in September provokes the dangerous autumn attack of *Oscinella frit* L., *Mayetiola destructor* Say. and *Phorbia securis* Tiensu. 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 (Table 2).

The experimental results suggest the following preventive control measures: late sowing data

Table 2 Dynamics of diptera pest attack in cereal crops in 2000-2002 period, in Transylvania

Winter wheat	2000	2001	2002	Average
Dead hart tillers -larvae/m^2	97	145	317	186
% dead hart tillers	13.7	18	12.6-62	14.7- 31
Spring wheat	2000	2001	2002	Average
Dead hart tillers -larvae/m^2	31	71	390	164
% dead hart tillers	5	9	42	19

(in the first half of October); zonal adequate agro-tehnological 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, Ariesan, 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.

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 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 behaviour of larvae within wheat tillers. The optimal moment of spring treatment application is at the first larval stage of *O. florum* and *D. 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 3). 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.

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. 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

Table 3. Efficiency of insecticides for wheat diptera-larvae-pest control, in April, 2000-2002, A.R.D.S. Turda

Product and dose/ha	Efficiency %	Grain yield			The cost (thousands lei/ ha)		
		Kg/ha	%	Difference	Yield benefit	Insecticide	Profit
Check (186 larvae/m^2)	-	4343	100.0	-	-	-	-
Regent 200 SC (90 ml)	36-45	4778	110.0	434***	1302	222	1080
Reldan 40 EC (1250 ml)	32-44	5039	116.0	695***	2085	828	1257
Victenon 50 WP (400 g)	36-43	4635	106.7	291*	873	212	661
Mospilan 20 SP (100 g)	44-56	4778	110.0	434***	1302	383	919
Enduro 258 EC (1000 ml)	34-41	4722	108.7	378***	1134	-	
Alpha-Combi (500 ml)	38-47	4865	112.0	521***	1563	200	1363
Calypso 480 EC (100 ml)	17-29	4735	109.0	391**	1173	400	773
Actara 25 WG (60 g)	37-45	4661	107.3	317**	951	304	647
Match 050 EC (300 ml)	36-58	4844	111.5	500***	1500	-	
Pyrinex 25EC (3500 ml)	20-50	4952	114.0	608***	1824	827	997
Dimezil 40 EC (2000 ml)	47	5256	121.0	912***	2736	600	1136
F=5.1* (3.05); LSD 5% - 225 kg; LSD 1%- 303 kg; LSD 0.1% - 404 kg							

adults and larvae for the establishment of their favourable nourishment conditions. The pest larvae damaging potential is much reduced by the predators activity and by certain unfavourable climate conditions as abundant rains and low temperatures, which are unfavourable 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 in due time as being infested with adults and eggs. The insecticide control of *Oulema* had more than 85% efficiency when different products and doses were used

Table 4. Insecticides efficiency on the control of *Oulema melanopus* larvae (A.R.S.D. Turda)

Period of treatments (May - June)			Efficiency (%)	
Insecticide	Product	Dose/ha	1991-1999	2000-2003
Synthetic pyrethroids				
Alpha-cypermethrin	FASTAC 10 EC	100 ml	100	100
Alpha -cipermethrin	ALPHAGUARD 10 EC	150 ml	99	-
Alpha -cipermethrin	ALPPHACIPERMETRIN	100 ml	-	95.8
Beta-cipermethrin	CHINMIX 5 EC	300 ml	100	-
Deltamethrin	DECIS 2,5 EC	300 ml	94	93
Deltamethrin	DECIS FORTE 12 EC	63 ml	91	95.0
Deltamethrin	DECIS 25 WG	30 g	-	96.6
Beta-Cyfluthrin	BULLDOCK 25 EC	200 ml	98	-
Esfenvalerat	SUMI-ALPHA 2,5 EC	400 ml	97	-
Esfenvalerat	SUMI-ALPHA 5 EC	200 ml	98	100
Labdacihalothrin	KARATE 2,5 EC	300 ml	99	98.3
Labdacihalothrin	KARATE 5 EC	150 ml	-	99.2
Labdacihalothrin	KARATE ZEON	150 ml	-	96.0
Zetamethrin	FURY 10 EC	100 ml	97	-
Cypermethrin	POLYTRIN 200 SC	100 ml	98	-
Cypermethrin	SUPERSECT 10 EC	150 ml	97	-
Cypermethrin	CIPERTRIN 10 EC	100 ml	-	96.0
Cypermethrin	CIPERMETRIN 20 EC	75 ml	-	100
Cypermethrin	FASTER	100 ml	-	93.0
Tau-fluvalinat	MAVRIC 25 EW	200 ml	-	99.1
Carbamats				
Fenoxicarb	INSEGAR 50 WP	300 g	66	-
Bensultap	VICTENON 50 WP	400 ml	88	-
Organophosphorus and mixtures				
Dimetoat	SINORATOX 35 EC	2000-3500 ml	95	-
Chlorpirifos metil	RELDAN 40 EC	1250 ml	100	99.6
Chlorpirifos etil	PYRINEX 25 ME	3000 ml	-	100
Pirimifos metil	ACTELLIC 50 EC	1000 ml	99	99.2
Fenitrotion	FENITROTION 500g/l	500 ml	-	80.4
Dimetoat + Cipermethrin	SINORATOX PLUS	1600 ml	100	-
Quinalfos+Tiometon	ECALUX S	1000 ml	75	-
Fenitrotion+Esfenvalerat	ALPHA-COMBI 26,25	500 ml	100	97.9
Oxidemeton metil+betacifluthrin	ENDURO 258 EC	1000 ml	-	98.3
Others products				
Etofenprox	TREBON 30 EC	250 ml	100	-
Novaluron	RIMON 10 EC	250 ml	91	-
Thiachloprid	CALYPSO 480 SC	100 ml	-	95.8
Thiametoxam	ACTARA 25 WG	60 g	99	89.2
Acetamiprid	MOSPILAN 20 SP	100 g	100	79.0
Fipronil	REGENT 200 SC	90 ml	99	97.2
The pest density: 250-350 larvae/m^2				

(Table 4).

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 œnea* 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.

Wheat thrips (*Haplothrips tritici* Kurdj.) is an important pest, the adults and larvae causing damages by feeding on wheat ears. The population level and the attack have been higher in crops with later vegetation development. Larvae cause the greatest damage at the end of June and beginning of July, all the more so as the wheat development stage is delayed. 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 agroecological 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 thrips adults, eggs and larvae. In June the, concentration of predators on wheat ears reduces the thrips population below the economic damaging threshold (EDT). Every year, at the beginning of spike appearance, the 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 (*Chrysopidae*, *Nabidae*, *Aranea*, *Aeolothripidae*, *Carabidae*, *Staphylinidae*, *Coccinellidae*, *Malachiidae*, *Cantharidae*, *Syrphidae*, *Empididae* etc.) in natural limitation of wheat thrips is attained at flowering and milky stage, in half of June. The ecological researches on the effect of predators involved in thrips destruction in wheat ears, pointed out significant yield differences (g kernels/ear) of 17.5-25.9% and TKW of 15% in the case of the spikes frequented by predators.

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.*

Comparative trials on abundance and dynamics of thrips and their predators were conducted in two crop systems of wheat, in open area and with agroforestry belts, at Turda and Cean-Boldut. Depending on the presence of agroforestry belts, the results showed a significant difference on thrips populations level: 12.5-22 larvae/ear in open area and 1.9-3.8 larvae/ear in forestry belts system; 23-32% of determination index and R = 0.48, respectively R = 0.57 significant correlations, due to the presence of agroforestry belts and the impact of the more abundant useful fauna on the thrips populations in the forestry belts agroecosystem.

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 5) and in period of June, 20-25 2000-2001, at milky-ripening phase (in 77-87 DC vegetative phase) in order to protect and use the beneficial predators peak activity, too (Table 6).

New treatments with adequate insecticides: chlorpirifos-metil, dimetoat, deltametrin, tiacbprid, thiametoxam, acetamiprid, fipronil, bensultap, fenitrotion-fenvalerat, oxidemetonmetil-

Table 5 . Effect of insecticides treatment on wheat thrips (*Haplothrips tritici* Kurdj.) control at heading-spikes appearance phase, in 45-59 DC stage, at May, 15-25 period, 2001-2002, A.R.D.S. Turda

Product and dose/ha	Efficiency %		Grain yield			The cost (thousands / ha)		
			Kg/ha	%	Difference	Yield benefit	Insecticide	Profit
Check (9.2 larvae/ear)	-		5081	100	-	-	-	-
Mospilan 20 SP (100 g)	(24-63)	44	5887	116	806*	2418	383	2035
Alpha-Combi 25,26EC (500ml)	(73-83)	78	5657	111	576	1728	200	1528
Victenon 50 WP (500 g)	(63-69)	66	5657	111	576	1728	212	1526
Actara 25 WP (60 g)	(32-82)	57	5696	112	615	1845	304	1541
Calypso 450 SC (100 ml)	(50-73)	62	5555	109	474	1422	400	1022
Nurelle D (400 ml)	(65-67)	68	5788	114	707*	2121	326	1795
Reldan 40 EC (1250 ml)	(61-79)	70	5946	117	865*	2595	728	1867
Regent 200 SC (90 ml)	(61-82)	72	6330	124	1249***	3747	240	3507
Treatment average (Average)			5805	114	724	2172	350	1822
Average cost and benefit							600	1572

LSD p 5%-641, LSD p1%-883, LSD p 0,1 %-1216

Table 6. Effect of insecticides on wheat thrips (*Haplothrips tritici* Kurdj.) larvae control at milky-ripening phase, in 77-87 DC stage, in the period of June, 20-25, 2000-2001, A.R.D.S. Turda

Product and dose/ha	Larvae/ear	Efficiency %	Grain yield			1000 grain weight	
			Kg/ha	%	Difference	TKV	%
Check	21.2	-	3970	100	-	46.8	100
REGENT 200 SC (90 ml)	6.0°°°	72	4565	115	595 ***	46.6	100
ALPHA-COMBI 25,26 (500 ml)	5.6°°°	74	4666	118	696 ***	48.1***	103
ENDURO 258 EC (1000 ml)	4.5°°°	79	4531	114	561 ***	47.7**	102
RELDAN 40 EC (1250 ml)	6.4°°°	70	4369	110	399 **	48.9***	104
DECIS FORTE 12 EC (65 ml)	7.1°°°	67	4794	121	824 ***	47.7**	102
ACTARA 25 WG (60 g)	6.3°°°	70	4874	123	904 ***	49.8***	106
VICTENON 50 WP (400 g)	8.2°°°	61	4813	121	843 ***	49.2***	105
MOSPILAN 20 SP (100 g)	5.4°°°	74	4868	123	898 ***	48.7***	104
LSD 5%	1.5				290	0.63	
LSD 1%	2.0				390	0.84	
LSD 0,1%	2.7				517	1.11	
F test = 3,12	95.7**				4.2**	12.1**	

betaciflutrin, chlorpirifos-cipermetrin etc. provided statistically significant gain yields amounting to 10 to 23 % and high thrips control efficiency to 70 on 90% (Table 7).

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 laevis* Rib., *M. sexnotatus* Fall. (*Cicadellidae*), *Javesella pellucida* Fabr. (*Delphacidae*) were find out with an important populations abundance. Because of agroecoclimatic 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 favourable years for the development of aphides and cicades populations. In field trials different insecticides were tested for ear aphid control (Table 8).

In laboratory feeding trials with *M. avenae* and *R. padi*, the achieved daily feeding rate and by individual predator species were studied, as follows: *Nabis ferus* L., adult: 60 aphides and larvae 17 and 25 aphides/day/individual), for *Chrysopa carnea* Stephn.(30 aphides), for *Episyrphus balteatus* Dg. (25 aphides), *Coccinella septempunctata* L. (25-50 aphides), *Propylaea quatuordecimpunctata* L. (25-40 aphides), *Cantharis fusca* L. (40 aphides), *Tachyporus*

Table 7. Insecticides efficiency (%) in the control of wheat thrips (*Haplothrips tritici* Kurdj.), (A.R.D.S. Turda)

Period of treatments (20-25 June)			Efficiency (%)	
Insecticide	Product	Dose/ha	1994-2000	2001-2003
Endosulfan	THIONEX 35 EC	1000 ml	61	-
Novaluron	RIMON 10 EC	250 ml	63	-
Tiametoxam	ACTARA 25 WG	60 g	88	89
Tiacloprid	CALYPSO 480 SC	100 ml	-	85
Acetamiprid	MOSPILAN 20 SP	100 ml	78	98
Fipronil	REGENT 200 SC	90 ml	78	71-90
Etofenprox	TREBON 10 EC	1000 ml	58	-
Bensultap	VICTENON 50 WP	500 g	80	-
Fenoxicarb	INSEGAR 25 WP	300 g	77	-
Fenitrotion	FENITROTION 500g/l	500 ml	-	86
Dimetoat	SINORATOX35 EC	3500 ml	84	-
Dimetoat	EFDACON 40 EC	3500 ml	91	-
Diazinon	DIAZOL 48 EC	1500 ml	59	-
Chlorpirifos	PYRINEX 50 EW	1500 ml	76	-
Chlorpirifos etil	PYRINEX 25 MF	3000 ml	-	97
Chlorpirifos metil	RELDAN 40 EC	1250 ml	90	-
Oxidemeton metil + betaciflutrin	ENDURO 258 EC	1500 ml	90	-
Dimetoat + cipermetrin	SINORATOX PLUS	1600 ml	95	-
Fenvalerat + fenitrotion	ALPHA-COMBI 26,25 EC	500 ml	88	-
Alfacipermetrin	FASTAC 10 EC	100 ml	51	77
Alfacipermetrin	ALFAMETRIN	100 ml	-	87
Cypermethrin	POLYTRIN 200SC	100 ml	69	-
Cypermethrin	CYPERTRHIN 10 EC	100 ml	-	60
Zetametrin	FURY 10 EC	100 ml	29	-
Deltametrin	DECIS 2,5 EC	300 ml	-	35
Deltametrin	DECIS FORTE 12,5 EC	65 ml	92	92
Deltametrin	DECIS 25 WG	30 g	-	76
Esfenvalerat	SUMI-ALPHA 5,0	200 ml	31	90
Esfenvalerat	ESFENVALERAT 5%	200 ml		94

hypnorum L. (25 aphides), *Poecilus cupreus* L. (60 aphides), *Harpalus rufipes* De Geer. *(Pseudophonus pubescens* Mull.) (50-60 aphides), *H. distinguendus* Duft. and *H. aeneus* L. (50 aphides), *Brachibus explodens* Duft. (25-30 aphides). Study on the dynamics and concentration of main predator species in wheat crops were approached too, depending on the presence of the agroforestry belts and field margins with aromatic plants (*Daucus carota, Achillea millefolium* etc.), with feeding attractiveness for the predator species.

Pest and beneficial arthropod fauna

Cereals agroecosystems of central Transylvania are rich in beneficial entomophagous arthropod fauna. The abundance and the quality of activity of entomophagous populations were higher in the system of field crops with protective forest belts, existing since 1952, in Cean-Boldut farm of A.R.D.S. Turda. A summarized presentation of annual abundance and structural interrelationship between pest and beneficial arthropod fauna captured, in wheat, spring barley, soybean, maize, marginal herbs, is shown for the two cereal agroecosystems from Turda, in open area and from Boldut, with forestry belts, in the table 9.

A large part of the captured arthropods consisted of entomophagous groups, amounting to 33% in the Turda agroecosystem characterized by open areas. Beneficial species represented 41% in winter wheat, 19% in spring cereals, 52% in soybean, at Turda, in open areas. The agroecosystem with protective forest belts of the field crops in

Boldut, had a higher percentage of entomophagous groups, reaching 78%. The auxiliary species represented under these conditions 82% in winter wheat, 73% in spring cereals, 79% in soybean and 75% in marginal herbs. No insecticide application was needed, in the pest control, because the farm with forestry belts from Boldut presents a real natural entomocenotic equilibrium, due to the decrease of pest populations below the economic density thresholds, related with the activity of entomophagous natural reservoir (Table 10).

Table 8. Insecticides efficiency (%) on the control of wheat ear aphides (*Sitobion avenae* Fabr. and other aphides) (A.R.D.S. Turda)

Period of treatments (20-25 June)			Efficiency (%)	
Insecticide	Product	Dose/ha	1994 - 1997	2001-2002
Novaluron	RIMON	250 ml	98	-
Tiametoxam	ACTARA 25 WG	60 g	-	80
Tiacloprid	CALYPSO 480 SC	100 ml	-	77
Acetamiprid	MOSPILAN 20 SP	100 ml	42	93
Fipronil	REGENT 80 WG	25 g	85	-
Fipronil	REGENT 200 SC	90 ml	58	87
Etofenprox	TREBON 10 EC	1000 ml	89	-
Bensultap	VICTENON 50WP	500 g	82	-
Fenoxicarb	INSEGAR 25 WP	300 g	71	-
Fenitrotion	FENITROTION 500g/l	500 ml	-	88
Dimetoat	SINORATOX35EC	3500 ml	93	-
Dimetoat	EFDACON 40 EC	3500 ml	91	-
Diazinon	BASUDINE 600EC	1000 ml	90	-
Diazinon	DIAZOL 48 EC	1500 ml	86	-
Chlorpirifos etil	PYRINEX 50 EW	1500 ml	91	-
Chlorpirifos etil	PYRINEX 25 MF	3000 ml	-	85
Oxidemeton metil+betaciflutrin	ENDURO 258 EC	1500 ml	99	-
Triclorfon+ cipermetrin	ONEFON "PLUS"	1500 ml	96	-
Endosulfan	THIONEX 35 EC	1000 ml	77	-
Dimetoat + cipermetrin	SINORATOX PLUS	1600 ml	100	-
Alfacipermetrin	FASTAC 10 EC	100 ml	79	87
Alfacipermetrin	ALFAMETRIN	100 ml	-	65
Cypermethrin	POLYTRIN 200SC	100 ml	80	-
Cypermethrin	CYPERTHRIN 10 EC	100 ml	-	65
Zetametrin	FURY 10 EC	100 ml	90	-
Betacipermetrin	CHINMIX 5 EC	300 ml	92	-
Deltametrin	DECIS 2,5 EC	300 ml	90	82
Deltametrin	DECIS 25 WG	30 g	-	63
Esfenvalerat	SUMI-ALPHA 2,5	400 ml	90	-
Esfenvalerat	SUMI-ALPHA 5,0	200 ml	86	82
Esfenvalerat	ESFENVALERAT 5%	200 ml	-	92
Lambda-cyhalotrin	KARATE ZEON	150 ml	-	64
Tau-fluvalinat	MAVRIC 25 EW	200 ml	-	88
Aphides density = 62 (collected by 100 sweep nets catches)				

Table 9. Structure and interactions between pests and entomophagous arthropod fauna in cereal agroecosystems in central Transylvania, in 2000-2002 period

Crops	Winter wheat		Spring cereals		Soybean		Marginal herbs		Summarized fields	
Annual abundance	No.	%	No.	%	No.	%	No.	%	No.	%
In open field area cereal agroecosystem, at Turda										
Pests	1787	59	1928	81	205	48	-	-	3920	67
Beneficial	1230	41	462	19	219	52	-	-	1911	33
Total	3017		2390		424		-	-	5831	40
In cereal agroecosystem with protective forestry belts, at Cean-Boldut										
Pests	715	18	485	27	115	21	609	25	1924	21
Beneficial	3357	82	1307	73	438	79	1846	75	6948	78
Total	4072		1792		553		2455		8872	60
Total	7089		4182		977		2455		14703	

Table 10. The average attack of the main cereal pests (2000-2002)

Oulema melanopus (larvae/m²)		*Haplothrips tritici* (larvae/ear)		*Aphides/ear*		*Diptera larvae* (% attacked tillers)	
Turda	Boldut	Turda	Boldut	Turda	Boldut	Turda	Boldut
350	9	22	3,8	32	3,2	25	5,5

Table 11. Comparative abundance of pest and entomophagous arthropod fauna in the agroecosystems in open area (Turda) and with forestry belts (Boldut)

Crops	Farm	Winter wheat	Spring cereals	Crops	Farm	Winter wheat	Spring cereals
Pests	Zone	No.	No.	Entomophagous	Zone	No.	No.
Col.Phylotreta, Chaetocnema	Turda Boldut	571 136	1029 215	*Heteroptera - Nabidae*	Turda Boldut	158 38	88 4
Col. Oulema melanopus	Turda Boldut	450 13	295 31	*Neuroptera- Chrysopidae*	Turda Boldut	5 6	1 11
Thysanoptera Haplothrips	Turda Boldut	330 230	191 60	*Coccinellidae*	Turda Boldut	16 13	26 5
Homoptera Aphidina	Turda Boldut	90 111	124 25	*Malachiidae, Cantharidae*	Turda Boldut	9 9	6 21
Homoptera- Cicadina	Turda Boldut	91 68	123 38	*Carabidae*	Turda Boldut	759 2814	139 938
Diptera Anthomyidae	Turda Boldut	6 6	9 18	*Sylphidae*	Turda Boldut	78 161	2 99
Dipter Chloropidae	Turda Boldut	131 65	107 35	*Dipter: Empididae, Syrphidae*	Turda Boldut	45 15	15 11
Heteropt. Aelia, Eurygaster etc.	Turda Boldut	107 79	45 49	*Hymenoptera*	Turda Boldut	33 34	57 118
Hymenoptera Lepidoptera	Turda Boldut	11 0	5 5	*Thysanoptera- Aeolothripidae*	Turda Boldut	18 86	0 25
Ortoptera	Turda Boldut	0 7	0 9	*Aranea*	Turda Boldut	109 171	128 75
Total pests	Turda Boldut	1787 715	1928 485	Total beneficials	Turda Boldut	1230 3357	462 1307
Total pests		2502	2413	Total beneficials		4587	1769

Adequate marginal biotops (protective forest belts, marginal grass belts) have a great importance for fast colonization of field crops and for the migration of entomophagous arthropods from one field to another, in accordance with the presence and abundance of pest populations (Tables 11 and 12).

The abundance, activity and conservation of entomophagous arthropods, especially predators, are favoured by diversified flora at the farm with forestry belts. The forestry curtains are composed of 36 species of trees and bushes: *Cerasus avium, Malus silvestris, Pirus piraster, Prunus spinosa, Crataegus pentagyna, Rosa canina, Vaccinium vitis-idaea, Corylus avellana, Ligustrum vulgare, Staphylaea pinnata, Sambucus nigra a.o.* on the external rows and *Quercus robur*, *Ulmus* spp., *Robinia pseudacacia, Acer platanoides, Acer pseudoplatanus, Fraxinus excelsior, Tillis cordata, Salix caprea* etc., on the internal rows (Popescu 1993; Malschi and Mustea, 1995; Malschi, 2003).

The marginal herbs, grasslands and pastures are composed of diverse flowering plants *(Pastinaca sativa, Daucus carota, Achillea millefolium, Hypericum perforatum, Tanacetum vulgare, Cichorium inthybus, Sinapis arvensis, Papaver rhoeas, Sonchus arvensis, Veronica persica, Matricaria chamomilla, Myosotis arvensis, Viola arvensis, Lolium perene, Plantago major* etc.*)***.** The existence of the diversified flora in the system with protective forest belts represents the main factor which determines the profusion of species, survival, the increase of

Table 12. Annual abundance and structure of entomophagous *Carabidae* and *Sylphidae* in cereal agroecosystems in open area (Turda) and with forestry belts (Boldut)

Agroecosystems	Turda	Boldut
Total *Carabidae*	1093	5265
Poecilus cupreus L.	715	3643
Harpalus aeneus L.	28	200
Harpalus distinguendus Duft.	55	72
Harpalus rufipes De Geer.	224	480
Pterostichus melanarius Ill.	31	12
Dolichus halensis Schall.	27	389
Brachinus explodens Duft.	11	31
Carabus coriaceus L.	-	16
Carabus nemoralis Mull.	2	366
Sylphidae total	94	974
Sylpha obscura L.	81	894
Necrophorus vespillo L.	13	80
Total	1187	6239

Table 13. Prey composition and feeding rate with cereal pests of the main predators 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.

abundance and seasonal migration of the useful entomophagous arthropods from one field to another (Welling, 1990; Rupert and Molthan, 1991; Malschi and Mustea, 1998; Malschi, 2003).

Laboratory tests and investigation regarding the role of the main species of predatory entomophagues as regulators of pest populations in cereal agroecosystems, demonstrated that various species feed preferentially on wheat flies, cereal aphides, thrips, bugs, *Oulema* etc. (Table13). The results of laboratory feeding trials with cereal pests regarding feeding habits of predators, prey composition and feeding rate per day and individual showed the importance of dominant predatory species, in agreement with literature (Wetzel, 1995; Banita et al. 1999; Malschi and Mustea, 1995, 1996, 1997, 1998, 1999; Malschi, 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., aphides (*Sitobion avenae* Fabr., *Rhopalosiphum padi* L.) etc., *Malachius bipustulatus* L. (*Malachiidae*) consumes larvae of *Lema*, aphides, adults and larvae of *Haplothrips tritici* etc. *Cantharis fusca* L. (*Cantharidae*), is capable of destroying *Lema* eggs, aphides, adults of *Haplothrips*, larvae and pupae of diptera (*Opomyza*). *Episyrphus balteatus* Dg. (*Syrphidae*) consumes especially aphides and thrips. *Chrysopa carnea* Stephn. *(Chrysopidae*) and *Nabis* spp. (*Nabidae*) could kill eggs and larvae of *Lema*, aphides, thrips, eggs of *Eurygaster* etc. *Sylpha obscura (Sylphidae)* consumes larvae and eggs of *Lema*, 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*) consumes aphides, eggs of *Eurygaster*, eggs and larvae of *Lema*, larvae and pupae of diptera etc.

CONCLUSIONS

The natural predators play an important role in decreasing the wheat pest abundance, under natural conditions of years with arid microclimate, with excessive dryness and warmith. The insecticide control is necessary, due to the increasing attack of the main wheat pests (diptera, aphides, cicades, thrips, bugs, leaf beetle etc.).

The usual insecticides treatments (organophosphorics, pirethroids, neonicotinoids, fipronil, acetamiprid, novaluron etc.) were tested in three different selective moments of application:

1. for wheat diptera-larvae-pest control in April, at the end of tillering phase, in 13-33 DC stage;

2. for wheat thrips (*Haplothrips tritici* Kurdj.) control at heading spike appearance phase in 45-59 DC stage, in the period of May, 15^{th}-25^{th};

3. for wheat thrips larvae control at milky-ripening phase, in 77-87 DC stage, in June 20-25, the treatments being efficient in controlling all dangerous pests of wheat crops.

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.

Cereals agroecosystem of central Transylvania are rich in beneficial entomophagous arthropod fauna. The abundance and the quality of activity of entomophagous populations were higher in the system of field crops with protective forest belts, existing since 1952, in Cean-Boldut farm of A.R.D.S. Turda. Therefore, on the farm with protective forestry belts and with field marginal herbs, favourable for the development of entomophagous arthropod fauna, it is achieved a real natural entomocenotic equilibrium and a natural biological control of important zone pests, like *Oulema melanopus* L., cereal flies, aphides, cicades, thrips, bugs etc. By comparison on the cereal agroecosystem in open field area it in necessary to apply the insecticide treatments, because the development of pest population exceeds the adjusting capacity of entomophagous arthropod fauna.

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Table 7. Insecticides efficiency (%) in the control of wheat thrips (*Haplothrips tritici* Kurdj.), (A.R.D.S. Turda)

Period of treatments (20-25 June)			Efficiency (%)	
Insecticide	Product	Dose/ha	1994-2000	2001-2003
Endosulfan	THIONEX 35 EC	1000 ml	61	-
Novaluron	RIMON 10 EC	250 ml	63	-
Tiametoxam	ACTARA 25 WG	60 g	88	89
Tiacloprid	CALYPSO 480 SC	100 ml	-	85
Acetamiprid	MOSPILAN 20 SP	100 ml	78	98
Fipronil	REGENT 200 SC	90 ml	78	71-90
Etofenprox	TREBON 10 EC	1000 ml	58	-
Bensultap	VICTENON 50 WP	500 g	80	-
Fenoxicarb	INSEGAR 25 WP	300 g	77	-
Fenitrotion	FENITROTION 500g/l	500 ml	-	86
Dimetoat	SINORATOX35 EC	3500 ml	84	-
Dimetoat	EFDACON 40 EC	3500 ml	91	-
Diazinon	DIAZOL 48 EC	1500 ml	59	-

Chlorpirifos	PYRINEX 50 EW	1500 ml	76	-
Chlorpirifos etil	PYRINEX 25 MF	3000 ml	-	97
Chlorpirifos metil	RELDAN 40 EC	1250 ml	90	-
Oxidemeton metil+betaciflutrin	ENDURO 258 EC	1500 ml	90	-
Dimetoat + cipermetrin	SINORATOX PLUS	1600 ml	95	-
Fenvalerat+fenitrotion	ALPHA-COMBI 26,25 EC	500 ml	88	-
Alfacipermetrin	FASTAC 10 EC	100 ml	51	77
Alfacipermetrin	ALFAMETRIN	100 ml	-	87
Cypermethrin	POLYTRIN 200SC	100 ml	69	-
Cypermethrin	CYPERTRHIN 10 EC	100 ml	-	60
Zetametrin	FURY 10 EC	100 ml	29	-
Deltametrin	DECIS 2,5 EC	300 ml	-	35
Deltametrin	DECIS FORTE 12,5 EC	65 ml	92	92
Deltametrin	DECIS 25 WG	30 g	-	76
Esfenvalerat	SUMI-ALPHA 5,0	200 ml	31	90
Esfenvalerat	ESFENVALERAT 5%	200 ml	-	94
Lambda-cyhalotrin	KARATE ZEON	150 ml	-	84
Tau-fluvalinat	MAVRIC 25 EW	200 ml	-	95
THRIPS DENSITY (larvae/ear)			12.5	16.5

Table 8. Insecticides efficiency (%) on the control of wheat ear aphids (*Sitobion avenae* Fabr. and other aphids), (ARDS Turda)

Period of treatments (20-25 June)			Efficiency (%)	
Insecticide	Product	Dose/ha	1994 - 1997	2001-2002
Novaluron	RIMON	250 ml	98	-
Tiametoxam	ACTARA 25 WG	60 g	-	80
Tiacloprid	CALYPSO 480 SC	100 ml	-	77
Acetamiprid	MOSPILAN 20 SP	100 ml	42	93
Fipronil	REGENT 80 WG	25 g	85	-
Fipronil	REGENT 200 SC	90 ml	58	87
Etofenprox	TREBON 10 EC	1000 ml	89	-
Bensultap	VICTENON 50WP	500 g	82	-
Fenoxicarb	INSEGAR 25 WP	300 g	71	-
Fenitrotion	FENITROTION 500g/l	500 ml	-	88
Dimetoat	SINORATOX35EC	3500 ml	93	-
Dimetoat	EFDACON 40 EC	3500 ml	91	-
Diazinon	BASUDINE 600EC	1000 ml	90	-
Diazinon	DIAZOL 48 EC	1500 ml	86	-
Chlorpirifos etil	PYRINEX 50 EW	1500 ml	91	-
Chlorpirifos etil	PYRINEX 25 MF	3000 ml	-	85
Oxidemeton metil+betaciflutrin	ENDURO 258 EC	1500 ml	99	-
Triclorfon+ cipermetrin	ONEFON "PLUS"	1500 ml	96	-
Endosulfan	THIONEX 35 EC	1000 ml	77	-
Dimetoat + cipermetrin	SINORATOX PLUS	1600 ml	100	-
Alfacipermetrin	FASTAC 10 EC	100 ml	79	87

Alfacipermetrin	ALFAMETRIN	100 ml	-	65
Cypermethrin	POLYTRIN 200SC	100 ml	80	-
Cypermethrin	CYPERTHRIN 10 EC	100 ml	-	65
Zetametrin	FURY 10 EC	100 ml	90	-
Betacipermetrin	CHINMIX 5 EC	300 ml	92	-
Deltametrin	DECIS 2,5 EC	300 ml	90	82
Deltametrin	DECIS 25 WG	30 g	-	63
Esfenvalerat	SUMI-ALPHA 2,5	400 ml	90	-
Esfenvalerat	SUMI-ALPHA 5,0	200 ml	86	82
Esfenvalerat	ESFENVALERAT 5%	200 ml	-	92
Lambda -cyhalotrin	KARATE ZEON	150 ml	-	64
Tau-fluvalinat	MAVRIC 25 EW	200 ml	-	88
Aphids density = 62 (collected by 100 sweep nets catches)				

Table 9. Structure and interactions between pests and entomophagous arthropod fauna in cereal agroecosystems in central Transylvania, in 2000-2002 period

Crops	Winter wheat		Spring cereals		Soybean		Marginal herbs		Summarized fields	
Annual abundance	No.	%	No.	%	No.	%	No.	%	No.	%
In open field area cereal agroecosystem, at Turda										
Pests	1787	59	1928	81	205	48	-	-	3920	67
Beneficial	1230	41	462	19	219	52	-	-	1911	33
Total	3017		2390		424		-	-	5831	40
In cereal agroecosystem with protective forestry belts, at Cean-Boldut										
Pests	715	18	485	27	115	21	609	25	1924	21
Beneficial	3357	82	1307	73	438	79	1846	75	6948	78
Total	4072		1792		553		2455		8872	60
Total	7089		4182		977		2455		14703	

Table 10. The average attack of the main cereal pests (2000-2002)

Oulema melanopus (larvae/m^2)		*Haplothrips tritici* (larvae/ear)		*Aphids/ear*		*Diptera larvae* (% attacked tillers)	
Turda	Boldut	Turda	Boldut	Turda	Boldu t	Turda	Boldut
350	9	22	3,8	32	3,2	25	5,5

Table 11. Comparative abundance of pest and entomophagous arthropod fauna in the agroecosystems in open area (Turda) and with forestry belts (Boldut)

Crops	Farm	Winter wheat	Spring cereals	Crops	Farm	Winter wheat	Spring cereals
Pests	Zone	No.	No.	Entomophagous	Zone	No.	No.
Col. *Phylotreta,*	Turda	571	1029	Heteroptera-	Turda	158	88
Chaetocnema	Boldut	136	215	Nabidae	Boldut	38	4
Col. *Oulema*	Turda	450	295	Neuroptera-	Turda	5	1
melanopus	Boldut	13	31	Chrysopidae	Boldut	6	11
Thysanoptera-	Turda	330	191	Coccinellidae	Turda	16	26
Haplothrips	Boldut	230	60		Boldut	13	5
Homoptera-	Turda	90	124	Malachiidae,	Turda	9	6
Aphidina	Boldut	111	25	Cantharidae	Boldut	9	21
Homoptera-	Turda	91	123	Carabidae	Turda	759	139
Cicadina	Boldut	68	38		Boldut	2814	938
Diptera-	Turda	6	9	Sylphidae	Turda	78	2
Anthomyidae	Boldut	6	18		Boldut	161	99

Diptera- *Chloropidae*	Turda	131	107	Dipt.Empididae, Syrphidae	Turda	45	15
	Boldut	65	35		Boldut	15	11
Heteropt. *Aelia Eurygaster etc.*	Turda	107	45	Hymenoptera	Turda	33	57
	Boldut	79	49		Boldut	34	118
Hymenoptera Lepidoptera	Turda	11	5	Thysanoptera-Aeolothripidae	Turda	18	0
	Boldut	0	5		Boldut	86	25
Ortoptera	Turda	0	0	Aranea	Turda	109	128
	Boldut	7	9		Boldut	171	75
Total pests	Turda	1787	1928	Total beneficials	Turda	1230	462
	Boldut	715	485		Boldut	3357	1307
Total pests		2502	2413	Total beneficials		4587	1769

Table 12. Annual abundance and structure of entomophagous carabidae and sylphidae in cereal agroecosystems in open area(Turda) and with forestry belts (Boldut)

Agroecosystems	Turda	Boldut
Total carabidae	1093	5265
Poecilus cupreus L.	715	3643
Harpalus aeneus L.	28	200
Harpalus distinguendus Duft.	55	72
Harpalus rufipes De Geer.	224	480
Pterostichus melanarius Ill.	31	12
Dolichus halensis Schall.	27	389
Brachinus explodens Duft.	11	31
Carabus coriaceus L.	-	16
Carabus nemoralis Mull.	2	366
Sylphidae total	94	974
Sylpha obscura L.	81	894
Necrophorus vespillo L.	13	80
TOTAL	1187	6239

Table 13. Prey composition and feeding rate with cereal pests of the main predators 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.