NARDI FUNDULEA, ROMANIA
www.incda-fundulea.ro

ROMANIAN AGRICULTURAL RESEARCH, NO. 29, 2012
Print ISSN 1222-4227; Online ISSN 2067-5720

WHEAT PESTS CONTROL STRATEGY ACCORDING TO AGRO-ECOLOGICAL CHANGES IN TRANSYLVANIA

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ABSTRACT

Elaborated in 2007-2011, at Agricultural Research Station Turda, the paper presents research on integrated pest management in winter wheat crops in relation to increased pest abundance and attack, on the agro-ecological changes, in Transylvania.

Entomological study has been carried out under different cultural soil technologies: classical (by ploughing) and conservative (by minimum soil tillage and no tillage), in open field agro ecosystems with anti-erosional terraces and in agroforestry belts farming system. The spring months of the last years were characterized by an increased warming and dryness periods, causing the pest abundance and damages growth on wheat. Were pointed out major outbreaks of attack of thrips (*Haplothrips tritici)*; wheat flies *(Chloropidae: Oscinella frit, Meromyza nigriventris, Elachiptera cornuta etc.* and *Anthomyidae: Delia coarctata, Phorbia securis, Ph. penicillifera);* stem flea beetles *(Chaetocnema aridula);* bugs *(Eurygaster maura, Aelia acuminata)*, leafhoppers (*Javesella pellucida, Psammotettix alienus, Macrosteles laevis*), aphids (*Sitobion avenae, Schizaphis graminum, Rhopalosiphum padi, Metopolophium dirhodum*) etc.

The research results proved the importance of integrated pests control and insecticide applications in two different moments: end of tillering phase and ear emergence, in open field with classical soil technology. Also, the integrated pests management (IPM) is a major section of successive soil no tillage technologies, comprising a special pest control strategy, with insecticides application in 2-3 successive treatments, entomophagous conservation and use, environmental protection. The IPM research pointed out the efficiency of biological control, only using the entomophagous natural resources, without insecticides application, in the farming system with protective agro-forestry belts – favourable for increasing of useful fauna.

Key words: wheat pests, integrated pest control, soil no tillage technology, protective agroforestry belts.

INTRODUCTION

During 2007-2011 period, especially under the conditions of profound agroecological changes caused by climate warming and also under the new technological and economical conditions in regional agricultural exploitations, the integrated control strategy of wheat pest was elaborated by the research on agricultural entomology and applied ecology, conducted at the Agricultural Research and Development Station Turda, in Central Transylvania. On the last years, the increase of pest damages was registered at the wheat crops intensely affected by unfavourable climatic conditions and by the exploitation system with incomplete or incorrect crop technologies (Malschi 2007, 2008, 2009).

The study performed during 1980-2010 showed the evolution of main cereal pest such as: *Diptera, Homoptera, Thysanoptera, Coleoptera* etc., as well as the importance of integrated pest control strategies (Malschi et al., 2011).

Integrated pest management (IPM) is an agro-ecological system approach to crop protection that uses different practices to control the pest and minimize the pesticide applications. IPM is an environment-tally approach and an economical means of pest management comprise: the environmental and ecological factors involved in pest behaviour, the knowledge on pest lifecycles and their interaction with the environment, biological and chemical pest control methods (Baicu, 1996; Bărbulescu et al., 2001; Malschi, 2009;

Received 04 February 2012; accepted 23 April 2012

Malschi et al., 2010, 2011; Popov et al., 2009; Wetzel, 1995).

MATERIAL AND METHODS

Based on the 30 year research studies at the Agricultural Research-Development Station Turda of The Romanian Academy of Agriculture and Forestry Sciences, the paper presents an agro-ecological study on the population dynamics and attack evolution of wheat pests and the adequate integrated pest control methods under different cultural soil technologies: classical (by ploughing) and conservative (by minimum soil tillage and no tillage), in open field agricultural system with anti-erosional terraces and in agroforestry belts farming system.

The research objectives have comprised aspects of interest such as:

♦ systematic and bio-ecological study of pest species;

♦ danger of attack expansion with increasing quotas, observed at present and affecting wheat crop yields in accordance with the agro-ecological conditions;

♦ testing the adequate methods of integrated pest management, which comprise preventive and modern pest control methods based on good efficiency, showing reduced side effects and a diminished negative impact on useful entomophagous fauna and environment;

♦ elaboration of agro-ecologically integrated pest control strategy by researches of attack diminishing methods in accordance with *technological factors*: - selective, efficient insecticides, agro-technical methods; *biotic factors*: - natural entomophags, tolerant varieties; and *environment protection factors.*

During 2007-2011, the study has revealed data on species composition, damage levels and experimental field tests regarding integrated pest control, in wheat crops. Species determination has been achieved based on the abundant samples, performed every 10 days**.** The analysed samples have been obtained by the method of complex traps, including pitfall soil recipients (the Barber traps for the epigeous arthropod fauna) and captures in 100 double sweep-net catches, for the arthropod fauna at the plant level. The structure and dynamics of the pest species populations interacting with predatory arthropod fauna have been studied in wheat crops.

RESULTS AND DISCUSSION

In order to optimise the environment-agriculture-sustainable development relation-ship, scientific and technological knowledge regarding the modernization of pest control management needs complex research approaches in a systemic, agro-ecologically integrated manner (Malschi, 2007, 2008, 2009). During 2007-2011, at the ARDS in Turda studies on the wheat pests such as diptera, aphids, leafhoppers, thrips, bugs, cereal leaf beetles etc, the levels of attack and the present integrated pest control strategy as part of the agro-ecological technological system of the sustainable development of wheat in Transylvania have been conducted (Tables 1 and 2).

Table 1. Dynamics of wheat pests structure (%) in 1980-2010, at ARDS Turda

Wheat pests	1980-1989	1990-1999	2000-2005	2006-2010
Wheat Thrips (*Haplothrips tritici)*	30.0	23.3	26.8	69.0
Cereal Aphids (*Sitobion avenae* etc.)	32.5	40.4	6.1	9.4
Wheat Leafhoppers (*Psammotettix alienus* etc.)	10.5	9.4	8.8	3.6
Cereal Flies (*Chloropidae, Anthomyiidae* etc.)	16.5	16.0	10.6	8.4
Wheat Fleas (*Chaetocnema, Phylotreta*)	9.0	4.1	26.0	4.5
Cereal Leaf Beetle (*Oulema*)	1.0	4.0	14.1	2.0
Cereal Bugs, sunn pest (*Eurygaster, Aelia*)	0.2	2.3	6.2	2.0
European Wheat Stem Sawfly (*Cephus pygmaeus*)	0.3	0.7	1.2	0.8

Table 2. Pests attack and density in wheat crops. ARDS Turda, 2000-2010

Pests	Attack level	Classic technology by ploughing (Turda, 2000-2005)	Conservative no tillage technology (Turda, 2006-2010)	Technology with agro-forestry belts (Cean-Bolduț, 2000-2010)
Wheat thrips	adults/ear	11	10.0	4
	larvae/ear	14	18.3	4
Aphids	aphids/ear	21	3.7	2
Cereal flies	deadheart tillers	46 %	40.1 %	9 %
Cereal bugs	bugs/m^2	5	2.0	0.5

The changes in the level of regional climate, represented by warming and excessive draught, ample alternation of temperatures and the presence of extremely warm periods especially in spring (Table 3), have caused the burst of pest populations which may cause unexpectedly important damages to wheat crops. Were pointed out major outbreaks of attack of thrips (*Haplothrips tritici*); aphids (*Sitobion avenae, Schizaphis graminum, Rhopalosiphum padi, Metopolophium dirhodum*); leafhoppers (*Javesella pellucida, Psammotettix alienus, Macrosteles laevis*); flies (*Chloropidae: Oscinella frit, Meromyza nigriventris, Elachiptera cornuta* etc. and *Anthomyidae: Delia coarctata, Phorbia securis, Ph. penicillifera)*; stem flea beetles *(Chaetocnema aridula)*; bugs (*Eurygaster maura, Aelia acuminata*).

Table 3. Average temperatures and sum of rainfall at Turda conditions by month, from March to August, and by year, in 2007-2011 (ARDS Turda)

Average temperatures (^oC)	March	April	May	June	July	August	Average/ year
2007	7.3	10.8	17.0	20.3	22.0	20.1	10.3
2008	5.4	10.5	15.0	19.4	19.5	21.0	10.1
2009	3.7	13.2	16.2	18.7	21.0	20.7	10.3
2010	4.3	10.5	15.4	18.9	20.7	21.0	9.7
2011	5.3	10.7	15.6	19.2	20.1	20.8	9.4
Multi-years average	4.0	9.8	14.8	17.8	19.5	19.4	8.9
Sum of precipitations (mm)	March	April	May	June	July	August	Sum/year
2007	24.4	10.1	103.8	77.1	54.4	118.1	655.3
2008	30.3	58.4	89.0	136.8	125.2	9.0	630.6
2009	53.5	8.4	31.4	113.4	52.5	38.1	493.4
2010	17.6	52.0	87.6	172.6	121.0	49.2	739.8
2011	15.3	22.6	41.4	116.8	130.4	12.8	433.0
Multi-years average	22.6	46.1	67.4	80.6	74.7	57.0	513.6

A diminish in the species range and an increase of the population abundance have been recorded in the problematic pests, especially in the monovoltin species or favoured by monoculture single crops and regional cereal agro ecosystems presence (*Haplothrips tritici, Delia coarctata, Opomyza florum, Phorbia penicillifera, Oulema melanopus*, *Chaetocnema aridula, Eurygaster maura, Aelia acuminata, Zabrus tenebrioides* and others, or diptera Chloropidae - *Oscinella frit, Elachiptera cornuta, Meromyza nigriventris* etc. and *Anthomyiidae polivoltine* - *Phorbia securis, Delia platura*, leafhoppers, aphids and others).

Due to aridization and climate warming, the critical attack moments have been recorded 3-4 weeks earlier than normal, and overlapped (Table 4).

Table 4. Population dynamics of main wheat pest. ARDS Turda, 2007-2011
(No./100 sweep net catches)

Sample collection data	10.04	20.04	30.04	10.05	20.05	30.05	05.06	10.06	15.06
Population dynamics of Thrips (*Haplothrips tritici*)									
Thrips 2007	0	0	3	335	68	0	96	17	0
Thrips 2008	0	0	0	23	183	106	6	17	148
Thrips 2009	3	1	4	11	139	150	0	72	23
Thrips 2010	3	0	8	8	312	897	28	9	31
Thrips 2011	0	0	6	230	34	85	25	7	10
Population dynamics of Aphids (*Sitobion, Schizaphis, Rhopalosiphum, Metopolophium* etc.)									
Aphids 2007	2	1	13	10	32	0	26	3	0
Aphids 2008	0	0	0	4	70	119	158	78	45
Aphids 2009	0	1	0	1	4	17	17	90	120
Aphids 2010	0	0	3	0	0	48	0	0	0
Aphids 2011	3	3	0	3	1	16	34	37	21
Population dynamics of Leafhoppers (*Psammottetix, Macrosteles, Javesella*)									
Leafhoppers 2007	3	7	3	6	3	0	3	1	0
Leafhoppers 2008	1	1	1	4	4	1	1	8	4
Leafhoppers 2009	0	2	5	12	16	6	0	3	4
Leafhoppers 2010	0	0	5	0	0	0	12	1	13
Leafhoppers 2011	9	4	10	6	1	18	1	12	5
Population dynamics of Wheat flies (*Delia, Phorbia, Oscinella, Meromyza etc.*)									
Cereal flies 2007	10	9	16	16	5	0	5	8	0
Cereal flies 2008	3	7	20	32	3	3	6	11	0
Cereal flies 2009	2	5	7	9	6	3	0	1	22
Cereal flies 2010	6	0	7	0	0	4	5	27	32
Cereal flies 2011	6	5	6	8	13	10	1	3	3
Population dynamics of Stem Wheat Fleas (*Chaetocnema aridula*) and Leaf Beetles (*Oulema melanopus*)									
Wheat fleas, Lema 2007	30	5	10	3	4	0	3	42	0
Wheat fleas, Lema 2008	8	12	2	27	2	6	0	0	51
Wheat fleas, Lema 2009	97	6	6	3	1	0	0	0	4
Wheat fleas, Lema 2010	53	0	23	0	3	0	7	0	7
Wheat fleas, Lema 2011	1	6	12	0	6	0	0	0	0
Population dynamics of Cereal Bugs (*Eurygaster maura, Aelia acuminata*)									
Sun Bugs 2007	2	0	3	3	3	0	2	3	0
Sun Bugs 2008	0	0	0	4	7	12	1 1	5	0
Sun Bugs 2009	0	1	1	0	1	3	0	6	1
Sun Bugs 2010	4	0	0	0	3	6	6	3	9
Sun Bugs 2011	0	0	0	0	0	2	0	0	2
Population dynamics of Other pests (Soil Pests *Agriotes, Opatrum, Anisoplia;* Wheat Stem Sawfly *(Cephus*) etc.									
Other pests 2007	0	0	0	0	0	0	0	0	0
Other pests 2008	0	0	0	4	2	3	0	1	0
Other pests 2009	2	2	0	3	2	2	0	0	0
Other pests 2010	4	0	0	0	0	0	3	0	3
Other pests 2011	0	0	3	0	4	2	3	3	0

Last year, pests have achieved 79% and entomophagous – 21% in the structure of entomofauna of winter wheat crops in open field area. *Haplothrips tritici* – reached a 73.5%; flies: 7%; aphids: 8.2%; leafhoppers 4.3%, in the pest structure, showing an important attack potential. *Haplothrips tritici* is the most abundant and important pest of wheat in classical (by ploughing) and conservative (by minimum soil tillage and no tillage) technologies.

An entomocenotic balance was maintained in agroforestry belts farming system of Cean Bolduţ.

The wheat pests had a structural share of 67% and the entomophagous achieved 33%

on the favourable conditions due to the forestry belts. Thrips showed 30% only and flies 27. 8%, aphids 24%, leafhoppers 3.9% in the pest structure (Table 5).

Table 5. Abundance and structure of pests and entomophags in wheat crops in open field agroecosystem in Turda and in the farming system with forestry belts at Cean-Bolduț, during 2010-2011 (No. /100 sweepnet catches)

Wheat pests and entomophags	Agroecosystem in open field area (Turda)				Agroecosystem with protective forestry belts (Cean-Bolduț)			
	2010		2011		2010		2011	
Phytophags	Total	%	Total	%	Total	%	Total	%
Thrips (*Haplothrips tritici)*	1257	84.00	756	73.5	134	25.0	129	30.0
Diptera (*Meromyza)*	4	0.30	10	1.0	17	3.0	11	2.5
Diptera *(Oscinella etc.)*	38	3.00	52	5.1	184	34.0	91	21.3
Diptera *(Delia, Phorbia)*	7	0.45	9	0.9	5	1.0	16	4.0
Col. *Oulema melanopus*	2	0.13	8	0.8	6	1.1	20	5.0
Col. *Chaetocnema aridula*	24	3.00	26	2.5	46	8.0	18	4.2
Col. *Phyllotreta vitulla*	55	4.00	3	0.3	11	2.0	4	1.0
Aphids (*Sitobion etc.)*	51	3.40	84	8.2	23	4.0	104	24.0
Leafhoppers (*Macrosteles*)	12	1.00	25	2.4	21	4.0	12	3.0
Leafhoppers (*Psammottetix*)	4	0.30	17	1.5	17	3.0	1	0.2
Leafhoppers (*Javesella*)	3	0.20	4	0.4			3	0.7
Bugs *(Eurygaster, Aelia)*	12	1.00	11	1.1	46	8.0	3	0.7
Het. *(Trygonothylus)*	5	0.32	14	1.4	26	5.0	9	2.0
Hym. *Cephus, Trachelus*	-				4	1.0		
Orthoptera	3	0.20	2	0.2	3	0.5	3	0.7
Wireworms (*Agriotes) etc.*	10	0.70	7	0.7	2	0.4	3	0.7
Entomophags								
Coccinellidae *(Coccinella* etc.*)*	11	5.5	9	3.4	4	2.0	2	1.0
Malachiidae *(Malachius bipust.)*	1	0.5	6	2.3	1	1. 0	2	1.0
Nabidae *(Nabis ferus)*	5	5.0	10	3.6	17	8.5	13	6.0
Staphylinidae (*Tachyporus hypn.)*	4	2.0	1	0.4				
Chrysopidae *(Chrysopa carnea)*	1	0.5	3	1.1	5	3.0	3	1.5
Syrphidae *(Episyrphus* etc.*)*	10	5.0	34	13.0	4	2.0	16	7.5
Empididae (*Platypalpus)*	8	4.0	27	10.1	15	8.0	15	7.0
Chloropidae *(Thaumatomyia)*	4	2.0	3	1.1	4	2.0	29	14.0
Hymenoptera *dif. parasites* etc.	101	49.3	72	27.0	46	23.5	61	29.0
Aranea	56	26.2	101	38.0	95	50.0	72	34.0
Phytophags Total	1487	88.0	1028	79.0	545	74.0	427	67.0
Entomophags Total	201	12.0	266	21.0	191	26.0	213	33.0
Total no.	1688		1294		731		640	

Comparative research on the abundance and structure of wheat pests in classical and conservative soil technologies proved a greater abundance and importance of the populations of flies, aphids, leafhoppers, wireworms reached at conservative no tillage technology, in open field agricultural system (Table 6). In order to provide a sustainable development of winter wheat crop under the present conditions, marked by the increase of pest abundance and attack, based on the accumulation of the effects of the unfavourable agro-ecological and technological factors in the agricultural exploitations, the adequate prevention and control measures have been required.

Table 6. Dynamics of abundance and structure of pests and entomophags in wheat crops, in two soil technology: classic system (by ploughing) and conservative no tillage system. ARDS Turda, 2009-2011

Entomophags	Abundance (no./100 sweepnet catches)						Structure (%)					
	Classic system			Conservative system			Classic system			Conservative system		
	2009	2010	2011	2009	2010	2011	2009	2010	2011	2009	2010	2011
Thrips	874	1896	384	802	970	294	67.4	85.50	64.2	69.0	78.0	54.4
Aphids	106	66	90	162	67	91	8.2	3.00	15.0	14.0	5.0	17.0
Leafhoppers	70	13	47	64	4	61	5.4	0.63	7.8	5.5	0.3	11.3
Cereal flies	82	20	38	68	36	55	6.3	0.92	6.5	5.8	0.9	10.1
Fleas and leaf beetles	48	201	26	30	149	19	3.7	9.13	4.3	2.6	12.2	3.5
Cereal bugs	98	12	3	24	7	4	7.5	0.54	0.5	2.1	1.0	0.7
Wireworms etc.	18	6	10	12	8	16	1.5	0.28	1.7	1.0	0.62	3.0
Phytophags	1296	2214	598	1162	1241	540	82.7	93.00	68.7	81.6	90.0	74.0
Entomophags	272	165	272	262	140	189	17.3	7.0	31.3	18.4	10.0	26.0
Total no.	1568	2379	870	1424	1381	729						

Testing the efficiency of the integrated pest control methods, has been carried out under different technological crop systems in open field area with anti-erosional terraces: classical system and conservative system (soil minimum tillage and no tillage) protective against draught, and in the agroforestry belts farming system. Within the testing experiments of economically and ecologically efficient insecticides, optimal application time, in an integrated technological system, has been studied including herbicides, fungicides, fertilizers applications etc. The integrated pest control methods under classical soil technology (by ploughing), in open field agricultural system, needs special attention on:

- analysis of zone and crop climate in interrelation with the periodical observation of attack potential (at crop emergence, in the spring at tillering and in the 2nd decade of May, at flag-leaf appearance and ear emergence);

- the use of agro-technological measures (the sowing in the second half of October, the volunteers wheat destruction, the balanced fertilization, herbicide treatment and others);

- insecticide treatment on seeds or vegetation;

- periodical multi-annual observation of the interactions with auxiliary entomophags, - predator populations enrichment and protection by careful treatment application on vegetation, by protection of entomophag refuge sites (by concentration area development at crop borders, protection of marginal flora diversity, protective agroforestry belts etc., which ensures the presence and growth of auxiliary species, fast colonization of the crops, and the occurrence of natural efficient biological pest control).

Insecticide application should be carried out when the economic damage threshold values of pest have been exceeded. Also, insecticide application is recommended taking into account the activity of the natural reserve of predatory and parasite entomophags. Especially, the polyphagous predators diminish actively the main pests in the crops. The natural predators play an important role in decreasing the pest abundance.

The wellknown systematic groups of entomophagous predators: *Aranea; Thysanoptera (Aeolothripidae); Heteroptera (Nabidae* etc.*)*; *Coleoptera (Carabidae, Staphylinidae, Coccinellidae, Cantharidae, Malachiidae* etc.); *Diptera (Syrphidae, Empididae* etc.); *Hymenoptera (Formicidae* etc.); *Neuroptera (Chrysopidae)* etc. were represented in the structure of arthropod fauna (Malschi, 2007, 2008, 2009).

The research proved that the insecticide treatments applied on vegetation have been used for the prevention and control of a pest complex. In the last years, two critical attack moments and risk situations have been reported to require treatment application:

1. In April, at the end of plant tillering in the 25-33 DC stage (at herbicide treatment), or earlier in some years; insecticide treatment for diptera and wheat fleas control (*Chaetocnema)*, bug and *Oulema* adults also to reduce thrips and leafhoppers attack potential, has been carried out by using systemic insecticides: neonicotinoids – tiacloprid, thiametoxam; organophosphorous and others, which achieved control efficiencies and yield increases. At this moment, entomophagous auxiliary fauna has been at the beginning of its occurrence in the crops and less exposed to insecticides.

2. The treatment in the flag-leaf appearance and ear emergence, in the 45-59 DC stage, in May 10-25, has been applied to control wheat thrips adults (*Haplothrips tritici* Kurdj.), aphids, bugs and others. The pyrethroids, neonicotinoids etc. achieved immediate control of the pest complex with efficiencies against thrip larvae development of the ears and yield increases. At this treatment time the most significant part of the entomophag natural biological control activity has been carried out, most of the species being less sensitive to insecticides as eggs and pupae.

The integrated pest management research on the cereal agro ecosystems with conservative no tillage soil technology, have been conducted in 2008-2011 and have recommended the insecticides chemical control, using 2-3 successive insecticides treatments (Table 7).

Table 7. Average effect of conservative system, in wheat Arieşan variety. ARDS Turda, 2008-2010

Tillage	Classic system by ploughing			Conservative system no tillage			% Impact of no tillage technology
Complex treatments Insecticides application moments	Grain yield (kg/ha)			Grain yield (kg/ha)			
	Average	%	Dif.	Average	%	Dif.	
C1(T1+…+T3+T4)	4155	100	+0	4358	100	+0	104.9
C2 (...+T2+T3+...)	4046	97.4	-110	4419	101.4	+61	109.2
C3 (...+T2+T3+T4)	3883	93.5	-272	4250	97.5	-108	109.5
C4 (...+T2+…+T4)	4059	97.7	-96	4487	103.0	+129	110.5
LSD 5%			+284			+265	

T1 (early spring) - Calypso 480 SC 100 ml/ha; T2 (end of tillering) - Calypso 480 SC 100 ml/ha;
T3 (flag-leaf) - Proteus OD 110 400 ml/ha; T4 (end of flowering) - Proteus OD 110 400 ml/ha.
Complex treatments with herbicides, fertilizers or fungicides:
C1 (T1 + T3 + T4); C2 (T2 + T3); C3 (T2 + T3 + T4); C4 (T2 + T4).

The applied integrated pest management on favourable agro ecological conditions in the farm with protective forestry belts, in Cean-Bolduţ, shows the efficiency of biological control, using the entomophagous natural resources, without insecticides (Malschi, 2009; Malschi et al., 2010). Identification of efficient insecticides in pests control on vegetation, the assessment of optimal application time, the evaluation of insecticide side effects on the auxiliary entomophags in the crops, the emergence of resistance to insecticide, have been conducted in 2008-2011, in demonstrative experiments and lots where systemic neonicotinoid insecticides (Calypso 480 SC-100 ml/ha), pyrethroids with instant shock action (Decis 25 WG-0,030 Kg/ha) and a mixture of these (Proteus OD 110-400 ml/ha), but also new formula of pyrethroids such as Cylothrin 60 CS- 80 ml/ha, Alphamethrin 10 CE-100 ml/ha, Grenade SYN-75 ml/ha have been applied. The research showed the value of some quality insecticides, adequate to the present high temperatures and abundance of pests, and the overlap of attack of several phytophags groups. Identification of adequate, quality, seed-applied insecticides, biologically, economically and ecologically efficient has been conducted in experiments using the Yunta 246 FS-2 l/t insectofungicide (Table 8).

Table 8. Effect of insecticide treatments in the wheat flag-leaf and ear emergence stage application (Ariesan variety) ARDS Turda, 2008

Treatment variants	Ears/m^2			Kg/ha		
	Average	%	Difference	Average	%	Difference
V1. Untreated	463	100.0	-	5456	100.0	-
V2. Yunta 246 FS, 2 l/t TS	389	84.2	- 74.0 $^{o\,o}$	5650	103.5	194
V3. Cylothrin 60 CS 80 ml/ha	575	124.2	112.0 ***	6850	125.5	1394 ***
V4. Alphamethrin 10 CE 100 ml/ha	504	109.0	41.0	7170	131.4	1714 ***
V5. Decis 25 WG 0,030 kg/ha	580	125.4	117.0 ***	6793	124.5	1337 ***
V6. Proteus OD 110 400 ml/ha	488	105.5	25.0	5990	109.8	534 *
V7. Calypso 480 SC 100 ml/ha	567	122.5	104.0 ***	6150	112.7	694 *
V8. Grenade SYN 75 ml/ha	556	120.2	93.0***	5540	101.5	84
LSD 5%		9.4	43.7		9.2	503.5
LSD 1%		13.1	60.6		12.8	687.9
LSD 0.5%		18.2	84.2		17.7	969.5
	F=21.74 (2.76)			F= 15.9 (2.76)		

The application of special insecticide treatments is required especially under unfavourable agroecological conditions of excessive heat and draught during the critical attack periods, in the case of crops with incomplete or incorrect technology related to the use of single crops and early sowing, before the regional optimal sowing time, and also, in no tillage and minimum soil tillage technologies (Carlier et al., 2006; Guş and Rusu, 2008; Haş et al., 2008; Malschi et al., 2010, 2011). Insecticide control using the variety of modern products (pyrethroids, neonicotinoids, plant penetrating systemic products) has been studies in order to test the biological efficiency of the treatments, insecticide remnant capacity, negative effects on useful entomophags (Tables 9 and 10).

Table 9. The side effect of Yunta 246 FS 2 l/t seed treatment on useful entomophags fauna in winter wheat crops ARDS Turda, 2008

A. Abundance and mortality of auxiliary soil fauna (Sum of Barber traps catches)				
Sampling date	29.05		24.06	
Variants	V1	V2	V1	V2
Brachinus explodens	3	1	25	15
Poecilus cupreus	84	28	250	150
Pseudophonus rufipes			50	30
Pterostichus melanarius	12	1	125	75
Harpalus distinguendus	2		15	9
Dolichus halensis	17	3		
Sylpha obscura	10	2	25	15
Necrophorus vespillo			10	6
Scarabeus	2			
Aranea	13	2		
Total	145	37	500	300
Mortality % - negative impact		74.5		40.0
B. Entomophags mortality after Yunta 246 FS (no./100 sweepnet catches)				
Sampling date	14.05		27.05	
Variants	V1	V2	V1	V2
Coccinellidae	1		1	1
Cantharidae	17	2		
Malachiidae			2	2
Syrphidae			1	
Empididae (Platypalpus)			2	
Hymenoptera - parasites	13	6	8	
Formicidae	2	3	3	1
Aranea	3		2	3
Total entomofags	36	11	19	8
Mortality % - negative impact		69		42

Variants of seed treatments: V1 = without insecticide; V2 = with Yunta 246 FS, 2 l/t.

Table 10. Dynamics of wheat pests after insecticide application at 30.05.2008, ARSD Turda (No./100 sweepnet catches)

Wheat pests	Treatment immediate side effect after 4 days							Insecticide side effect after 12 days						
	Sampling date 3.06.2008							Sampling date 11.06.2008						
	Mt.	V3	V4	V5	V6	V7	V8	V1	V3	V4	V5	V6	V7	V8
Phytophags	564	11	38	57	46	53	21	121	42	71	96	35	67	22
Insecticide efficiency, %		98	93	90	92	91	96		65	41	21	71	46	82
Entomophags	23	6	11	5	6	11	2	44	11	14	31	7	12	9
Mortality,%		74	52	78	74	52	91		75	68	30	84	80	80
	Insecticide side effect after 26 days							Insecticide side effect after 34 days						
	Sampling date 25.06.2008							Sampling date 3.07.2008						
	Mt.	V3	V4	V5	V6	V7	V8	Mt	V3	V4	V5	V6	V7	V8
Phytophags	111	28	30	14	40	70	12	141	58	101	80	77	107	44
Insecticide efficiency, %		75	73	87	64	37	89		59	28	43	45	24	69
Entomophags	48	15	26	26	18	39	21	96	110	103	89	66	75	82
Mortality, %		69	46	46	63	19	56				7	31	22	15

Variants:
Mt.= untreated; V1= seed without insecticide treatment; V2= seed treated with Yunta 246 FS, 2 l/t.;
V3=Cylothrin 60 CS 80 ml/ha; V4=Alphamethrin 10 CE 100 ml/ha; V5=Decis 25 WG 0,030 Kg/ha;
V6= Proteus OD 110 400 ml/ha; V7=Calypso 480 SC 100 ml/ha; V8=Grenade SYN 75 ml/ha.

CONCLUSIONS

A complex technology as part of the integrated pest control system has been recommended, comprising the use of agro-technical measures, having an overall role in the prevention and diminish of the pest attack, virtually achieved by:

- crop rotation ensuring the optimum preceding crop and avoidance of monoculture single crops;
- soil preparation and maintenance, soil activities (tilling, disking, wheat volunteers destruction, other conservative technology specific of minimum tillage and no tillage technologies);
- keeping density and optimal sowing time (October 10-20), so that wheat crop emergence avoids massive infestation by pests (diptera, aphids, leafhoppers) and provide good plant growing rhythm and vigour;
- balanced application of fertilizers, herbicides and disease control treatments which provide a good plant growth.

The integrated control of wheat pests by optimising the technological factors such as: sowing time, insecto-fungicide seed treatments, insecticide vegetation treatments, fertilization, and by optimising the biotic factors: natural entomophags, environment protection, preservation and sustainable use of biodiversity has been studied in experimental lots, in vegetation year 2008-2011.

The economic and ecological efficiency of the integrated wheat pest management system in Transylvania can be achieved by using the prevention and risk control strategy due to the present pest abundance and aggressiveness, by protection and sustainable use of the natural resources of biodiversity, including the activity of auxiliary entomophag activity in the crops. The abundant populations of thrips, flies, aphids and leafhoppers were reduced efficiently by applying insecticides.

The IPM research on the cereal agroecosystems in open field area with classic by ploughing and conservative no tillage soil technology, in ARDS Turda, pointed out and recommended the insecticides chemical control, using 2-3 successive insecticides treatments. The recommended attack diminishing methods of wheat pests include the application of insecticides, with economic and ecological efficiency, in two different selective moments: 1 – for the control of wheat flies larvae, leafhoppers and other pests, in April, at the end of tillering phase (13-33 DC stage); 2 – for the ear pests control – thrips, aphids, bugs, leafhoppers and other pests at the flag-leaf appearance and ear emergence in 45-59 DC stage, in the period of May, 10^{th}-25^{th}; the use of biological factors (entomophags limiters). Yield results have shown that the technological system provided the control of risk factors, and the harvest results at the level of yielding capacity.

Special attention should be given to the farming system with agroforestry belts, which provide auxiliary entomophags conservation and development and the natural biological pest limitation, not to mention the antierosion role. The applied IPM on favourable agroecological conditions in the farm with protective forestry belts, in Cean-Bolduţ, shows the efficiency of biological control, using the entomophagous natural resources, without insecticides.

The knowledge concerning the integrated pest management system achieved in accordance with the contemporary expectations regarding the optimisation of the relations between environment, agriculture and sustainable development have been outlined and specified. The integrated wheat pest management has a special significance because it represents one of the priorities of agricultural sustainable development. The objectives are the achievement of yield safety under risky conditions caused by the attack of these pests in relation with the climate and regional agroecological changes, the attaining economic and ecological efficiency of the control methods; the protection of environment and food quality; preservation and use of biodiversity.

Acknowledgements

The authors acknowledge special to Agricultural Research and Development Station Turda, to the working group of plant protection laboratory for their interest shown in the research. Special thanks to The National University Research Council (CNCSIS) and to The "Babeş-Bolyai" University and Faculty of Environmental Sciences, Cluj-Napoca, for the support of the research.

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