Integrated pest management in relation to environmental sustainability

Part I
Ecological management of wheat pests

Dana Malschi

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FOREWORD

The new book entitled ***„Integrated pest management in relation to environmental sustainability. Part I. Ecological management of wheat pests.”*** Course notes and practical applications. Manual online, elaborated by Dana Malschi, PhD, proves remarkable for the systemic approach of the relationships between the sustainable development objectives, environmental protection and integrated pest control as part of cereal farms environmental management, under the agroecological conditions related to present climate and technological changes.

The main aspects of the present problems regarding the characteristics of agriculture and agroecosystem sustainable development in relation to the presence and evolution of damaging fauna and entomophagous auxiliary fauna have been described in a logical content structure and with an English presentation.

Author’s original contribution consist in the results of the long term research conducted in Central Transylvania at the Agricultural Research and Development Station in Turda where she has approached the facets of the integrated pest control management in cereal ecosystems including species inventory, understanding of biology, ecology and pest populations dynamics and their control.

Special attention has been given to the monitorization of cereal pest emergence and attack, the book concluding with the concept of preventive measures and the pest control strategy.

The author is well-known within the specialists community in the field of plant protection as a dedicated scientist showing scientific accuracy in her scientific works, professional abnegation in her researches presented in over 100 published scientific papers. The elaborated book, entitled “Environment-agriculture-sustainable development, and the integrated pest management of cereal agroecosystems”, standed out by a prize distinction “Constantin Sandu Aldea“ of the Academy of Agricultural and Forestry Sciences, in 2007, receiving the recommendations of Univ.prof.dr.entomologist Teodosie Perju, U.A.S.V.M. Cluj-Napoca and Univ.prof.dr. Ioan Haş, Director of A.R.D.S. Turda.

The book is intended to both students and all those involved in the study of the integrated pest control in agricultural crops, and is a major contribution to the broadening of knowledge regarding the relation between the objectives of agricultural yield and environmental mamagement in the context of agricultural ecosystem sustainable development.

Prof.univ. Gheorghe SIN
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Authors' word

Elaborated in 2009, the paper ”Integrated pest management in relation to environmental sustainability. Part I. Ecological management of wheat pests. Course notes and practical applications. Manual online.” is a synthesis of the author`s research on the plant protection and environmental applied domain of entomology and ecology. The reason for publishing this book has been the knowledge progress in the entomological research domain concerning the agricultural production safety by the development of the pest control technologies, by the management of biological resources from agro-ecosystems, increase and quality of the agricultural productions, in concordance with the concept of sustainable development, under the present climatic and agro-ecological changes.

Based on author's 30 year research studies at the Agricultural Research Station in Turda (The Romanian Academy of Agriculture and Forestry Sciences), in central Transylvania, the paper presents the agro-ecological study on the population dynamics and attack evolution of wheat pests entomofauna: Diptera, Homoptera, Thysanoptera, Coleoptera, Heteroptera etc., and biotechnological experiments on the adequate integrated pest control methods, including insecticides efficiency, cultural measures and entomophagous predators limiters, environmental protection, conservation and sustainable use of biodiversity, involved in the actual pests control strategy, as part of the technological system for sustainable development of cereal crops.

In the book chapters: 1. The environment-agriculture-sustainable development relations and integrated pest management; 2. Ecology and cereal agroecosystems; 3. Auxiliary entomophagous fauna in cereal agroecosystems; 4. The integrated pest management of cereal agroecosystems, the paper presents data on the pests and useful arthropod fauna, biological and agro-ecological 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, to protect and use the natural reservoir of entomophagous in cereal agro-ecosystems.

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 has pointed out the increasing attack of main wheat pests: wheat flies, leafhoppers, aphids, trips, sun bugs, cereal leaf beetle etc., and the opportunity of insecticide control.

The spring months of the last years have been characterized by increasing warming, heating and dryness periods, causing the increase of pests abundance and damages on wheat crops, in Transylvania. A decrease in species diversity has been noticed together with an increasing abundance of the species with a single generation by year: *Delia coarctata* FALL., *Opomyza florum* F., *Phorbia penicillifera* JERMY, *Oulema melanopus* L., *Chaetocnema aridula* GYLL., *Eurygaster maura* L., *Aelia acuminata* L., *Haplothrips tritici* KURDJ., *Zabrus tenebrioides* GOEZE, and of the other species of chloropids, anthomyiids, cecidomyiids flies, leafhoppers (*Psammotettix alienus* DAHLB., *Macrosteles laevis* RIB., *Macrosteles sexnotatus* FALL., *Javesella pellucida* FABR.), aphids (*Schizaphis graminum* ROND., *Macrosiphum (Sitobion) avenae* FABR., *Rhopalosiphum padi* L., *Metopolophium dirhodum* WALK.) etc., well favored by consecutive wheat crops and by zone cereal ecosystems presence.

The attack critical moments of the different species were recorded 3–4 weeks earlier and superposed. The insecticide treatments were imposed during the spring phase, in April and during the spike appearance phase, in mid May.

The paper points out the extension risk of wheat pests attack with an increasing potential, affecting the wheat crops yields and causing possible crop damages or leading to the compromise especially of the sown 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 diminishing methods of the ICS are: - 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; - 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 efficiently 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 during spike appearance phase in 45-59 DC stage, during May 15^{th}-25^{th}, 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 yield rates of 7-24 % have been the experimental results recommending an adequate technological system and modern insecticides pest control strategy.

The natural predators play an important role in decreasing the wheat pest abundance. 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. Laboratory tests and investigation regarding the role of the main species of predatory entomophagues as regulators of pest populations in cereal agro-ecosystems, has proved that various species feed preferentially on wheat flies, cereal aphids, trips, cereal sun bugs, *Oulema* etc. 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 predatory species. 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 the Cean-Bolduţ farm of A.R.D.S. in Turda. Therefore, on the farm with protective forestry belts and with field marginal herbs, favorable for the development of entomophagous arthropod fauna, a real natural entomocenotic equilibrium and a natural biological control of important zone pests, like *Oulema melanopus* L., cereal flies, aphides, cicades, thrips, cereal sun bugs has been achieved. By comparison it is necessary to apply the insecticide treatments on the cereal agroecosystem in open field areas, because the development of pest population exceeds the adjusting capacity of entomophagous arthropod fauna.

The book is a systemic approach of the relationships between the sustainable development objectives, environmental protection and integrated pest control as part of cereal integrated environmental management. The book is intended to students and all those involved in the study of the integrated pest control in agricultural crops, in the context of agricultural ecosystem sustainable development.

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Plate 1

Aspects of different agricultural exploitations in the centre of Transylvania, Cluj Country.

Aspects of the farm with agroforestry belts, in Bolduţ, A.R.D.S. Turda.

Plate 2

Aspects of the agroecosystems biodiversity situated in open field area, in antierosional terraces and in the farm with protective forestry belts, at A.R.D.S. Turda.

1. The environment-agriculture-sustainable development relations and integrated pest management

1.1. Sustainable development in agriculture

Ecological thinking applied to agriculture and environment was founded decades ago within the universities and the national network of research institutes of the field. This interest has undergone an impressive development nowadays, in the context of the problems arising from the sustainable development and biodiversity conservation which happens at present. The present changes in climate, the often divided agricultural working systems and the frequent deficient and incorrect crop technologies cause significant agroecological changes. These changes refer to the severe effects on soil and crop plant development, technological mistakes, pollution, draught and heat, storms, torrents, landfalls, inundations etc., together with the structural changes and the abundance of damaging entomofauna which may lead to agroecosystem destruction.

The trends of the ecological conscience evolution require interdisciplinary approaches specialized in agricultural and environmental science and engineering where the sustainable development of agriculture, including the question of integrated management of pest control in cereal agroecosystems, represents an important element of environmental safety, the supply for social progress, and the use of environmental factors friendly to the biosphere in all its diversity.

1.2. Directions and perspectives for sustainable agricultural development

In Romania, the applied preoccupations for a sustainable development of agriculture based on thoroughgoing study and long-term fundamental researches on crop yield factors, on biodiversity, environmental protection and on the use of natural or anthropized resources, have been important objectives for the scientific research institutes and higher education for the last decades in Europe and worldwide (Berca, 2006, Cristea, 2006, Hera et al., 2004, Haiduc, 2006, Kiss et al., 1991, Man, Ivan, 1999, Toncea, 1999).

On the basis of higher education and research formation, the Romanian school of ecology applied to environment, contemporary researchers and field specialists have approached regionally and globally integrated systemic research (Botnariuc, Vădineanu, 1982, Stugren, 1994, Vădineanu, 1998, Cristea 1993, Cristea, Gafta, Pedrotti, 2004), in order to achieve:-the projection and elaboration of regional technologies for a sustainable agricultural development, for biocenoses yield increase or restoration, for ecological reconstruction and for the use of ecological agriculture involving the integrated management of stabilized ecological interrelations, of agroecosystem yield rate and self-preservation, and the creation of biodiversity needed by agriculture (Berca, 2006, Ghidra, 2004, Haş, 2006, Hera et al., 2004, Munteanu et al., 2005, Malschi et al., 2005, Puia et al., 2001, Toncea, 1999); **- practical aspects of environmental protection** related to yield growth, regional agricultural, forestry, urban ecosystem conservation and sustainable development (Cristea, 2006, Dordea, Coman, 2005, Fabian, Onaca, 1999, Fiţiu, 2004, Malschi, 2003, 2004, 2005); **- aspects of integrated management of environmental impact** in different polluting economic activities (Ozunu, Teodosiu, 2002, Răuţă, Cârstea, 1983), as well as **ecosystem reconstruction** as a result of biocenoses destruction in the areas affected by natural and anthropic calamities, by pollution and technological malfunctions, by present climate changes (Cristea, 1993, Cristea, Gafta, Pedrotti, 2004, Kiss et al., 1993).

New directions towards conservative agriculture are taking shape within the systems of sustainable agricultural development, in the context of present climate changes by implementing the results of the research regarding: the farming and soil tillage by **terracing on contours** in order to avoid the damaging effects of soil erosion; the planting of **antierosion agroforestry belts** with many protective effects on cultures, biodiversity, stability and biocenotic balance, avoiding insecticide pollution etc; the non-polluting **ecological agriculture**; the **minimum and conservation soil tillage**, in order to avoid the damaging effects of draught; the soils ecological reconstruction etc. (boards 1 and 2). The studies of integrated management, including the planning of the use of sustainable agricultural development management in accordance with European legislation and integration requirements, will be used in environment activities (Government Law no. 195/22.12.2005 regarding environmental protection, Order 876/2004 issued by The Ministry of Environment and Sustainable Development to authorize the activities significantly influencing the environment). The concern to optimize the environment-agriculture-sustainable development relationship is globally required as part of the operational programs of the United Nations for development, that is for sustainable conservation and use of the biological diversity in agriculture, the biodiversity related to soil degradation problems, pesticide-based persistent organic pollution limitation. The primary objectives of the researches for a sustainable development and biodiversity conservation envisage: the use and management of biodiversity on the level of ecosystem; the use of biological diversity, so vital for agriculture through regional agrobiocenose stability and yield growth, by making the natural biological control of crop pests more efficient, and by suppression of insecticides pollution etc.; the antierosional protection and diminish of soil degrading effects caused by climate changes; the planning of integrated agricultural systems which lead to the protection of land with environment-friendly technologies, thus contributing to agricultural improvement and regional community progress on long-term.

1.3. Sustainable preservation and use of bioresources, reconstruction of biodiversity

In order to have a sustainable development of agriculture in Central Transylvania, the integrated management system of agricultural crops (Fiţiu, 2004, Haş, 2006, Malschi et al. 2005, Munteanu et al. 2005, Puia et al. 2001, Roman et al. 1982) and pest control (Malschi, 2003, 2004, 2005) includes - as an important link – the complex measures of conservation, use and reconstruction of biodiversity, plant diversity in the agrosystems, diversity of useful arthropod fauna – mainly entomophagous – through biological methods. These biotechnologies regard several aspects of sustainable use of bioresources: - Protection and increase of using the activity of pest natural entomophagous stock; - Enriching the cultivated field edges with auxiliary entomophag-attracting plants; - Conservation of plant diversity belonging to marginal grass, area-specific meadows and pastures made of several plants with flowers important to entomophag growth *(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.*);* - Afforestation of protective tree and shrub belts, protective and antierosional grassed belts also favorable to entomophag growth in the ecoton areas and to their migration into the crops; - Plantation of agroforestry belts comprising tree and shrub species: *Cerasus avium, Malus silvestris, Pirus piraster, Prunus spinosa, Crataegus monogyna, Rosa canina, Corylus avellana, Ligustrum vulgare, Staphylea pinnata, Vaccinium spp., Sambucus nigra etc* on the outer sides and *Quercus robur, Ulmus spp, Robinia pseudacacia, Acer platanoides, Acer pseudoplatanus, Fraxinus excelsior, Tillia cordata, Salix caprea* etc. on the inner sides (Lupe, Spîrchez, 1955, Malschi, Mustea 1995, Malschi, 2003, 2005, 2007, Popescu 1993).

The existence of diversified flora within the protective belt system represents the main factor to ensure richness of the species, survival, increase of abundance and seasonal migration from one field to another of useful entomophagous arthropods.

1.4. Ecological reconstruction in agriculture

The ecological reconstruction in agriculture – ecogenesis – on agricultural fields means phyto- and zoocenosis restoration, soil microbiotic recovery and pedogenesis by spontaneous recolonization or controlled phyto- and zoocenosis recropping, technical and biological pedogenesis methods, controlled methods for stabilized biocenotic relations favorable to ecological reconstruction; methods of biotope constituents reconstruction (mechanical works, organic fertilization, green manure, chemical fertilization etc.); monitorization of species dynamics, pest and invasive species control; erosion and climate unfavorable conditions control.

The ecological reconstruction in agriculture plays a major role within the context of present climate changes, the system of agricultural exploitation and applied crop technologies. There are changes in the structure, richness and dominance of the damaging species occurring in agrobiocenoses, severe effects on soil and plant development are taking place caused by technological mistakes, pests, pollution, draught and excessive heat, storms, torrents, landfalls, floods etc. which may lead to the destruction of the affected agroecosystems.

The damaging effect of the disturbing factors and ecological disasters on the agricultural biocenoses requires the ecological reconstruction of the affected area or of living beings depopulated area with the agricultural or forestry purposes, with the antierosional or protective aims against present and future climate and technological changes; with the environmental, sanogenetic (parks, green areas) and landscaping purposes etc.

The ecological reconstruction applied on abiotic substrates, polluted and contaminated biotopes from industrial and agricultural activities use technical and biological methods which may provide the ecogenesis, that is pioneered phyto- and zoocenosis emergence, simultaneous pedogenesis, restoration of microbiosis, humus and soil properties, phyto- and zoocenotic reconstruction, species cultivation and colonization, and stabilization of interspecific relations in favor of yield growth and biocenotic balance in the new ecosystem.

The environmentaly genesis and regulatory functions of phytocenosis provide ecological reconstruction by anthropic landscape fixation, pedogenesis adjustment and soil protection, zoocenosis formation and fauna conservation, microclimate control, precipitation interception and water control, decrease of wind speed, decrease of surface flows, deep erosion (landsliding, ravines), slime sediment etc. (Cristea, 1993, Cristea, Gafta, Pedrotti, 2004).

1.5. Pest control-related strategies of sustainable development

In the last three decades the results of applied entomological scientific research has lead to the conclusion that in Transylvania pest control has been required as an important technological sequence of crop integrated system. Every year, pests, represented by many species of phytophagous insects, have caused significant and unpermissible yield losses taking into account the objectives regarding food resources safety, the economic objectives and those related to agriculture and environment sustainable development (Malschi et al., 2005).

Thinking about the many cereal crop pests, we must emphasize the importance of the attacks leading to the unachievement of plant yielding potential or even yield compromising under extreme insect richness-related risk situations.

Understanding pest insects is of special practical importance because the moment of attack appearance is often hard to detect due to the small, sometimes millimetric size of the species or their phytophagous stages, and also due to the characteristics of the hidden parasitary attack inside or among plant tissues, in the ground or sometimes hidden by vegetative growth and plant phenological development.

During the mentioned period over 50 species of cereal crop-affecting pests have been shown in the structure of cereal entomocenoses of Transylvania. Due to the substantial economic damages a regional specific complex made of diptera species: *Opomyza florum F., Delia coarctata Fll., Phorbia securis Tiensuu, Ph. penicillifera Jermy. Oscinella frit L.;* aphid species: *Schizaphis graminum* Rond., *Macrosiphum avenae* Fabr *Rhopalosiphum padi* L., *Metopolophium dirhodum* Walk. and cycad species: *Psammotettix alienus* Dahlb., *Macrosteles laevis* Rib., *Javesella pellucida* Fabr.; wheat thrips: *Haplothrips tritici Kurdj.*; barley leafbeetle *Oulema malanopus L.*; flea beetles: *Chaetocnema aridula* Gyll.., *Phyllotreta vitulla* Redt.; other soil pests: *Agriotes, Opatrum, Zabrus, Agrotis etc.* (Malschi, Mustea, 1992, 1997, Malschi, 2001, 2003, 2004, 2007) has been pointed out.

The damages may reach significant values: 300-1500 kg/ha yield losses in the case of diptera spring attack recorded in rate of 50-90% of attacked plants and intensities of 10-25% larvae-destroyed tillers; losses of 14-25% wheat and spring barley yield as a consequence of *Oulema* larvae attack in densities exceeding the damaging economic threshold; 15-20% yield losses with wheat-ear pests at average densities of 22 thrips larvae and 32 aphids/ear. In the case of early September sowing, cereal flies, aphids and cycads may cause crop damages (Malschi, Mustea,1998, Malschi, 1999, 2000, 2001, 2004, 2007).

In the last years, the permanent concern regarding the study of pest attack dynamics related to the evolution of regional agroecological constituents has developed the observation of the impact caused by the climate changes in the cereal crop entomocenoses. Climate warming, the settlement of extremely hot periods, draught and heat during spring and summer months have been severe ecological factors which induced changes in species structure, facilitating the growth of populations belonging to a more narrow spectrum of problem-arising species which have become dominant and dangerous due to the number increases, even number bursts, and due to local invasions and powerful attacks.

These changes have also been favored by several types of agricultural exploitations, crumbling of cultivated areas, the diversity of agroecological conditions, the use of incomplete or incorrect cropping techniques such as: using of consecutive crops, sowing out of optimal regional period, deficiencies of agrotechnical and phytosanitary measures.

Researches have also shown the presence of a natural entomophagous-useful fauna resource characterized by richness of species and efficiency of limiting activity of phytophagous insects, all known groups of auxiliary predators and parasites being recorded (*Aranea; Dermaptera; Thysanoptera (Aeolothripidae); Heteroptera (Nabidae* etc.); *Coleoptera (Sylphidae, Coccinellidae, Carabidae, Cicindelidae, Staphylinidae, Cantharidae, Malachiidae*); *Diptera (Syrphidae, Scatophagidae, Empididae ş.a..); Hymenoptera (Formicidae* etc.) *Neuroptera (Chrysopidae*) etc. The presence of entomophags in the crop, spring to autumn, ranging from 25 to 59% in the structure of arthropod fauna has a natural biological pest limitation effect.

Laboratory researches performed after the model of prey-predator interactions observed in regional cereal biocenoses have shown the role and importance of auxiliary entomophags (Malschi, Mustea 1995, 1998, 2003). Therefore, the need to elaborate and project sustainable development strategies within the integrated pest control management is obvious. This should include regional biodiversity conservation and use, in order to achieve agrosystem yield growth and stability. It has also been proven that the application of chemical control measures in order to avoid yield losses caused by phytophagous insects should be based on the study of all factors involved, and it is not a unique solution. Instead, the use of a complex agroecological integrated system has proved beneficial, with measures of preventive and curing control based on interdisciplinary investigation.

The integrated pest control system represents a significant, modern and present direction in phytosanitary practice (Baicu, 1996, Bărbulescu et al.,1997, Malschi, Mustea, 1992, 1998, Malschi, Perju, 1999, Malschi, 2000, 2001, 2003, 2007, Perju, Muresanu, Malschi, 2004).

Insecticide application is a strong and complex-impact operation on agroecosystems regarding high interest aspects, such as: **the achievement of adecquate biological efficiency** against pests corresponding to the optimal application time established in accordance with climate, phenological, biological conditions and the stage of insect development; **obtaining economic efficiency** of treatment; **diminishing negative secondary effects** on the populations of useful entomophagous species, on the interactions and biocenotic balance between pests and entomophags; tracing the emergence of **pests genetic resistance** to insecticides; **phytotoxicity** on seeds and plants; **the polluting effects** on environment, agricultural and food products and humans.

The modern insecticides elaborated to destroy attack focuses or to prevent damages in the risk areas have been tested in order to comply with the present requirements regarding economic and ecological efficiency of their application within the integrated control system.

For a sustainable development of agriculture, complex interdisciplinary researches have focused on the integrated systemic approach of pest control strategies.

The integrated pest control management. The integrated control includes application of modern approved insecticides where necessary in accordance with the prognosis and warning of the pest attack. Nevertheless, this integrated pest management also recommends prioritary implementation of the preventive non polluting activities and measures: agrotechnical, phytosanitary, biotechnological crop measures for the pest attack-limiting.

The elaboration of pest integrated management requires several stages of complex researches:

1. The inventory of damaging species, the understanding of regional characteristics of pest biology, ecology and control;
2. The evaluation of population dynamics under regional agroecological conditions, including climate factors, crop pheonological development, the dynamics of entomophag natural reserve;
3. The monitorization of pest apparison and attack and the interactions with auxiliary species;
4. Planning preventive measures and control strategies which comprise several aspects regarding:

- cropping regionally adapted, tolerant, highly yielding, damage-compensating varieties;
- sowing during optimal time, protective against pest attack and the first dangerous invasions, and also important to provide starting rate and crop initial vegetative strength;
- the agrotechnical methods which mechanically diminish a large proportion of pest biological reserve (crop rotation, soil tillage – ploughing, disking, destroying volontier herbs etc.;
- phytosanitary methods of disease and weed integrated control, balanced fertilization – crucial for plant healthy growing in their fight against phytophagous insects;
- protection, use and development of the natural entomophags reserve through conservation of auxiliary species and plant biodiversity, special development of ecoton marginal areas including trees, shrubs, herbs, their protection against herbicides etc.;
- the use of nonpolluting-selective biotechnologies such as: cultivation of new resistant breeds and varieties, controlled parasites and predators breeding and release, placing of pheromonal traps etc.;
- caution in implementing only phytosanitarily certified, nonpolluting control measures into the system that do not cause negative effects on the agroecosystem balance and stability.

Pest control strategies in compliance with the objectives of agricultural sustainable development in Central Transylvania have been designed in accordance with the agroecological conditions of agricultural exploitations, especially agroecosystem biodiversity.

Long term researches have revealed the distinct situations in several agricultural systems, open field crop systems with intensive technology or poorly technologized (in small lots), and also antierosional agricultural systems with terraces and forestry belts which preserve flora and auxiliary fauna diversity etc.

The use of insecticides in the case of field crops, has been recommended within the proper integrated technological system under the condition of application optimal time which means selectiveness, adequate biological efficiency, economic and ecological efficiency, protection and use of auxiliary natural reserve.

During the recent past years, climate warming and land aridization have caused changes regarding pests emergence and dynamics. Some species have simultaneously gathered in crops in high densities and overlapped attacks three to four weeks earlier, in contrast to the normal situations when pest attacked were staggered in time, and therefore special control measure have been required (Malschi, Perju, 1999. Malschi 1998, 2000, 2001, 2005, 2007).

Thus, the first risk situation for the plants shows up in April coming from the diptera species complex, fleas, bugs which kill young stems, and also from *Oulema*, cicads, thrips etc. which attack the leaves. During this vegetation stage, by the end of wheat tillering the insecticide application is recommended before or at herbicidation. In order to control diptera larvae in April, by the end of plant tillering, during DC 13-33 stage (or at herbicidation), the following insecticides: chloropyrifos methyl, chlorpyrifos ethyl, dimethoate, fenitrorion fenvalerate, tiaclopride, thiametoxam, acetamipride, phypronil etc., have been used achieveing control rates of 40-50% and yield increases of 7-21% (300-900 kg/ha). Researches have shown positive results and yield increases in the case of pyrethroids-treated plants with instant effect on the threatening pest complex thus annihilating the first wave of dangerous species and limiting the emergence of new insect generations. Through their short action, pyrethroids affect in a lesser extent the occurrence of auxiliary entomophags in the crop. The second treatment application may be required for spike protection under the conditions of aphid colonies attacks, thrips adults and larvae, bugs, etc. This attack is growing dangerous in the grain formation and ripening stage. Insecticide application is strongly recommended before the spike emerges from the flag leaf-skin, and the treatment can be associated with the administration of fungicides and foliar fertilizers. Thus yield increases are supported and the biological potential of pest species is decreased, diminishing the danger represented by their migration to other cultures or for the following year.

When applied during May 15-25, the insecticides phypronil, chloropyrifos methyl, chlorpyrifos cipermetrine, fenitrorion fenvalerate, thiametoxam, tiaclopride, acetamipride, bensultap, have performed instant control of pest complex, 63-83% efficiency rates for thrips larvae and 9-24% yield increase (500–1200 kg/ha), in wheat thrips (*Haplothrips tritici* Kurdj.), aphids, bugs control in the stage of flag leaf-skin and spike emergence, in DC 45-59 stage.

In order to restrain pest populations and to get better results of control with positive results accumulated in the agroecosystem and extended in the following years, enriching techniques of natural entomophag reserve are recommended by means of drawing and preserving auxiliary species in the crops. Thus, we may grow marginal belts of different entomophags-attracting flower plants (carrot, parsley, flavored plants etc, and also trees and shrubs such as oak, locust tree, cherry and other fruit trees, wild rose etc.). Moreover, the placing of specific and selective pheromonal traps is very significant method of pest control and useful to the monitorization of their emergence in the crops, especially in the case of some important pests such as *Ostrinia nubilalis, Agrotis segetum, Autographa gamma, Agriotes lineatus, Diabrotica virgifera* (Perju, Muresanu, Malschi, 2004, Mureşanu Felicia, 2004, Stan, Malschi, Oprean, 2007).

The biological control by parasite mass breeding and controlled release, especially of *Trichogramma* wasps (Felicia Mureşanu, 2003), the predators *Coccinella, Chrysopa,* may be an important pest restraining method, with no negative, polluting effects.

In the **forestry belts-based agricultural system** the conservative effects of biodiversity, flora diversity and the fauna of auxiliary entomophagous arthropods have been shown together with antierosional effects.

Crop ecoton areas represented by agroforestry belts made of trees and shrubs and also the marginal belts of herbs are extremely rich in entomophagous species (Malschi, Mustea 1995, 1998, Malschi 2003, 2004, 2007). The abundance, activity and conservation of entomophagous arthropods are supported by the presence of diversified flora which is the main factor of species richness, survival, abundance increase and seasonal migration from one field to another of useful entomophagous arthropods (Welling 1990, Rupert, Molthan 1991, Malschi, Mustea 1998, Malschi, 2003, 2007).

In the protective forestry belts-based farms a real entomocenotic balance has been established, and a natural biological control has been performed in the case of the following important regional pests such as *Oulema melanopus* L., cereal flies, aphids, cicads, thrips, cereal bugs etc. which have been kept under the economic damage threshold, with no demand for insecticides control application.

The yields obtained in the two agriculture systems show little differences, under the level of benefits from insecticide treatment which proves the economic and ecological efficiency of natural biological control in the protective forestry belts-based cereal system, as compared to the field crops where insecticide treatments have been performed within the applied integrated technological system.

Therefore, 55 years after their initiation, antierosional protective forestry belts-based farms may constitute models of ecological agriculture, of conservation and sustainable use of biodiversity, and a strategy of sustainable agricultural development in Transylvania.

The results of long-term researches performed at the Agricultural Research and Development Station in Turda recommend the application of integrated pest control management system which requires the understanding of pest species biological potentials and the use of adequate crop technology, including general preventive agrotechnical and phytosanitary measures as well as the use of quality seeds, especially of the regional varieties with good compensatory capacity and tolerance to specific area pest attack.

Studies have shown the important role of natural entomophagous predators, their efficiency in diminishing the abundance of crop pests under normal conditions. Consequently, the conservation and sustainable use of natural entomphagous limiters of crop pests measures should be used by rational application of insecticides at the optimal time and selective to auxiliary fauna activity, by protecting fauna and marginal flora against pesticides, especially herbicides and insecticides, by enriching these marginal belts with plants that are favorable to the life of auxiliary fauna.

Special attention should be given to protective agroforestry belts which provide favorable conditions for entomophag growing and for the natural biological pest limitation.

Insecticide control has proved successful in open field agroecosystems in Central Transylvania under the conditions of years 2000-2008, characterized by microclimate aridization, excessive draught and heat, when the attack of the main pests intensified (diptera, aphids, cicads, thrips, bugs, barley beetle etc), (boards 3, 4, 5, 6, 7, 8).

Therefore, the control strategy recommends usual insecticide treatments (organophosphorus, piretroides, neonicotinoids, fipronil, acetamiprid etc.) in two different selective application times: 1. for diptera larvae and pest complex control in April, and 2. for wheat thrips (*Haplothrips tritici* Kurdj.) and pest complex control, during the flag leaf-skin and spike emergence stage (boards 9, 10).

The advantages of integrated pest control management application in cereal agroecosystems derive from the objectives of these strategies adapted to present times:

1. **Promoting some integrated agricultural systems** which lead to yield rate increase and agroecosystem stability, limitation of pollution with pesticides, protection of arable lands, the sustainable use of natural resources and of biodiversity.

2. **Biodervisity conservation and sustainable use required by agriculture**, leading to agrobiocenoses stability and productiveness, insecticide depollution through natural biological crop pest control, performed by the natural reserve of auxiliary entomophags, especially in the case of agroforestry belts-based farms.

3. **Improvement, efficiency and sustainable development of regional agriculture,** through long-term contribution of antierosional protection works, and the diminish of land degradation effects caused by present climate changes, the tendancy of climate aridization with excessive heat, dryness, storms, wind, torrents in the case of agroforestry belts-based farms.

1.6. New problems regarding the agroecological integrated management of pests and environmental protection. Attack aggression under the impact of climate and technological changes in wheat crops.

Long-term researches in the field of applied entomology in agriculture with objectives focusing on the elaboration of the integrated pest management technologies and environmental protection in the cereal-based agroecosystems in Transylvania have been carried out at the Agricultural Research and Development Station in Turda. As in other research domains, aspects regarding the sustainable development have been envisaged, related to yield increase, quality, biotechnical and agroecological systems adjustment, and the impact of these technologies on the environment. Agricultural and food production is a major objective to society together with the requirements for food and forage quality, protection of environment quality and sustainable development of agroecosystems integrated in the geographical areas and the global level of the ecosphere.

In the last years, the climate changes, the new forms of agricultural exploitations and the technological crop systems have caused changes in the significance of the pest species, changes in the structural interactions within the agroecosystems with impact on crop stability, yield increase and quality. Especially the climate warming, draught and aridization during the decisive periods of the crops, between 2006-2008, have favored increases in abundance and aggressiveness of some pest groups which require special attention for plant protection. The incorrect crop technologies, the demarcation of the arable land into small area crop strips, the missing of phytosanitary measures have lead to a more severe increase of pest biological reserve.

The modern, conservative soil technologies involving minimal tillage or ploughless tillage recommended for dry and arid conditions have been regarded as favorable development conditions for some pest species, especially those with soil-related life spam stages, requiring complex phytosanitary hygiene systems for the integrated pest control. For the elaboration of the integrated pest management technology and environment protection the following topics have been studied: the occurrence and dynamics of pest populations, attack stages and aggressiveness, the structural evolution of the dangerous pests and adequate control measures for this new agroecological condition, the pesticide-pollution diminishing, environmental improvement.

Wheat pests during agroecological changes and present technology. The following pests have been recorded as significant within the complex of regional phytophagous insect fauna: cereal flies: *Opomyza*, *Delia*, *Phorbia*, *Oscinella* and others); aphids (*Sitobion*, *Schizaphis*, *Metopolophium*, *Rhopalosiphum)*and cicads (*Psammotettix*, *Macrosteles*, *Javesella*); thrips (*Haplothrips tritici*); wheat flea-beetles (*Chaetocnema aridula*), cereal leafbeetles (*Oulema melanopus*), cereal bugs (*Eurygaster, Aelia*); ground pests (*Agriotes*, *Opatrum*, *Zabrus, Anisoplia*) etc.

Increased pest abundance and aggressiveness in attack three to four weeks earlier than normal which required control treatments applied as prevention have been recorded especially in the case of cereal flies with their species complex, and wheat flea-beetles, both groups being important for the larvae attack inside the stems in April-May. They require preventive seed treatments and sprinkled on vegetation with systemic insecticides in spring or at the herbicide application at the latest. The special importance of cycads and aphids as vectors of pathogenic agents (viruses, mycoplasma) causing wheat yellow dwarf has also been shown requiring preventive control measures.

Wheat thrips represent some of the most significant pests nowadays due to adults' attack on the spikes (at the spike appearance–45-59 DC stage) in May, and the attack on the flowers and emerging grains from the spikes at the end of May and the beginning of June. Consequently, the preventive treatments for this pest have provided the most significant yield increases by using efficient shock-effected insecticides (pyrethroids and others) which ensured the control of the whole spike pest complex when applied during the flag leaf-skin phenophase (adult thrips, bugs, aphids, cycads, chloropide diptera). It is also important to emphasize that at the moment of treatment the insecticides have a moderate side effect on the evolution of entomophagous auxiliaries in the crops. Cereal bugs may be regional pests of wheat spikes and grains with increasing potential. The cereal beetles (*Anisoplia*), ground beetles (*Zabrus),* wireworms *(Agriotes*) etc. are also significant pests in this respect.

2. Ecology and cereal agroecosystems

2.1. Regional agroecological characteristics.

The Agricultural Research and Development Station in Turda

Applied researches regarding the modern strategies of field crop pest control has been characterized by regional features concerning pest structure and the natural agroecological and technological conditions, by the proper control measures for yield increases and by achievement of residue-free agricultural and food products, and environmental protection. Entomological researches comprised the trials and demonstration of the new regional pest control objectives and strategies using modern and adequate methods adapted to the present changes in pest structure, and alarming increases of their attack potential under the conditions of climate warming and aridization. During 2000-2008, pest aggression has shown value increases, reaching top values in the spring of 2003. Structural economically-important changes of regional pest complex has been reported three to four weeks earlier than normal. Earlier attack initiation during the vulnerable vegetation stages has also been reported.

The understanding of connexion and interdependence relations between crop plants and agroecological factors, including damaging biotic factors, represented the basic research objective, and also the elaboration bases of phytosanitary control measures, based on the principle of chemical, technological, biological and genetic control measures integration in relation with pest characteristics in all control technologies (Roman et alab., 1982).

The ecological framework in Transylvania is given by the interaction of a large number of factors. Thermal reserve has shown a dominant action for the agroecosystem at its relatively low temperature level and high time variations. These characteristics require restrictions for termophile plants such as: corn, soybean, sunflower, sorgum and others. Land hilly orography, with lots of degraded soils by erosion or temporary excessive humidity requires restrictions regarding crop structure and machines and tractors system to provide slope work mechanization. In a natural environment there are many other factors with aleatory meteorological or cosmic influence in connection with the Sun's cyclic activity such as: over 60% ratio of dry years and under normal precipitation quantities, the interaction between sometimes hot temperatures in May, June and July, and the lack of precipitations causing frequent excessive heat for wheat and corn, early frost during the first decade of September which breaks corn and legumes vegetation, then heavy rains in May, June, July which often break vegetation or can cause great yield losses. The characteristics of the natural environment determine the shape, reserve and efficiency of the agricultural system. This is the reason why agricultural sciences have been defined as area sciences (Roman et alab. 1982).

The Agricultural Research and Development Station in Turda is placed North-West to Turda, 30 km away from Cluj-Napoca. The geographical coordinates of the area are: 46°35'15" Latitude /23°48'10" Longitude for the research field; while the coordinates by Universal Transverce Mercator System (Lehrer, 1977) for the city of Turda is GS 16.

The experimental fields and lands lay in the Western part of the Trasylvanian Plateau, but the area of influence or service of the station is much wider and stretches over the geographical intramountain areal called The Transylvanian Plateau, with the following districts: Transylvanian Plain, Someş Plateau, Târnave Plateau, Sibiu, Făgăraş and Braşov Depressions, a geographical area administratively organized into 11 counties.

Natural environment. The landscape is a hilly oragraphic land, 71% being represented by plateau low hills 345-493 m high, with different exposures and slopes subject to a constant severe erosion process. The valleys represent 11%, are relatively narrow and are heading East-Westwards and have an natural impaired drainage. The upper terrace of the Arieş river stretches over 18% of the territory, displays a flat appearance with frequent microdepressions. The area landscape has similar general characteristics, but the hills of The Someş Plateau are higher than those of the Transylvanian Plain. The valleys of the Mureş, Sibiu, Făgăraş, Braşov Depressions are much wider.

Hydrography. The land lays in the middle and lower basin of the Arieş river. Surface waters are collected by a thick network of fleets and torrents at the top of the slope and slow darin at the base of the slope which lead to frequent sinkage and marshes. The depths of freatic water are different in accordance with the landscape, reaching 1.5-2 m in the valleys, 15-20 m in the plateaus and 0-18 m on slopes. The latter ones often form slope springs causing excessive temporary water by slope drainage thus wiping out considerable agricultural land. The regional hydrography is represented by the Mureş river with its main affluents Târnava Mare and Târnava Mică, Valea Gălzii, Ampoiul, Sebeşul, and Someş river with its main affluents Someşul Cald, Someşul Rece

Climate, soil, vegetation. Area climate is four season temperate-continental. Normal mean annual temperature is 8,6°C. The hottest month of the year is July with mean monthly temperature of 19.3 °C while the coldest is January with mean monthly temperature of -4.4 °C. The last freesing or frosts set in during April 10 – May 10, while the first frosts show during September 20 – October 10. Mean frost-free period is of 176 days, and the period amplitude ranges from 145 to 205 days. The normal temperature sum of the last and first frost in April 12 – September 12 with the daily mean value above 0°C has been 2574 °C, and with the daily mean over 10° C it was 1021°C, respectively.

Annual mean precipitations averaged 540 mm, out of which 68% fall during the vegetation period, the most rainy month being the month of June, when the precipitation values reach 85.3 mm, while the driest month is February when the mean value of precipitations doesn't exceed 22.6 mm. The precipitation amplitude in the region varies between the normal annual sum of 537mm and 976 mm. The annual variations in the station have been relatively high and ranged between 325 mm and 671 mm with frequency of dry years having precipitation quantities below the normal value of 53.8%. The dominant wind in the region is the icy North Wind – Crivăţ, blowing from North, North-East with 41.5% frequency, while the second in frequency is the South-Western wind – Austru – with 18.4% frequency. Over the year, the frequency of windy days has been 59.9%, while the calm days average 40.1%.

The prevailing soils in the station are the chernozem types. In the valleys there are sometimes allomorphic soils. In accordance with slope inclination degree and usage, soils have different erosion stages. The texture of the prevailing soils is argillanceous with good hydrophysical properties: glomerular structure, high porosity - 59% at the surface – and 47% in depth, with high capacity of water retaining. The agrochemical indexes have been characterized by the following mean values: 3.5% humus content, over 4.5 mg mobile phosphorous P_2O_5/100 g soil, while the mobile potassium averages 30 mg K_2O/100 g soil). Soil reaction is neutral. The same types of soil are found in the Transylvanian Plain.

Vegetation. The plant associations are typical for the forest steppe, with advanced degree of steppization. Grass vegetation is extremely varied, in accordance with the complexity of the ecological conditions. Thus, on the Southern slopes the associations of *Festuca sulcata, Carex humilis, Stipa lessingiana, Stipa capillata, Stipa pulchyorina* are prevailing. On the erosion-degraded lands there are *Stipa sp., Thymus sp.* and *Andropogon ischemum* type of associations. In the Northern slopes the *Festuca sulcata, Festuca pseudovina* and *Danthonia calycina* associations are widely spread.

At higher altitudes above 400 m there are associations of *Brachypodium, Bromus şi Agrostis*. On the arable soil there are many weeds, some of them being widely spread, others undergo a steadyecological expansion.

The most spread weeds are: *Agropyron repens, Agrostema githago, Amaranthus retroflexus, Capsella bursa-pastoris, Centaurea cyanus, Sinapis arvensis, Raphanus raphanistrum, Fagopyron convolvulus, Polygonum hydropiper, Galium aparine, Matricaria inodora, Echinochloa crusgalli, Convolvulus arvensis, Cirsium arvense, Avena fatua, Lepidium draba, Rubus caesius* and others.

The more frequent shrub species are: *Crataegus monogyna, Rosa canina*. Wood vegetation is represented by plantations or isolated specimens of *Quercus petraea, Robinia pseudacacia, Ulmus foliacea, Carpinus betulus* and others.

Disease and pest biological reserve. The orographic and ecological conditions characterizing Transylvania produce a favorable microclimate for the emergence of damaging diseases in wheat, barley, corn, bean and soybean. Moreover, there are many insects and damaging animals causing losses and damages. Their damaging potential frequently exceeds 30-40% of the yield, in some years and on smaller areas causing even wheat and barley crop loss. The following are the most damaging species and pathogens: *Tilletia tritici, T. controversa, Puccinia sp., Erysiphae graminis, Septoria sp., Fusarium sp., Cercosporella sp., Rhyzoctonia sp., Micoplasma, Ustilago nuda, Helminthosporium teres, H. turcicum, Ustilago maydis, Colletotrichum lindemuthianum, Xanthomonas phaseoli, Peronospora manchiurica, Sclerotinia sclerotiorum, Marmor phaseoli, Marmor soja, Corium solani, Marmor betae*; insecte: *Macrosteles laevis, Psammotettix aliaenus, Toxoptera graminum, Sitobion avenae, Opomyza florum, Phorbia securis, Delia coarctata, Oscinella frit, Delia platura, Contarinia sp., Chaetocnema aridula, Oulema melanopus, Haplothrips tritici, Eurygaster maura, Aelia acuminata, Zabrus tenebrioides, Ostrinia, Diabrotica, Agrotis sp., Agriotes sp, Bothynoderes punctiventris, Tanymecus palliatus, Leptinotarsa decemlineata, Sitona sp., Apion sp***.; mammels:*** *Microtus arvalis şi Cricetus cricetus etc.* The agricultural system, crop variety structure and the application degree of technology in their dynamics has lead to the emergence and damaging manifestation of some new diseases, pests, and has changed weed associations by intensifying their distructive character, averaging over 30-40% losses (Roman et al.,1982)

2.2. Agroforestry belts and sustainable agricultural development

Laying in the South-Western part of the the Transylvanian Plain, The Agricultural Research and Development Station in Turda is the beneficiary of a field crop farm arranged as an antierosional system with protective forestry belts at Cean-Bolduţ, planted since 1952. The farm comprises 342 hectars of arable land and pastures, surrounded by the 14 hectars of forestry curtains made of 36 tree and shrub species, maintaining almost completely the initial planting plan, and thus being the only one of this type in Romania.

With an obvious balance of the cereal-based agroecosystem, the farm is the symbol of research and agricultural practice concerns focusing on crop protection and soil erosion control (Popescu, 1993, Lupe, Spîrchez, 1953), and also on the conservation of useful arthropod fauna (Dana Malschi şi Mustea, 1993, 1995; Malschi, 1996, 2003, 2004, 2005, 2007).

This method of soil and agricultural crop protection with forestry belts has been well understood in the european countries.

In our country this method was started in 1861 and developed in the years of devastating calamities, excessive draught, sand storms (1890, 1935, 1946), and then over 6000 hectars of forestry belts have been created until 1961, whereas during 1970-1975 some 1700 ha more have been planted in Southern Oltenia (Popescu, 1993).

The efficiency of the forestry belts have been proved in the fight against draught and other adversities related to climate and relief: storms, torrents, snow-storms, landslidings, in preventing and control of massive soil degradation processes, and also in the protection and growth of the natural entomophagous reserve.

By protecting agricultural crops, the forestry belts play a decisive role because of their direct effect on the microclimate, the blocking of landslidings and local torrents, increase and conservation of soil fertility. All these effects induced by the presence of protective forestry belts have also contributed to the protection and development of flora and fauna diversity.

The role played by the forestry belts in the conservation of useful arthropod fauna has had a special impact on the dynamic development of the agroecosystem with effects on stabilizing the entomocenotic balance.

At the Cean-Bolduţ field crop farm a wide diversity of entomophagous species and the natural biological pest control in forestry belts-protected cereal crops have been recorded (Malschi şi Mustea, 1993, 1995). Researches have shown the advantages of using forestry belt-based agroecosysytem such as:

- stabilization of entomocenotic balance that limitates and keep significant pests (cereal leaf beetle - *Oulema melanopus*, cereal flies, wheat thrip - *Haplothrips tritici*, aphids etc.) under the levels of economically damaging thresholds;
- ecological efficiency in the fight against pests and their massive invasions by protective effect, growth and conservation of natural entomophagous reserve;
- savings resulted from avoiding the use of insecticide control (Malschi, Mustea, 1995, 1996, 1997, 1998, 1999, Malschi, 2003, 2005, 2007)

As regarding the conservation and use of biological diversity for the natural biological pest limitation, the protective and quality importance of forestry belts-based agricultural system as a model of sustainable and non-polluting technology has been accentuated in comparison with open field agriculture. During 1990-2008 the agroecoclimate conditions and pest attacks represented real risk situations, and the application of insecticide treatment has been required, in the open field agriculture.

2.2.1. The antierosional protective forestry belts-based agrosystem of Cean-Bolduţ

The network of antierosional forestry belts of Cean-Bolduţ lies in a typical low-hilled area of the Transylvanian Plain having natural, geomorphological, climate, edaphic and phytocenotic characteristics. The geographical coordinates of this region in the Cluj county for this particular place Cean-Bolduţ, the agroforestry-belted farm are: Latitude 46°36'00"/Longitude 23°56'30"; while the coordinates by the Universal Transverse Mercator Coordinate System is GS 27 (Lehrer, 1977). The landforms are not high, having altitudes varying from 280 to 460 m and a moderate slopes from north-est to south-est. Some areas are more abrupt and even show vertical fractures and slidings between the belts 1, 3, 8 and in the western pastures, on the upper third of the slopes (fig. 2).

Multiannual values regarding the mean temperature and annual precipitations average 8.6% and 509.2%, respectively. The prevailing soils are the chernozems (9 types and 20 subtypes), and show different degradation processes: erosions, landslidings, alluvial deposits. Popescu, 1993, reported a superficial erosion on the 3-5° slope dip, where the vegetable soil is 40-50 cm thick, an advanced erosion on the 6-12° slope dip, where the vegetal soil is 23-35 cm thick, and extreme erosions in the case of 16-30° slope dip. On the other hand, the arable land protected by forestry belts showns a good soil conservation.

Vegetation is typical for the lower border of the forestry area meeting forest steppe.

The antierosional curtains are made of mixtures of over 36 species of trees and shrubs. The side rows comprise fruit tree species and fruit bearing shrubs: the cherry tree (*Cerasus avium*), apple tree (*Malus silvestris*), pear tree (*Pirus piraster*), black thorn (*Prunus spinosa*), hawthorn (*Crataegus monogyna*), wildrose (*Rosa canina*), gooseberry (*Vaccinium spp.*), hazel (*Corylus avellana*), wild privet (*Ligustrum vulgare*), bladdernut (*Staphylaea pinnata*), elderberry (*Sambucus nigra*) and others. The inner rows of the curtains comprise forestry species especially oak *(Quercus robur*), Turchestan elm tree (*Ulmus* sp.), black locust (*Robinia pseudacacia*), Norway maple (*Acer platanoides*), sycameore maple (*Acer pseudoplatanus*), common ash (*Fraxinus excelsior*), small-leaved lime (*Tillis cordata*) and willow (*Salix caprea*), (Lupe, Spîrchez, 1953 Popescu, 1993).

Side pastures and grass belts comprise the species which characterize the area. Field crops are those of cereal rotation, usually a three year rotation with autumn wheat, spring barley, corn, bean, leguminous forage plants–clover, alfalfa–cultivated in crop rotation fields of 9-16 maximum 22 hectars. These ecological conditions and especially the diversified flora structure in the forestry belt-based agroecosystem represent an extremely favourable environment for the growth of useful arthropod fauna.

The multiannual observations (Malschi şi Mustea, 1993) have recorded the presence of all significant groups of predatory entomophagous arthropods: *Aranea; Dermaptera (Forficulidae); Heteroptera (Nabidae* etc.); *Thysanoptera (Aeolothripidae); Coleoptera(Sylphidae, Coccinellidae, Carabidae, Staphylinidae, Cantharidae, Malachiidae*, and others); *Diptera (Syrphidae, Scatophagidae, Empididae* and others*); Hymenoptera (Formicidae)*; *Neuroptera (Chrysopidae*), (Malschi şi Mustea, 1993, 1995), the data being similar with the scientific literature (Chambon et al., 1985; Sunderland et al., 1985, 1987; Stark, 1987; Basedow, 1990; Welling, 1990; Wetzel, 1992, 1995). These data reveal the damaging capacity of entomophagous species in cereal-based agrobiocenoses, especially the aphidiphagous activity.

As regarding the use of sustainable natural resources and biodiversity conservation in Central Transylvania, the researches performed at the Agricultural Research and Development Station in Turda have shown that antierosional protective forestry belts-based agricultural system is providing a healthy development of biodiversity, antierosional and microclimate protection being extremely rich in auxiliary entomophagous arthropod founa. Field crop agroecosystem based on forestry belts stands for a model of ecological tehnology used in pest control and for a sustainable cereal crop development in the hilly area of Central Transylvania. The forestry belts-based agricultural system is part of the modern strategy and legislation of the country regarding sustainable development, environmental protection and biodiversity.

The reason for this thorough research has been depicted from the interesting ascertainement that there is a real entomocenotic balance in the field crops with antierosional forestry belts 50 years after network planting; thus, no critical pest attack situations have been recorded, and no insecticide treatment application has been required. Moreover, under the conditions of climate warming during 2000-2008, in the open field agricultural system, pest control has shown real risk or calamity situations which proved the protective and qualitative importance of consolidated agroforestry belts-based agricultural system. The investigations have been intensified by recording some extremely powerful prey-predator interactions.

2.2.2. Entomocenotic characteristics of forestry belt-based agroecosystem

Along the long-term study performed, we have observed that in the structure of collected arthropod fauna the auxiliary entomophags have a statistical weight of 31% in agroforestry belt-based agroecosystem, while in open field farms, the statistical weight of useful arthropod fauna reached only 24%, from the beginning, during 1991-1992, under normal area climate conditions.

During 2000-2005 the entomological researches in the field crop farm with antierosional protective belts of Cean-Bolduţ have been developed on the theoretical basis of previous researches (Malschi şi Mustea 1992, 1993, 1995, 1999).

In comparison with the data from 1993-1999, the period 2000-2005 was characterized by area cereal agroecosystems warming and aridization, and by the increase of pest attack. Thereore the entomophags reached 78% of the entomophagous fauna structure in the forestry belt-based farm, and only 33% in the open field cereal farm. In the complex of arthropod fauna collected over the two stages of the study (1991-1999 and 2000-2005), annual structural percent of active entomphags in the forestry belt-based agroecosystem increased from 35 to 82% as regarding winter wheat crop, from 24 to 77% in spring barley crop, and from 57 to 75% in bordering grasses in the ecoton areas between the crops and the forestry belt.

In the forestry belt farm the entomophags have been favoured in their development and seasonal crop circuit, by the presence of forestry curtains, and the existent flora diversity: trees, shrubs, pastures, marginal grass belts. Every year, no damages in stalky cereals caused by *Oulema melanopus* larvae (ceral leaf beetle) have been recorded here, nor significant damages caused by diptera, aphids, thrips, sun bugs etc., because the populations of these pests have been much diminished by entomophags activity.

Under the conditions of the years with climate warming and severe draught (2000-2005) that are so favourable to pest attacks, the efficiency of natural biological control performed by entomophags in the cereal crops at the agroforestry belts-based farm of Cean- Bolduţ caused only 3-8% densities of diptera attacked tillers, 2.2 thrips larvae/ear and 1.7 aphids/ear compared to the attacks recorded in the open field crops, where 40-60% densities of diptera damaged tillers, 14-24 thrips larvae/ear and 5-8 aphids/ear, 250-350 *Oulema* larvae/m^2 have been reached.

It has been noticed that in the protective forestry belt-based farm under the conditions of the climate warming and aridization of the present, complete natural biological control of barley beetle populations *(Oulema melanopus L.)* and the limitation of some other cereal pest populations aphides (*Sitobion avena* Fabr. and others.) and thrips (*Haplothrips tritici* Kurdj.), at levels under the damaging economic threshold has been recorded. The development of phytophagous insects populations in interaction with the entomophags is fluctuating. In the last years the level of pests in the open field cereal farms exeeds the possibilities of natural self regulation through entomophags, insectidide treatments being required. In these farms the role of natural reserve of entomophags is still substantial and important in the natural limitation of the populations of some pests such as *Eurygaster, Cephus, Haplothrips, Sitobion* and others, for which insecticide treatments are needed in the cereal areas in the Southern part of the country.

The use of auxiliary natural reserve in the control of cereal crop pests represents a great advantage for the area agriculture. The need for researches on agricultural entomocenoses results from the content, dynamics and intensity of structural prey-predator interactions in different ecological crop area. In the case of cereal-based agroecosystems in Central Transylvania the positive role of predating entomophags is a certainty. The natural entomophag reserve in the reagional cereal agroecosystems represents an extremely important defense system against the growth of biological and attack potential of cereal pests, and prevention of carantine species invasions. In Central Transylvania it is necessary to promote the protection of auxiliary damaging entomophag diversity in field crops. Useful arthropod fauna is favored by flora and entomophauna diversity, the presence of vegetation-rich crop borders, grass belts, pastures, shrubs, trees, forestry protection plantations. The auxiliary efficiency is favored by the rational and selective application of pesticide treatment, when warned; by the small sizes of the cultivated lands, by the diversified structure of the crops, in insertion lots of small grain cereal, corn, soybean, beans crops, forage crops (alfalfa, lucerne and others) which provides the continuity of the feeding and refuge sites for entomophags.

2.3. Damaging and useful arthropod fauna in cereal-based agroecosystems

The comparative study regarding the entomocenoses abundance and structure in the cereal crops of open field area and in the farm with protective agroforestry belts have shown certain aspects recorded in the researches on entomocenoses from the A.R.D.S. in Turda.

Complex aspects of the agroecosystem has been viewed:

- the structure and adundance of insect species in the entomocenoses in the winter wheat, spring barley crops and the marginal grasses found between the cultivated fields and the forestry belts;
- the dynamics of the structural interactions between phytophagous and entomphagous species;
- the activity efficiency of useful species regarding the diminish of pest populations in forestry belt-protected crops (cultivated lots of 9-16 hectares) as compared to the crop situation in the open field cereal agroecosystem without common plant bordering (lots of 3-6 ha and more);
- the role of plant species diversification at the border of crop fields (the trees and shrubs of the forestry belts and spontaneous grass unaffected by pesticides), as well as the structure of cereal crop rotation for the conservation, development and use of the natural entomophagous reserve;
- laboratory test checking of the importance of the main active entomophagous pest species isolated from the cereal crops by establishing prey composition and their damaging capacity on phytophagous species;

- the correlated study of laboratory results and of the observations from the cereal entomocenoses regarding some interaction sequences between phytophags and entomophags, has been performed with the purpose the better understanding of the quantitative relations involved in pest population dynamics in open field agroecosystems in Turda and in the farm with protective forestry belts in Bolduţ, underlying the entomocenotic balance moments.

Data collection has been performed by complexe soundings tests in crops and in the bordering plant belts made of grasses, trees, shrubs of the forestry belts. Ground soil traps (Barber) and 100 gatherings with the entomological sweepnet have been used, three different times, in the three testing sites located 30 m away from the border and 30 cm spacing between them in the middle of each lot (fig. 1 and 2).

The study of interactional sequences between phytophagous species and entomophagous pests have been performed based on the natural model established in the cereal abrobiocenoses, in the two types of technological systems: open field area and antierosional forestry belts. Pest and alive entomophags have been collected for laboratory studying of pest activity. In individual isolation rooms for entomphagous predators, the prey composition and individual daily feeding ration, for the main predatory species of the families: *Chrysopidae* (*Neuroptera*), *Nabidae (Heteroptera); Coccinellidae, Carabidae, Staphylinidae, Sylphidae, Cantharidae, Malachiidae (Coleoptera); Syrphidae (Diptera)* and others have been studied in repeated tests using phytophagous insects as food (Malschi, 1996).

2.3.1. Structural interactions of damaging and useful arthropod fauna

The structure of damaging and useful arthropods has been established based on the morphological, ecological, geographical and etologic criteria of species determination (table 1 and 2). The results have been similar to the literature in the field of useful entomofauna role and activity (table 3).

2.3.2. Dynamics of entomophagous predator species populations

The observations performed in the cereal-based agroecosystems have shown that the field crops have been colonized by entomophagous populations iver the entire vegentation period, following their species biology-related dynamic cycle. Most of the entomophagous species migrate towards crops from the appropriate hybernation and refuge places, represented by belts with the forestry curtains and bordering grasses (Welling, 1990; Sabine Stork Weyhermüller şi Welling, 1990; Basedow, 1990; Sustek, 1994; Wetzel,1995; Malschi, 1996 and others). The role of polyphagous entomophagous predators flying as adults, from one crop to another over the entire vegetation period is extremely important in pest limitation.

Another important group is made of ground level active predators. *Sylpha obscura (Sylphidae)* feeding with *Oulema* larvae and eggs, diptera larvae and pupa (*Phorbia*); *Tachyporus hypnorum* L., *Staphylinus* sp. (*Staphylinidae*) şi Carabidaele (*Poecilus cupreus* L., *Harpalus rufipes* De Geer, *Brachinus explodens* Duft., *Amara aenea* De Geer), feeding with aphids, *Ostrinia, Eurygaster* eggs and *Oulema* larvae, diptera larvae and pupa and others, colonizing different crops. Some carabid beetles (*Poecilus, Pterostichus, Amara, Agonum*) get 100-150 m into the crop in 2 weeks (Welling, 1990), being very dynamic and passing through grass, trees and shrubs corridors at the field border in their seasonal route from one crop to another (Sustek, 1994). In cereal crops, these species are extremely active and rich, species dominance changing from one period to another due to species migration dynamism. In spring, the following species have been dominant: *Harpalus aeneus* F., *H. distiguendus* Duft., *Amara aenea* De Geer, in April; *Poecilus cupreus* L., *Brachinus explodens* Duft. and less abundant, *Pterostichus* sp., *Agonum* sp. and *Dolichus chalensis* Schall., in May, June; while *Pterostichus niger* Schall., *P. cylindricus* Hrbst. And especially *Harpalus (Pseudophonus) rufipes* De Geer in July, August and September.

Before the initiation of entomophagous activity in crops, many entomophag species head towards some maximum concentration sites represented by some favourite food sources or refuge sites. Thus, great attractiveness areas and banks are: the grass belts for *Aranee*, *Carabide, Staphylinide, Formicide*; *Urtica dioica* for *Coccinella* şi *Chrysopa*; blossoming oak (*Quercus robur*) for *Coccinella septempunctata*; blossom cherry treee (*Cerasus avium*) for *Cantharis fusca*; *Sambucus nigra* and other blossoming shrubs for *Cocinellide*; moreover, other flowering plants such as: *Pastinaca sativa, Daucus carota, Achillea millefolium, Hypericum perforatum, Tanacetum vulgare, Cichorium inthybus, Sinapis arvensis, Papaver rhoeas, Sonchus arvensis, Veronica persica* ş.a. (Malschi, 1996, Rupert şi Molthan, 1991, Welling, 1990) display special attractiveness for parasite Syrphide and Hymenoptere; the flower plant species in the field border or in crops such as: *Matricaria chamomilla, Myosotis arvensis, Viola arvensis, Lolium perene, Plantago major* (Stark, 1987; Welling, 1990), show attractiveness for the *Empididae* diptera.

The main species of entomophagous predators from the families *Chrysopidae, Coccinellidae, Cicindelidae, Carabidae, Staphylinidae, Cantharidae, Malachiidae, Syrphidae, Formicidae* and *Aranea* use profitably the plants in the spontaneous flora, in grass and pastures belts, as well as the shrubs and trees in the forestry belts; they represent concentration and feeding banks of the individuals prior to entering the crops and passing corridors, and spreading into the agroecosystem, the field crops.

Crop colonization by the entomophagpus predators is achieved a lot faster in the case of cultivated lands surrounded by forestry belts than the agroecosystems in open fields. The diversification of cereal rotation crop structure and the network of the existing forestry curtains and marginal grasses, allow entomophags migration from one crop to another, in accordance with the requirements of the biological cycle, the ecology of each species and in accordance with phytophagous insect population development which represents their prey in the crop. The presence of diversified vegetation in the forestry belt-based farm offers refuge places and favorable niches of microclimate and extra feeding in preparing diapause and hibernation, thus ensuring the conservation of entomophagous species.

2.3.3. Role of entomophags in cereal agroecosysytems

Under the entomocenotic conditions of the region since spring till autumn, polyphagous predator species flying as adults from one crop to another over the entire vegetation period play a crucial role in natural pest limitation. Consequently, an entomocenotic balance will be established between the damaging and useful arthropod populations in the forestry belt cereral agroecosystem. In their annual evolution, these structural interactions reflect a solid and efficient synchronization which, in time, leads to the decrease of pest populations.

In the complex of collected arthropod fauna, the annual statistical weight of active entomophags is 82% in Bolduţ, as compared to only 41% in the open field farm, 73% in the winter wheat crop as compared to 19%, in spring cereal crops, 79% as compared to 52% in soybean crop, and 75% in marginal grasses between the field and the forestry belt.

Based on the samples taken every 10 days, the mode in which arthropod population dynamics has been staggered in time, and the quantity assignation of the entomophags population peaks involved in the diminishing of pest statistical weight has been revealed. Thus, starting in spring months with massive concentration in the marginal vegetation, the entomophags colonize in the crop establishing maximum interactions in first part of June when the main phytophagous populations (*Oulema*, aphids, thrips, diptera and others) have been diminished to values under the damaging economic threshold.

Inspired by the natural model of prey-predator interactions and their balancing entomocenotic effect in the protective forestry belt-based farm, detailed observations have been performed regarding the dynamics of the main mentioned pest populations. These laboratory-simulated interaction sequences between phytophags and active entomophagous predators (table 5) have shown the role and importance of dominant predatory species collected from the cereal agroecosystems and have measured polyphagism and their distruction capacity over the studied phytophagous species.

Laboratory tests have shown and explained the dynamic interactions observed in agrobiocenosis, enabling the establishment of the numeric ratio between prey and predator, the theoretical ratio required to diminish phytophagous populations under the economic damaging threshold (EDT). The bibliographic references related to this EDT value for *Oulema melanopus, Sitobion avenae* or *Haplothrips tritici* have been mentioned in several works (Tanskii,1981; Popov et al., 1983; Baicu, 1989, 1996; Holz, Wetzel, 1989; Wetzel,1995; Malschi, Mustea,1993). The observations performed in the wheat and barley crops show a strong correlation between the richness and evolution of polyphagous predator populations and dynamics of phytophagous populations, both in protective forestry belt-based agroecosystem (in Bolduţ) and the cereal open field agroecosystem without bordering vegetation favourable to useful fauna (in Turda).

Detailed laboratory tests have checked that the *Oulema melanopus* population can be widely destroyed by several predators in the cereal agrobiocenoses of Central Transylvania. Thus, each individual (larvae) of *Chrysops carnea* or of *Coccinella 7-punctata* and *Staphylinus* sp. may eat 10 *Oulema* eggs/day; *Tachyporus hypnorum* eats 7 eggs/day, while *Cantharis fusca* - 6 eggs/day; *Amara aenea* and *Poecilus cupreus* eat 9 *Oulema* eggs each/day/individual. Such a bank of 7 predators may destroy 61 Lema eggs/day, while a theoretical density of 28 predators/m^2/day (of the listed species) might completely destrpy the number of 250 *Lema* eggs, a number equal to the EDT value (250 *Oulema* larvae/m^2).

Oulema melanopus larvae may be destroyed by a preying capacity of 5 larvae/day for each individual of: *Crysopa carnea, Nabis* sp., *Poecilus cupreus, Brachinus explodens, Amara aenea, Harpalus rufipes*; and an individual destroying capacity of: 3 larvae/day of the *Coccinella 7-punctata* species; and 10 larvae/day of *Malachius bipustulatus* species. Thus, the 8 individuals of the mentioned predatory species (table 5), may eat 43 *Oulema* larvae every day and would decrease by a number of 250 *Oulema* larvae equal to the EDT value **in 6 days**. Therefore a theoretical density of 48 such predators/m^2 would destroy 250 *Oulema* larvae in one day. It has been noticed that in the cereal agrobiocenoses in Central Transylvania the actual ratio between the *Oulema* individuals and the number of thei predators is far smaller than the theoretical estimate ratio of 9/1 (*Oulema* eggs/1 predator/day) or of 5/1(*Oulema* larvae/1 predator/day), at the critical moment of prey-predator active interactions. The annual report resulted from the annual structural interactions has been under the theoretical value estimated by laboratory tests. The multiple correlation coefficient R=0,998, is highly significant indicating the strong influence and efficiency of predatory entomophag natural reserve activity involved in keeping the *Oulema melanopus* population under the damaging economic threshold regarding the entomocenoses with stable balance in the protective foretry belt-based agroecosystem.

As regarding spring barley, the ratio *Oulema*/entomophags is favourable to the pest in both forestry belt agroecosystems and open field crops. Though, the fact that at the critical moment of maximum interactions the bank of active known predators diminished the *Oulema* larvae abundance to values under EDT has been remarkable. A thorough natural biological control of this pest under the condition of forestry belt farm has been achieved. In the case of spring barley crops in open field, the value of the observed ratio of 6.2 *Oulema* to 1 predator at the moment of maximum interactions has been higher than the theoretical calculated ratio (5/1). This indicates the failure of predatory populations concentrated in the spring barley crop to efficiently reduce the *Oulema* larvae population. The pest should be chemically controlled in this case. The evolution of prey/predator interactions in a chemically untreated spring barley crop in open field has shown-through the final annual values of 3.9 *Oulema* individuals/1 entomophag - the importance of active fauna activity and the need of its protection by applying integrated control measures. These should include the application of selective insecticides for the active entomophag complex at the maximum biological selectivity moment. The analysis of square regression regarding the impact of predatory entomophagous arthropod fauna in spring barley on the *Oulema melanopus* pest population has shown very significant correlations both in the protective forestry belt agroecosystem where an efficient biological control has been achieved, and the open field agroecosystem where the auxiliary fauna should be protected, its activity being included in the complex integrated control measures, or special measures of enriching the uselful fauna by its attraction into the crops could be used.

The importance of the interactions studied in spring barley entomocenoses has been reflected in multiple correlation coefficient values of 0.884 for the *Oulema* – forestry belt-based farm predators, and 0.965 in the case of open field cereal crops.

From the data in table 5 we can also correlate the observations regarding the interaction sequences between the **winter wheat** ear pests (aphids, thrips) and their predators. Thus, under laboratory conditions, it has been shown that *Sitobion avenae* has been eaten during the wheat earing by the following predators having individual damaging capacity of: 60 aphids/day with *Poecilus cupreus, Harpalus rufipes* and *Nabis* sp.; 50 aphids/day with *Coccinella 7-punctata*; 40 aphids/day with *Propylaea 14-punctata* and *Malachius bipustulatus*; 30 aphids/day with *Chrysopa carnea* and *Staphylinus*; 25 aphids/day with *Brachinus explodens* and *Episyrphus balteatus*, and 20 aphids/day with *Cantharis fusca*. Such a bank of 11 active predators (from the mentiond species) cand destroy 440 aphids every day. We estimate that the population of EDT value of the aphid *Sitobion avenae*, at a density of 62 predators/m^2, might be destroyed in **5 day**.

Under the conditions of winter wheat agrobiocenoses at the critical attack moment of aphids on the ear, the calculated theoretical ratio of 41 *aphids*/1 predator/ ay has not been reached due to the activity of the many predators growing on aphid colonies on the ear (and wheat leaves) around June 16. Both under the conditions of forestry belt-protected crops and open field crops the impact of the natural reserve of entomophagous predators, concentrated in the winter wheat crop, on the decrease of aphid populations has been reflected by the very significant multiple correlation coefficients (R=0.609 for the forestry belt farm and R=0.715 for the open field crop). As a consequence of these very strong structural interactions, the EDT values of 25 *aphids*/ear during wheat grain growth and filling usually are not reached, or in exceptional years aphid colonies exceeding the EDT value will be diminished by entomophag activity within several days. As regarding wheat thrips (*Haplothrips tritici*), the adults and eggs have been actively eaten by numerous polyphagous predators in the crop. During the critical attack period – the period of grain filling in wheat – the thrips larvae are destroyed by the *carnea* larvae, the species having a preying capacity of 40 thrips/day/individual; *Coccinella 7-punctata* larvae with a destruction rate of 35 thrips/day/individual; *Malachius bipustulatus* and *Nabis* sp. (30 thrips/day/individual) and *Cantharis fusca* (15 thrips/day/individual). From the observations made we have noticed that such a predatory bank can destroy 150 thrips larvae/day, while with a density of 133 predators/m^2 during **5 days** the number of thrips representing the EDT value might be diminished (40 larvae/ear), the calculated theoretical ratio being of 30/1 (prey/predator). In winter wheat agrobiocenoses the natural ratio established during the critical thrips attack period is much lower, while the annual ratio (thrips/predators) have also shown an intense entomophagous activity of diminishing the populations of *Haplothrips tritici* under the EDT values. The active pray/ polyphagous predators interactions lead to the stabilization of very significant correlations (R=0.634) and an efficient natural biological control in the forestry belt-protected crop agrobiocenoses. In open field wheat crops although benefiting from a rich active entomophagous fauna in the destruction of damaging thrips, has recorded in more favourable years increases of thrips larvae densities in the ear. Complex observations should be made and the application of integrated control measures should be performed in order to protect and use the activity of entomophag natural reserve in the crops. It has been shown that the level of pest populations (*Oulema melanopus, Sitobion avenae, Haplothrips tritici*) in protective forestry belt-based cereal agroecosystems has been strongly influenced and much lower than in open field crops, due to the more intense and efficient activity in the surfaces of crops protected by forestry belts. The abundance of active predatory species in diminishing pests have been higher in the crops of protective forestry belts farm.

From the structure of pests observed in winter wheat and spring barley crops, the most important groups of phytophags typical for the cereal agroecosystems in Central Transylvania have been observed (Malschi şi Mustea, 1992). Thus, under the regional ecological conditions the development of diptera (*Aphididae* and *Cicadinae*), thysanoptera and choleoptera (especially *Chrysomelidae*) has been favored. Represented by numerous species, these pest groups are dominany within the complex of crop phytophags and can cause serios damages during the critical attack moments, especially at the beginning of phenological plant development (autumn or spring), and during earing and grain formation under certain conditions.

From test data performed on pest structure the different statistical weight of bordering grass groups and field crops have been recorded. Bordering grasses are ecological niches for some pest groups, and may be focuses for *Chrysomelidae, Curculionidae, Nematocerae, Chloropidae, Orthopterae, Heteropterae* and others, but they haven't been reported as dominant groups in the area crops, but a series of other species which grow depending on plant and crop soil (diptera, cycads, aphids, thrips species).

On the other hand, bordering grasses and forestry belts show a complex structure of entomophagous arthropod fauna, and in accordance with the structure and abundance of the same systematic groups recorded also in wheat and barley crops. The main groups of active entomophags in the crops have a significant statistical weight in the structure of entomophagous arthropods recorded at the border of the crop fields. The study on the correspondence of entomophag group abundance in the crops and grassed borders and forestry belt protected emphasizes the extremely favourable ecological niche value of the field border flora- diversified and the important role they play for useful fauna circuit, activity efficiency and conservation.

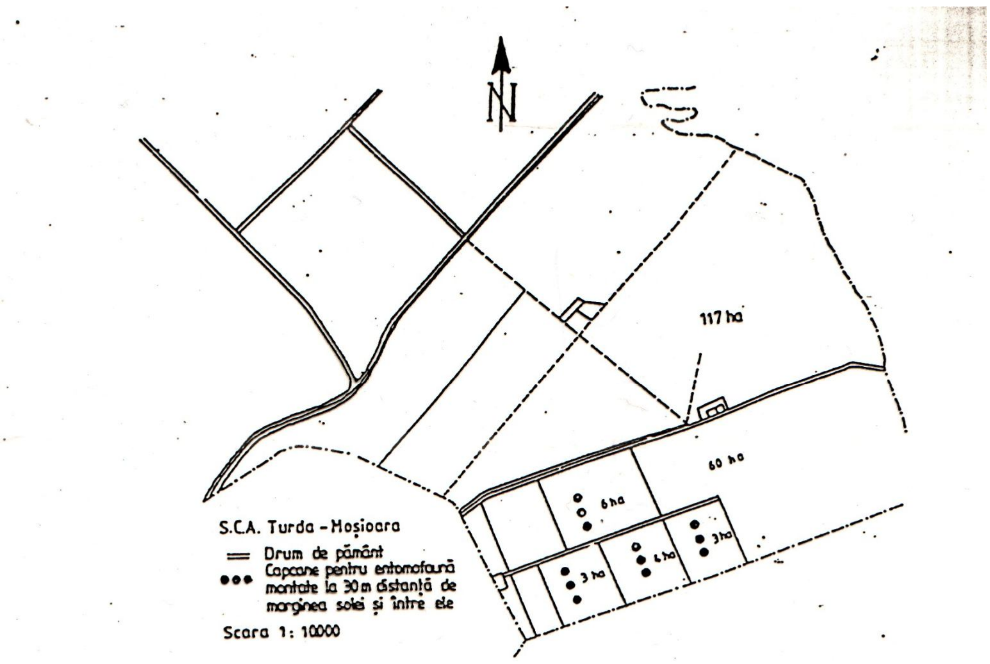


Fig. 1. The map of crop plots in Turda open field area and the place of catches for entomofauna.

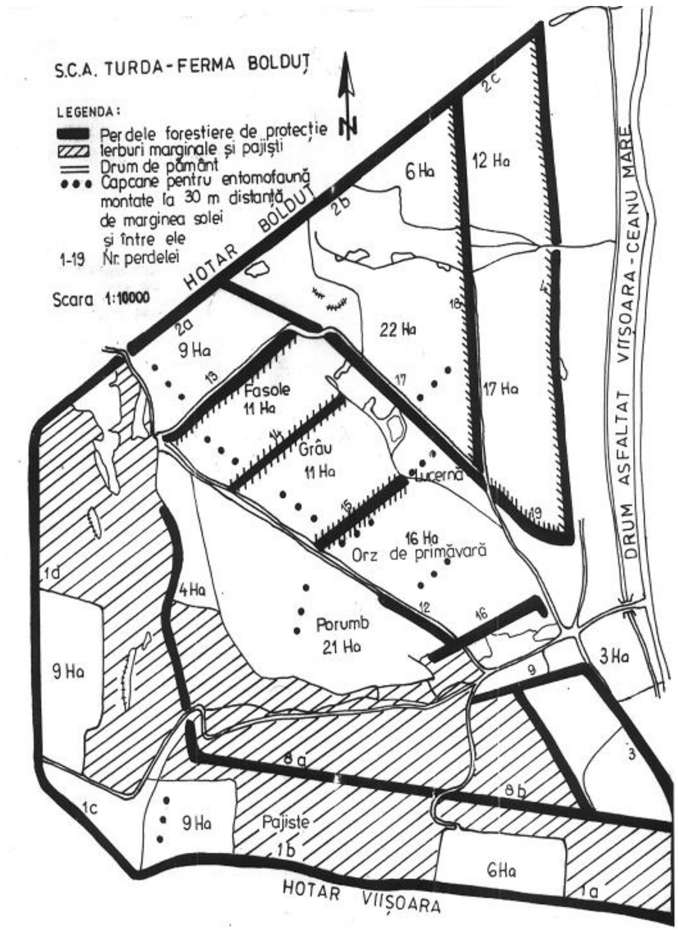


Fig. 2. The map of forestry belts net in Cean-Boldut and the fields place of catches for entomofauna (Agricultural Research and Development Station Turda

Tab. 1

List of registered pest species in ARSD Turda

1. Ord. Collembola,	Fam. Sminthuridae: Sminthurus viridis L.
2. Ord. Orthoptera,	Fam. Tettigoniidae: Tettigonia viridissima L. Fam. Cantatopidae: Decticus verrucivorus L. Fam. Acrididae: Dociostaurus marocanus Th., Calliptamus italicus L. Fam. Gryllidae: Gryllus campestris L.
3. Ord. Heteroptera,	Fam. Scutelleridae: Eurygaster maura L. Fam. Pentatomidae: Aelia acuminata L. Fam. Miridae: Trigonothylus ruficornis Geofr., Lygus pratensis L., L. rugulipennis P.
4. Ord. Homoptera, Sord. Cicadina:	Fam. Cicadellidae: Psammotettix alienus Dahl., Macrosteles laevis Rib. M. sexnotatus Fall. Fam. Delphacidae: Javesella pellucida Fabr.
Sord. Aphidina:	Fam. Aphididae: Schizapis graminum Road., Sitobion avenae Fabr., Rhopalosiphum padi L., Metopolophium dirhodum Walk.
5. Ord. Thysanoptera	Fam. Tripidae: Stenothrips graminum Uz., Limothrips denticornis Hal. Fam. Phlaeothripidae: Haplothrips tritici Kurdj., H. aculeatus Fabr.
6 Ord. Coleoptera	Fam. Carabidae: Zabrus tenebrioides Goeze. Fam. Elateridae: Agriotes lineatus L., A. ustulatus L., A. sputator L., A. obscurus L. Fam. Tenebrionidae: Opatrum sabulosum L. Fam. Scarabeidae: Anisoplia segetum Hb. Fam. Chrysomelidae: Lema melanopus L., Chaetocnema aridula Gyll., Phyllotreta vitulla Redt.
7. Ord. Hymenoptera	Fam. Cephidae: Cephus pygmaeus L. Fam Tenthredinidae: Dolerus haematodis Klg.
8. Ord. Diptera Sord. Nematocera:	Fam. Tipulidae: Tipula oleracea L. Fam. Bibionidae: Bibio hortulanus L. Fam. Cecidomyiidae: Contarinia tritici Kyrby., Mayetiola destructor Say., Haplodiplosis equestris Wagn., Sitodiplosis mosellana Gehin.
Sord. Brachicera:	Fam. Opomyzidae: Opomyza florum F., O. germinationis L., Geomyza tripunctata Fall. Fam. Anthomyiidae: Delia coarctata Fall., D.platura Meig., D.liturata Zett. Phorbia penicillifera Jermy., Phorbia securis Tiensuu. Fam. Chloropidae: Oscinella frit L., O. pusilla Meig., Tropidoscinis albipalpis Meig., Elachiptera cornuta Fall., Chlorops pumilionis Bjerk., Meromyza nigriventris Mac., Lasiosina cinctipes Meig., Cetema elongata Mg., Comarota curvinervis Latr. Fam. Scatophagidae: Amaurosoma flavipes Fll. Fam. Agromyzidae: Phytomyza nigra Fll. Fam. Ephydridae: Hydrellia griseolla Fll.
9. Ord. Lepidoptera	Fam. Tineidae: Ochsenheimeria taurella Schiff. Fam. Noctuidae: Hadena basilinea F., Agrotis segetum Schiff.

Tab. 2

List of registered entomophagous arthropods in A.R.S.D. Turda.

Clasa Arahnida	
1. Ord. Aranea	Fam. Lycosidae: Trochosa sp. Fam. Araneidae: Araneus diadematus Clerck
2. Ord. Acari	Fam. Phytoseiidae: Phytoseiulus persimilis Ath-Hen. Fam. Trombidiidae: Trombidium holosericeum L.
Clasa Insecta	
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 ş.a.
6. Ord. Planipennia	Fam. Chrysopidae: Chrysopa carnea Stephn.
7. Ord. Diptera	Fam. Cecidomyiidae Fam. Asilidae: Dioctria rufipes De Geer. Fam. Empididae: Platypalpus sp. Fam. Dolichopodidae: Medetera sp. Fam. Scatophagidae: Scatophaga stercoraria L. Fam. Tachinidae: Lydella sp. Fam. Syrphidae: Episyrphus balteatus Dg., Syrphus ribesii L., Metasyrphus corollae Fabr.

Tab. 3

List of active main entomophagous predators in cereal agrobiocenosis of Transylvania (A.R.D.S. Turda)

Grupe şi Familii Groups and Families	**Genuri şi specii dominante** Dominate genres and species	**Menţiuni bibliografice. Activitatea entomofagă (raţia / zi / individ)** Literatures on the entomophagous activity (pray ratio / day / individual)
Aranea		Cândea, 1986, Mühle-Wetzel, 1990, Wetzel, 1995, Malschi-Mustea, 1997
Forficulidae	Forficula auricularia L.	Hassan, 1992, Wetzel, 1995, Malschi-Mustea, 1997
Chrysopidae	Chrysopa carnea Stephn.	Cândea, 1986 (32 afide/zi), Wetzel, 1995, Malschi-Mustea, 1997
Nabidae	Nabis	Wetzel, 1991 (15 afide/zi), Wetzel, 1995, Malschi-Mustea, 1997
Anthocorydae	Orius	Voicu, 1993, Perju, 1988
Coccinellidae	Coccinella 7-punctata L. Prophylea 14-punctata L.	Mühle-Wetzel, 1990 (115 afide/zi), Wetzel, 1995 Basedow,1990(38afide/zi), Malschi-Mustea, 1997
Cantharidae	Cantharis fusca L.	Wetzel, 1991 (8 afide/zi), Wetzel, 1995, Malschi-Mustea, 1997
Malachiidae	Malachius bipustulatus L.	Steiner, 1976, Cândea, 1986, Malschi-Mustea, 1997
Staphylinidae	Tachyporus hypnorum L. Staphylinus	Basedow, 1990 (19 afide/zi), Wetzel, 1995, Chambon, 1984, Sunderland, 1985, Malschi-Mustea, 1997
Carabidae	Poecilus cupreus L. Amara aenea De Geer Harpalus rufipes De Geer Brachinus explodens Duft.	Welling M., 1990, , Wetzel, 1995, Ciochia, 1986, Basedow, 1990 (11 afide/zi) Basedow, 1990 (27-130 afide/zi) Cândea, 1986, Malschi-Mustea, 1997
Sylphidae	Sylpha obscura L.	Sunderland, 1985 (afide), Malschi-Mustea, 1997
Cicindellidae	Cicindela germanica L.	Panin, 1951, Ciochia, 1986
Emipididae	Platypalpus	Chambon, 1984, Stark, 1987, Wetzel, 1995, Malschi-Mustea, 1997
Chloropidae	Thaumatomyia glabra Mg.	Skufin, 1978, Malschi-Mustea, 1997
Syrphidae	Episyrphus baltaeatus Dg.	Mühle-Wetzel,1990(20-80afide/zi), Wetzel, 1995, Malschi-Mustea, 1997
Scatophagidae	Scatophaga stercoraria L.	Chambon, 1984
Aeolothripidae	Aeolothrips intermedius Bagnall	Chambon, 1984, Mühle-Wetzel,1990, Wetzel, 1995, Malschi-Mustea, 1997
Formicidae		Cândea, 1986, Sunderland, 1985, Mühle-Wetzel, 1990, Wetzel, 1995, Malschi-Mustea, 1997

Tab. 4.

Valorile indicilor biocenotici structurali comparativi ai entomocenozelor din culturile de grâu în agroecosisteme cu perdele forestiere (Bolduţ) şi în câmp deschis (S.C.D.A. Turda. Comparative structural biocenotic indices of wheat crops in the forestry belts agroecosystems in Cean-Boldut and in open field area agroecosystems (A.R.D.S. Turda).

Cultura Field crop	**Artropode** Arthropods	**Localitatea** Location	**H'**	**E %**	**C_j**	**D %**
Grâu Wheat	**Dăunătoare** Pests	**A. Turda**	**2,127**	**0,62**	**5,2**	**68,29**
		B. Bolduţ	**2,203**	**0,67**		
	Utile Useful	**A. Turda**	**2,378**	**0,79**	**3,6**	**53,17**
		B. Bolduţ	**2,504**	**0,82**		

Respectively:

Diversity, $H' = -\sum_{i=1}^{n} \frac{n_i}{N} \ln \frac{n_i}{N}$;

$E\% = \frac{H'}{\ln S}$;

Jaccard coefficient of similarity, $C_j = \frac{c}{a+b}$;

Dominance of common species, D %;

a = the number of species present at field crop A, only;
b = the number of species present at field crop B, only;
c = the number of species present at both field crops ;
ni = the number of individuals of each species;
i = 1, 2, 3, ..., n species ;
N = the total number of individuals;
S = the number of species from investigated field crop.

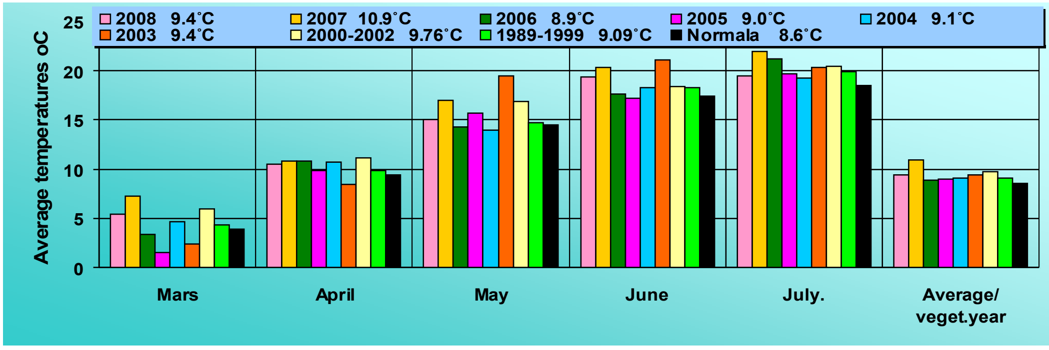
Tab. 5

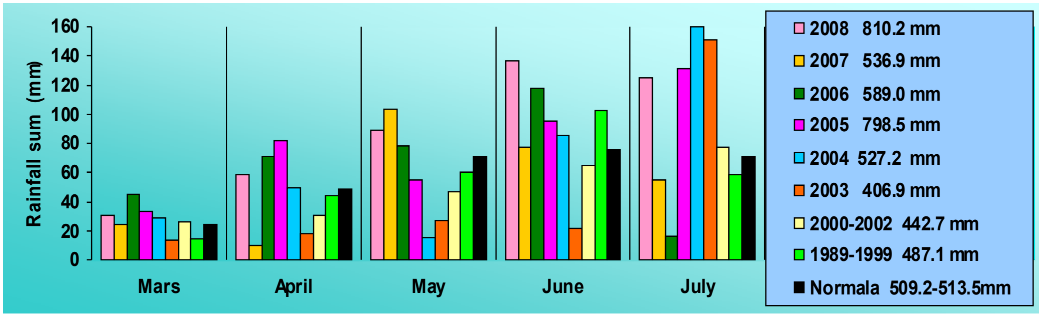
Study on the interrelations among some phyophagous pest species and entomophagous predators, on laboratory trials multiplication, from the cereal agrobiocenosis natural model

The pest and Economic Damage Threshold. **E.D.T.P.**	**Aspects of the rapport prey- active predators involved on E.D.T.P decreasing**							
	Interrelations in laboratory trials				**Yearly naturale interrelations (1994)**			
	Feeding rate of predators	**Reducerea P.E.D.P. (Theoretic number)**		**Daily rapport**	**Agroecosystem with forestry belts (Bolduţ) and in open field (Turda)**			
		Nr. of days	**Predators density**		**Crop**	**Sampling**	**Bolduţ**	**Turda**
Oulema melanopus L. **250 larvae / m^2**	**61 eggs / day / 7 predators**	**4 days**	**28 / m^2 / 1 day**	**9 / 1**	**Wheat**	**30.05**	**1 / 24**	**1 / 3**
						yearly	**1 / 8,4**	**1 / 4,4**
	43 larvae / day / 8 predators	**6 days**	**48 / m^2 / 1 day**	**5 / 1**	**Spring barley**	**09.06**	**1,7 / 1**	**6,2 / 1**
						yearly	**1,3 / 1**	**3,9 / 1**
Sitobion avenae Fabr., other sp. **25 aphids /ear, 12500 aphids/m^2**	**440 ahids / day / 11 predators**	**28 days**	**62 / m^2 / 5 days**	**41 / 1**	**Wheat**	**16.06**	**2,1 / 1**	**3,9 / 1**
						yearly	**1 / 1,3**	**3,2 / 1**
Hapothrips tritici Kurdj. **40 larvae/ear. 20000 larvae /m^2**	**150 larvae / day / 5 predators**	**133 days**	**133 / m^2 / 5 days**	**30 / 1**	**Wheat**	**16.06**	**1,5 / 1**	**1,3 / 1**
						yearly	**1,9 / 1**	**4,4 / 1**

Plate 3

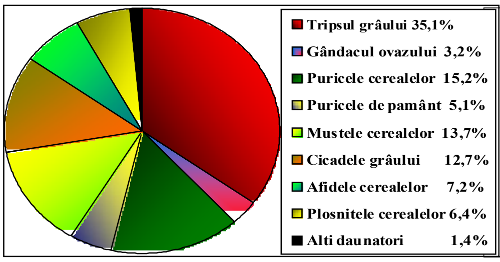
Monthly average temperatures and sum of rainfall at Turda conditions, from March to July, by comparison with annual average/vegetation year, in 1989-2008



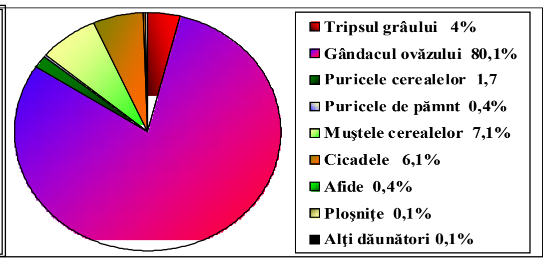


Pests structure in small grain cereals.

Winter Wheat

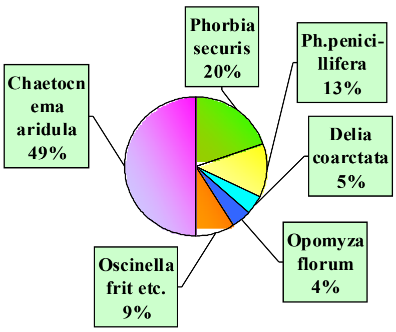


Spring Barley

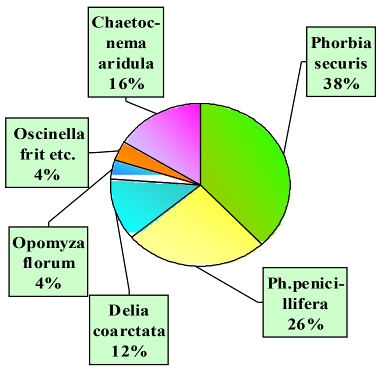


Structure of the damaging larvae extracted from winter wheat tillers, at the 10-20 th period of May 2003-2005.

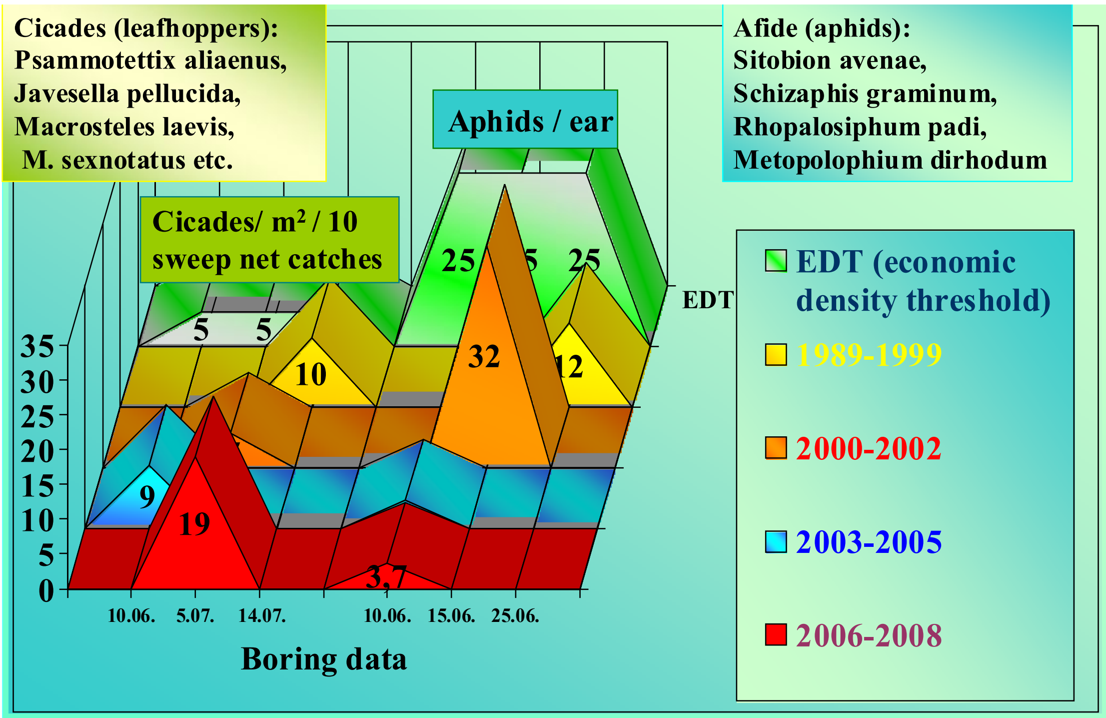
Wheat at bean precursory field



Wheat at monoculture field



Average attack potential of cereal aphids and cicads in the years 1989-2008, in A.R.D.S.Turda



Average attack potential of cereal flies in the years 1989-2008, in A.R.D.S.Turda

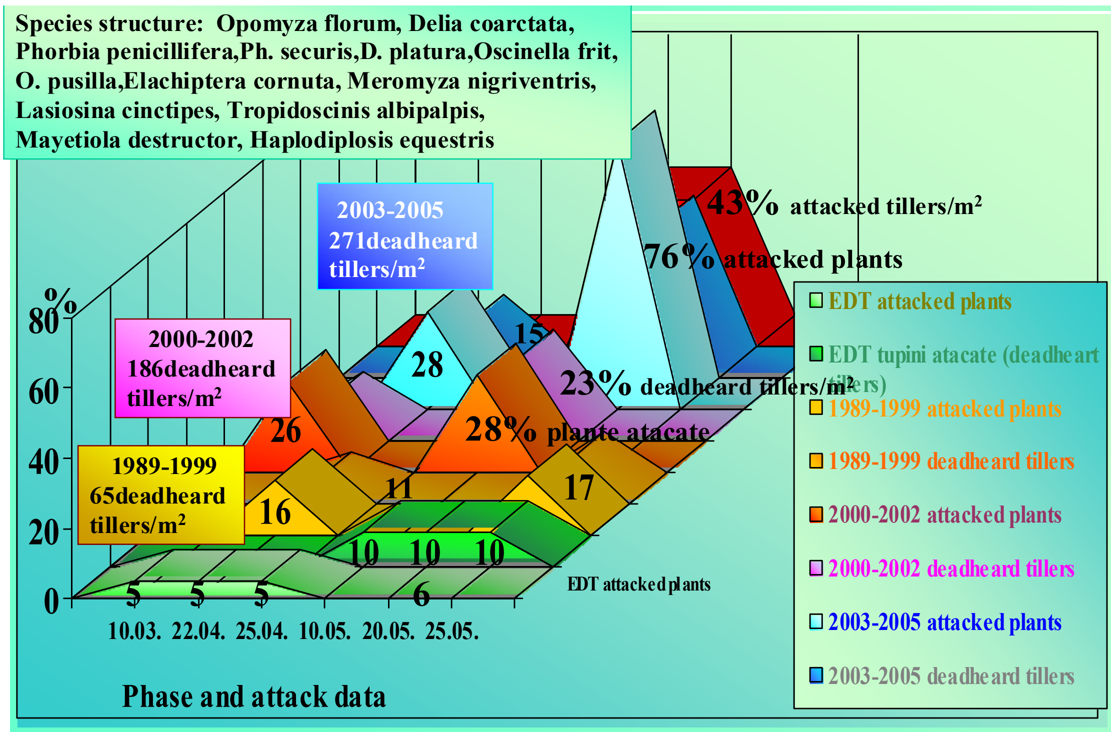
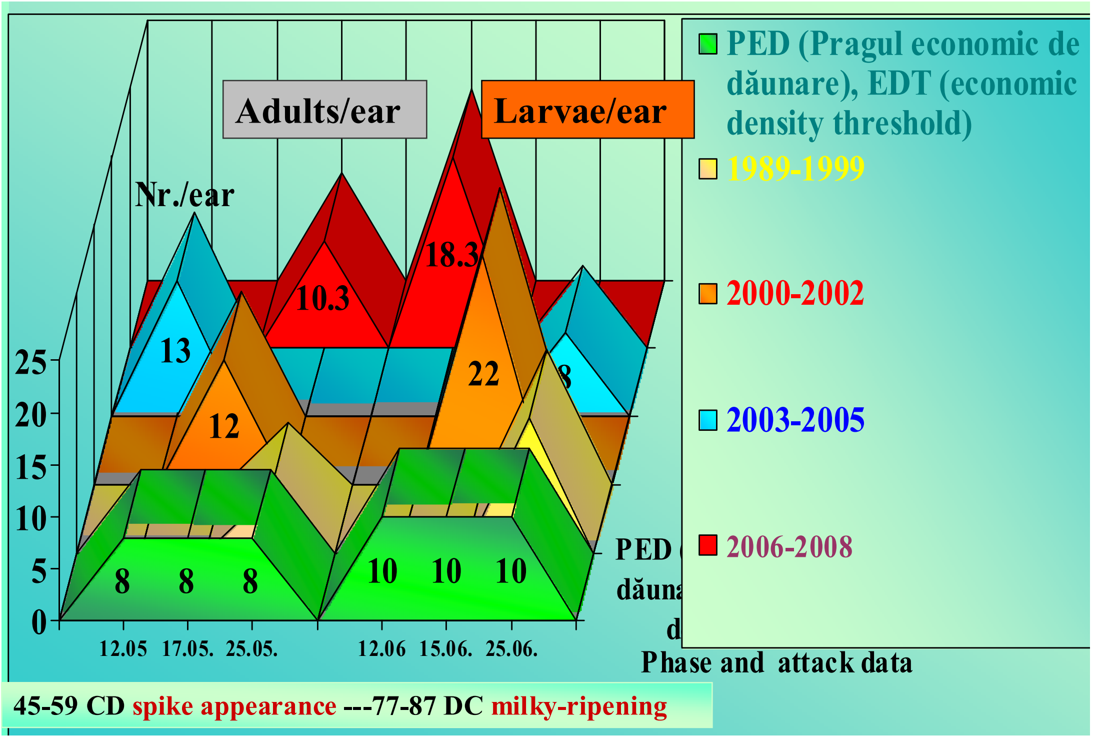


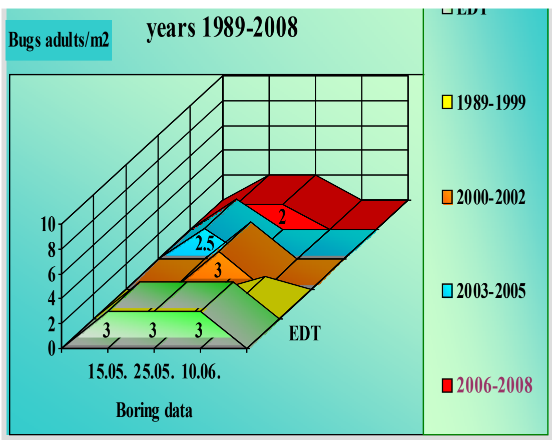
Plate 5

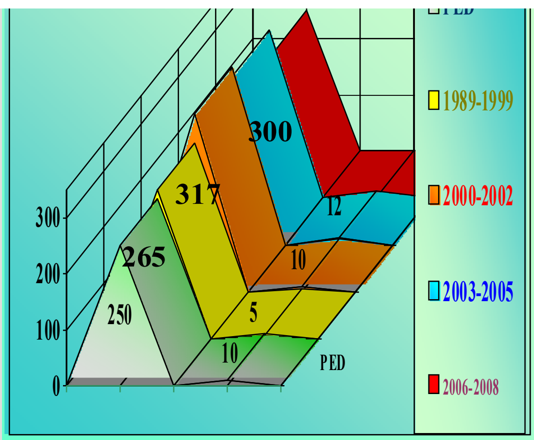
The attack potential of wheat thrips
(***Haplothrips tritici***) in the years 1989-2008, at A.R.D.S.Turda



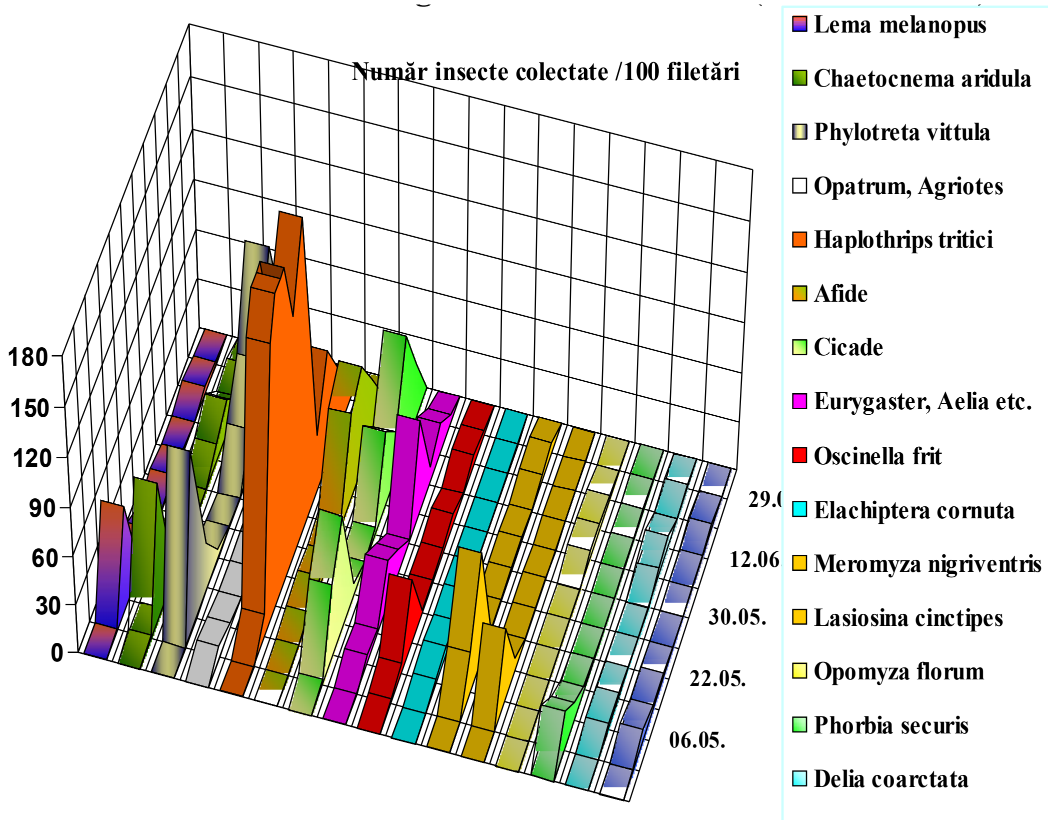
The attack potential of cereal bugs
(***Eurygaster maura, Aelia acumunata***)
in the years 1989-2008,
at A.R.D.S.Turda

The attack potential of ***Oulema melanopus***
in the years 1989-2008,
at A.R.D.S.Turda





Dynamics of wheat pests in 2005, A.R.D.S.Turda
(Insects number/100 sweepnet catches).



Dynamics of entomophagous arthropods in winter wheat fields in 2005.

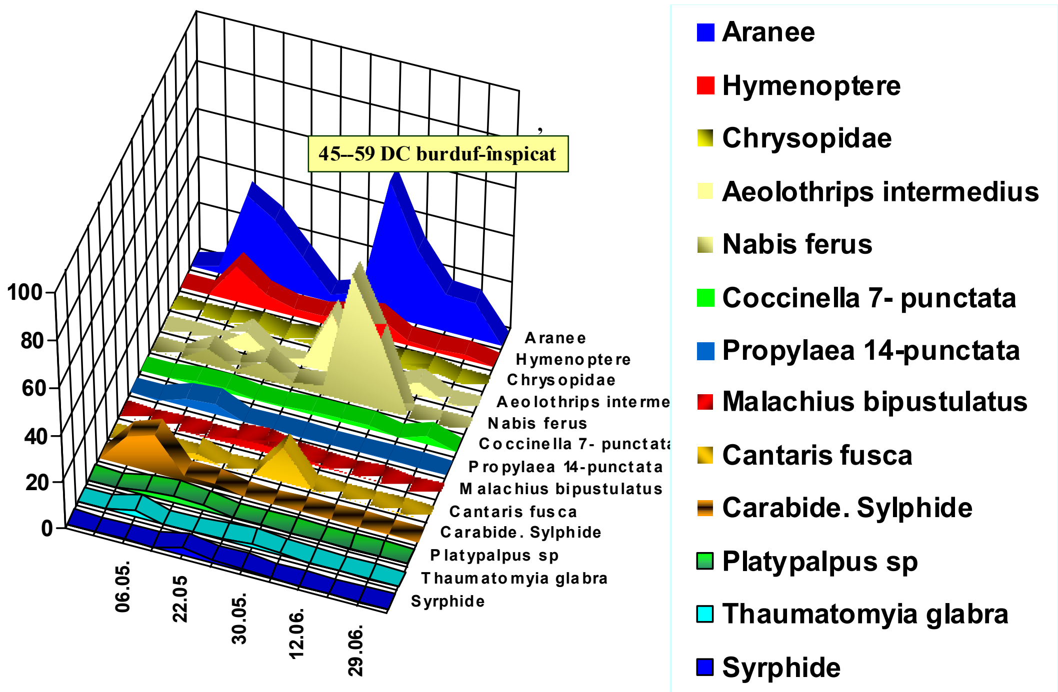
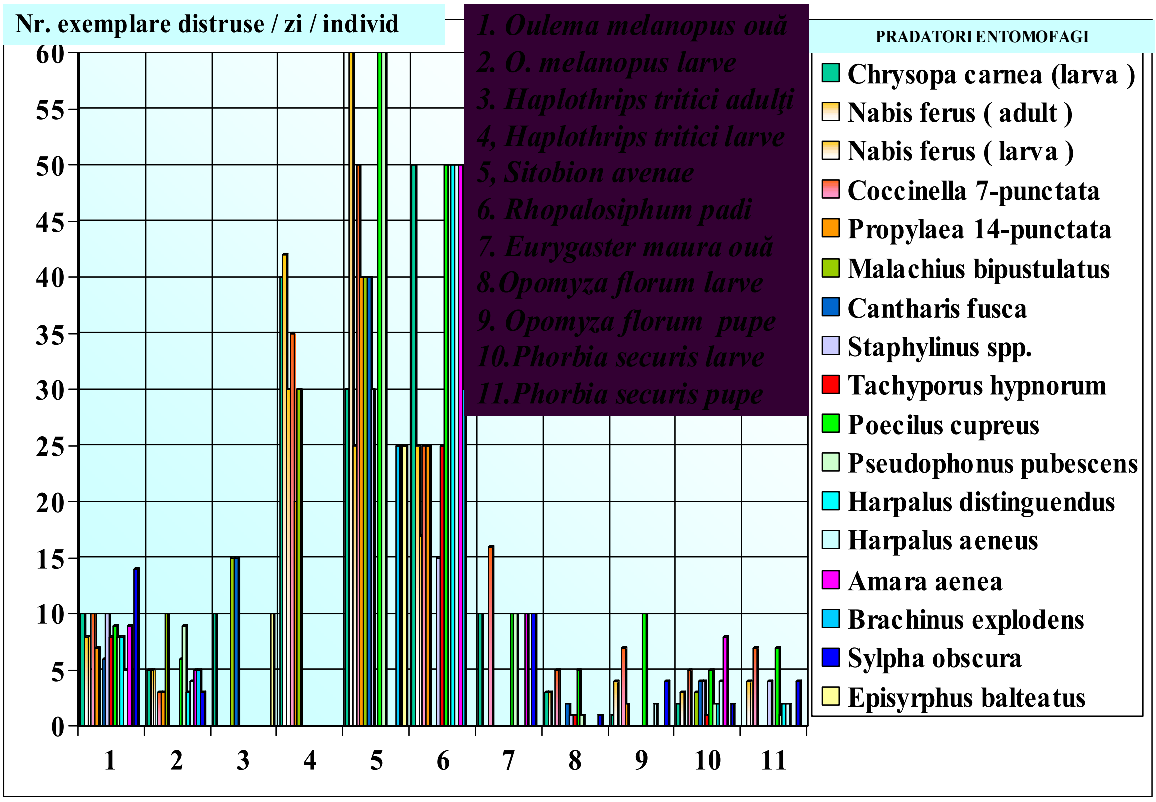
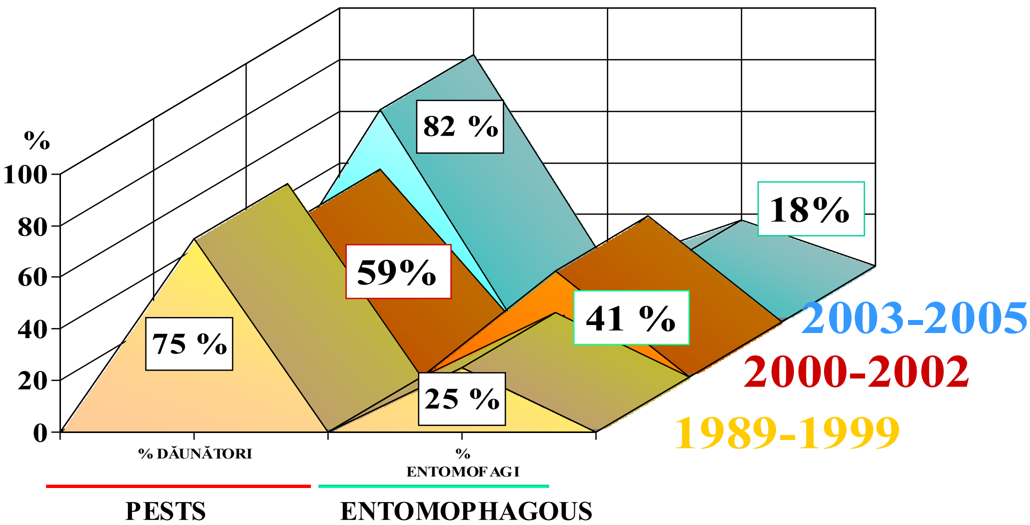


Plate 7

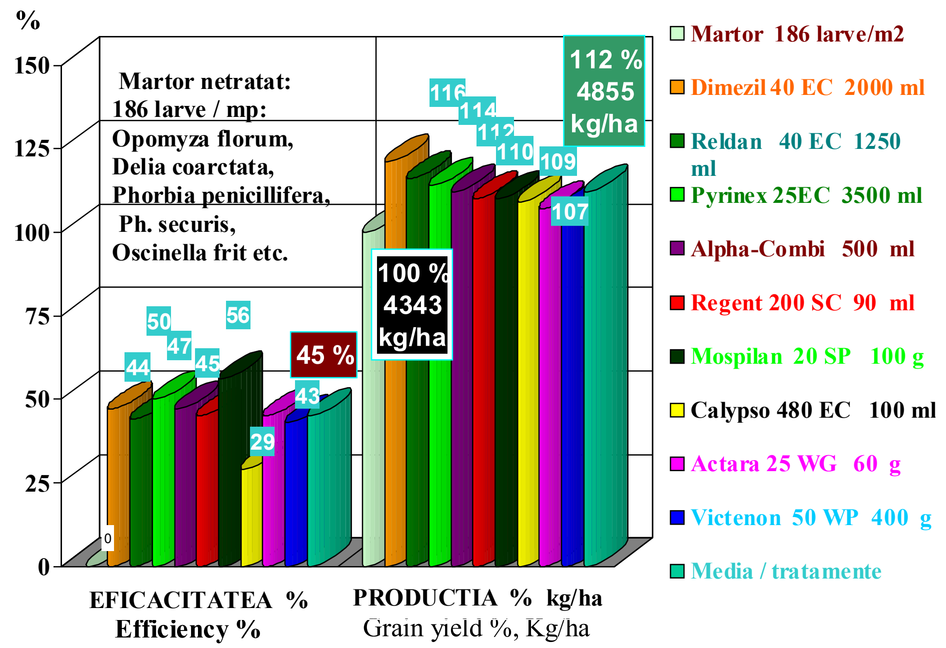
Individual daily prey capacity of the cereals main entomophagous predator species in laboratory trials (A.R.D.S.Turda). (consumed pests number/day/individual predator)



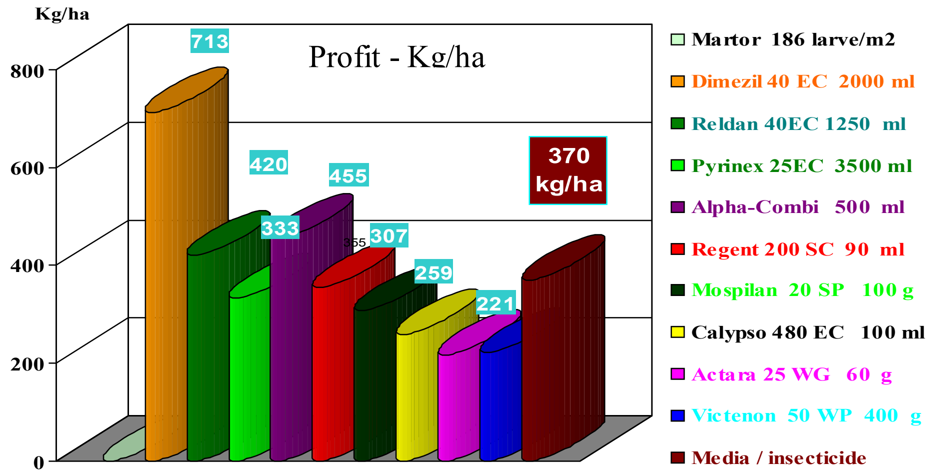
Structure and interrelation of the pests and useful arthropods fauna in wheat crops (A.R.D.S. Turda 1989-2005).



Biological efficacy and economic efficiency of applied insecticides for diptera larvae control, in winter wheat crops, at the 10-20 th April 2000-2002, A.R.D.S.Turda

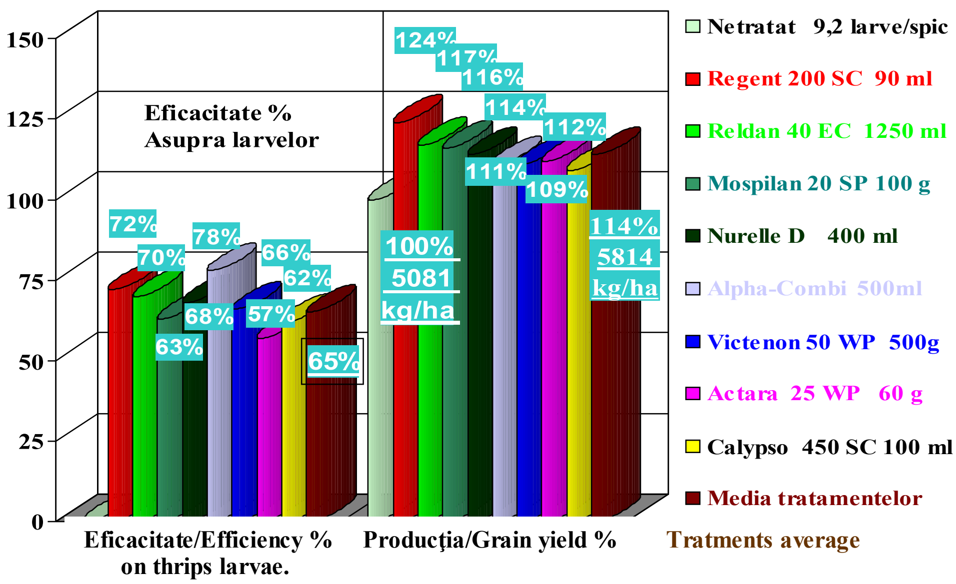


Economic efficiency of applied insecticides for diptera larvae control, in winter wheat crops, at the 10-20 th April 2000-2002, A.R.D.S.Turda

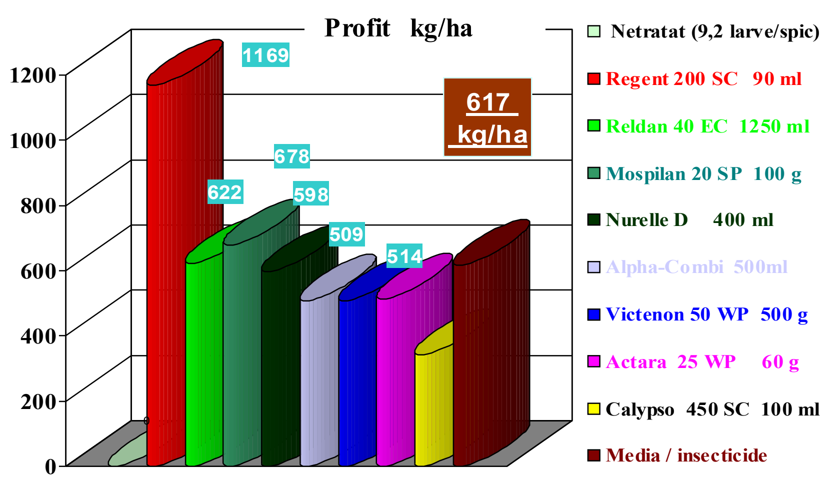


F=5,1* (3,05). DL p 5%-225 kg; DLp 1%-303 kg; DLp 0,1%-404 kg

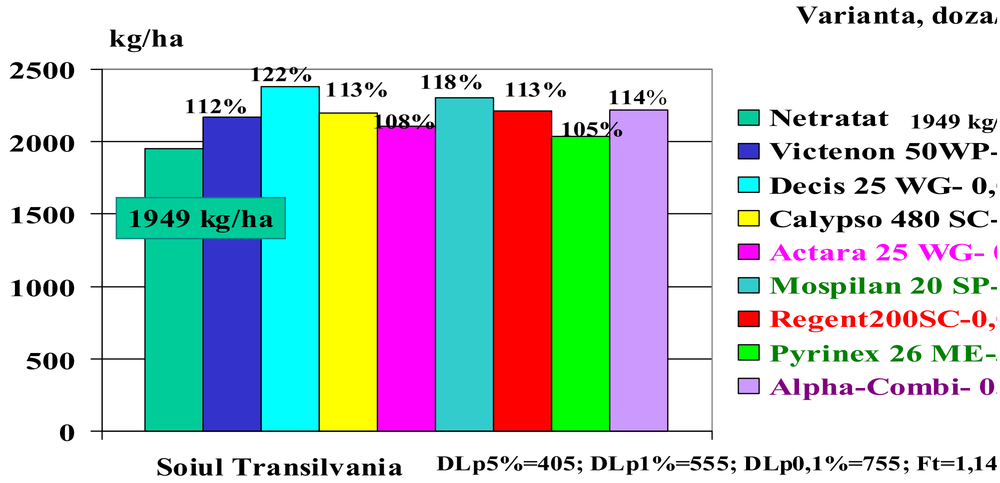
Effect of wheat thrips control treatment, applied at 45-59 DC stage, at flag leaf and ear apparison, in the 15-25th May 2000-2002, at A.R.S.D.Turda.



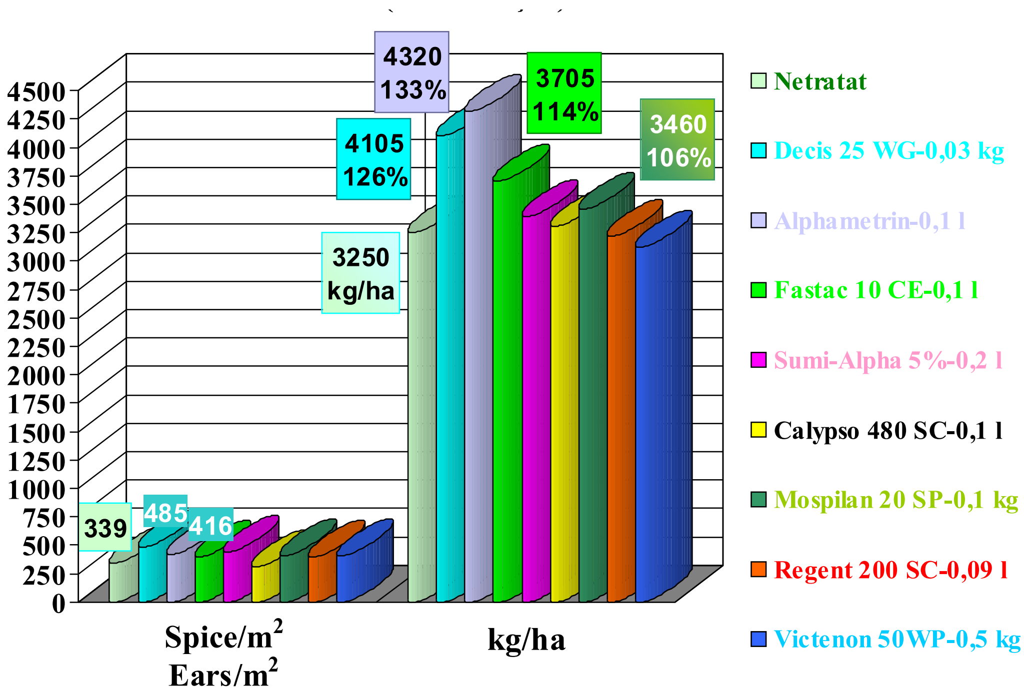
Achieved profit after wheat thrips control treatment, applied at 45-59 DC stage, at flag leaf and ear apparison, in the 15-25th May 2000-2002, at A.R.S.D.Turda.



Effect of treatment for winter wheat diptera, fleas, sun bugs, *Oulema* adults etc., applied at the weeds control time, the 12th May 2003, A.R.S.D.Turda.



Effect of treatment for ear pests control, applied at the flag-leaf phase, on winter wheat ears density and yield, of Arieşan variety, in 2003, at A.R.S.D.Turda.



3. Auxiliary entomophagous fauna in cereal agroecosystems

3.1. Predatory entomophags and cereal pest control in Central Transylvania

The elaboration of the integrated cereal pest control has been the result of some serious ecological investigations. The complex entomological study of cereal biocenoses for the understanding of the natural biological, biotic and technological factors which influence pest abundance and the damages they cause in the crops represent concerns related to plant protection. Among these concerns, the researches on useful entomophagous arthropod fauna have a special place (Baicu, 1978, 1996; Chambon, 1984; Hassan, 1985; Wetzel, 1995). Modern researches in the field have been conducted in the main cereal regions of Romania (Bărbulescu, 1984; Baniţă, 1994; Popov et al., 1994; Malschi, Mustea, 1995, 1997; Voicu et al., 1993; and others).

The study of predatory entomophags and cereal pests (winter wheat, spring barley and others) in the Central part of Transylvania, at the Agricultural Research and Development Station in Turda during 1990-1997 has lead to creation of thorough taxonomic lists in accordance with the scientific literature (Malschi and Mustea 1995, 1997). Experiments and observations have been conducted regarding the cereal entomocenoses in the Transylvanian Plain in the crop classical technological system under the open field conditions.

The dynamics of the main phytophagous and entomophagous species in the crops has been established by samples taken every 10 days containing entomological sweepnet catches (300 double sweepnet/sample), while for the species at the ground level the samples have been based on capture in water traps (Barber traps) placed in three repetitions/variant.

The attractiveness of some aromatic plants of the marginal spontaneous flora in the wheat field for entomophags by using kairomonal traps with inflorescence glued to white gummed boards, in 5 repetitions/variant.

Insecticide impact on the main active predatory species has been studied also under semi-field conditions on the individuals of the species in isolators (thick-sieved cover boxes containing 5-10 insects in favorable life conditions: soil, water, food) in 2-3 repetitions for each species and variant, in the experimental field by standard testing methods (Hassan, 1985).

The depressive side effect of insecticide application in crops on the predatory entomophags has been studied by establishing the mortality caused under fild conditions and by studying auxiliary population recovery after treatments, in samples taken with the entomological sweepnet catches or Barber traps (at ground level).

The effect of predatory activity on ear pests (aphids, thrips) has been studies in filed ecological experiments, on normal ears visited by predators (especially during the larvae stage) and in comparison with isolated ears by an adhesive collar at the base of every ear, ear infestation with pests (aphids, thrips larvae) being even in the two variants. Yield loss (grams of grains/ear) has been observed in the ears unvisited by predators in accordance to the wheat variety, marking 30 ears/variant.

Under laboratory conditions the predators in individual isolators have been studied (3-10 repetitions) establishing feeding spectrum with several phytophags and damaging potential/day /predatory individual.

Research results have revealed important aspects of agroecology. Among the numerous phytophagous species present in the cereal biocenoses in Central Transylvania significant damages have been caused - under special conditions - by homoptera (Cicadellidae, Aphididae), thysanoptera, coleoptera (Chrysomelidae) and especially diptera (Anthomyiidae, Opomyzidae, Chloropidae and others). Researches have proven that yield losses could be diminished by using an integrated agroecological plant protection system including also the biotic factors beside the technological factors, which help a good crop plant growing and yield improvement (Malschi, Mustea, 1992, 1995, 1997). Among these biotic factors, useful arthropod fauna present in crops has been recorded as belonging to the natural entomophag reserve (Malschi, Mustea, 1995). Entomophagous predators are extremely active regarding phytophagous insect population limitation maintaining them at values under the economic damaging threshold (EDT) under normal agroecological conditions. The role and damaging potential of the main poliphagous predatory species have been shown through tests and laboratory checking (Malschi, Mustea, Popov, 1997), thus justifying researches regarding the importance of following protection measures, predatory entomophag conservation and use in the cereal agrobiocenoses in Central Transylvania (Malschi, 1997, 2007). The study has supported the understanding of entomophagous predators eco-biology and their enriching possibilities in cereal crops. The impact of entomophagous predators as auxiliaries in cereal crop protection has been shown, even in the case of intensive open field technological system characterized by the diminishing effects and the fragmentation of natural biotopes, which are considered as unfavorable effects to auxiliaries. If the agricultural entomology has mainly focused on the main pests and some specific entomophags, modern entomocenotic researches have revealed that in cereal-type agroecosystem, auxiliary entomophagous species play an important role due to their richness and diversity Chambon et al., 1985, Derron, Goy, 1996, Wetzel, 1995 and others).

Entomophags have taken their place in the trophic network in the agrobiocenoses, made of crop plants as producers, of phytophagous pests, zoophagous useful fauna, saprophags and disintegrators. A large part of the entomophagous arthropods live in the crop at the ground level and are polyphagous predators. Others are occurring while they fly on the crops being attracted by the development of certain pest populations.

In the area of Central Transylvania predatory arthropod fauna has an obvious richness, over 45 species or systematic groups being recorded (table 2).

Despite the intensification of agriculture, crops have been gradually colonized by auxiliary entomophagous species. This abundance in the crops has been explained by the proximity with vegetation area which represent true ecologically compensating areas (Derron, Goy, 1996) having diverse flora favorable for entomophags and a certain role in species survival (Welling, 1991, Sabine Stork-Weyhermuller, Welling, 1991, Rupert, Molthan, 1991, Sustek, 1994, Wetzel, 1995). From these natural biocenoses with pastures, grass bordering belts, shrubs and trees, forests and agroforestry belts the useful species gather in crops. Some important entomophagous species with poor dispersion capacity, such as those of the genuss Carabus and Calosoma, have been reported to have disappeared from the investigated crops.

The study of the structural interactions established between predators and pests in cereal agrobiocenoses has revealed the dynamics and biology of the main species during several sequences of wheat crop phenological development (fig. 3 and 4).

At ground level the entomophagous arthropod fauna belonging to aranea and insect classes have been pointed out with the help of the Barber traps. The results of these captures do not reflect the actual density of the epigeous fauna but the activity of species running on the ground. In late spring, April-May, Aranea, Staphylinidae, Carabidae şi Sylphidae were captured. In June-July, at the ground level especially Carabidae and Sylphidae were captured (table 6). Few himenoptera, diptera, heteroptera (Nabidae) and dermaptera have been found.

The epigeous fauna is formed of pioneer species capable of moving fast in search food. Polyphagous entomophags feed on several phytophagous species since the beginning of spring. By their activity they limit the pest growth, avoiding their intense reproduction in the crop. Therefore they have a significant role aphytophagous population regulators. The prey range (Derron, Goy, 1996) comprises eggs, larvae, pupa of diptera, coleoptera, heteroptera, aphids, thrips and others (tables 7, 8, 9, 10). Being adapted to diverse food, the epigeous fauna has been maintained in cereal crops at relatively high densities (100 individuals/m^2, Wetzel, 1995).

Carabides are of special interest, noticing that the most common species in the cereal crops (*Poecilus cupreus* L., *Pterostichus melanarius* Ill., *Harpalus rufipes* De Geer. (*Pseudophonus pubescens* Mull.), *H.distinguendus* Duft., *H. aeneus* L., *Dolichus halensis* Schall., *Platynus dorsalis* Pont., *Loricera pilicornis* F., *Brachinus explodens* Duft. and others) show homogenity in European regions (Chambon, 1984, Chambon et al., 1985, Sunderland et al., 1985, Basedow, 1990, Welling, 1990, Sustek, 1994, Wetzel, 1995, Derron, Goy, 1996), being recorded also in Central Transylvania (Malschi, 1997, 2007). The feeding regime of carabide species is mostly zoophagous. If the larvae are known as zoophagous excepting those belonging to the Zabrus genus, the adults of several species may occasionally feed on vegetal tissues too. Some species of the *Harpalus, Amara, Brachinus* genus are known mainly as phytophagous (Derron, Goy, 1996), while the active species mentioned by us have been revealed in laboratory tests as being plyphagous entomophags (Sunderland et al., 1985, Basedow, 1990, Malschi, Mustea, 1997).

The seasonal activity of carabides have shown two periods of intensification, the first in May, corresponding to the species that hibernate as adults and the second in June-July corresponding to the species that spend the winter as larvae and migrate later (Derron, Goy, 1996). The staphylinids and araneae in wheat crops grow gradually having the same two maximum development in April-May, corresponding to ground level activity and on small plants, and in June-July, corresponding to the growth of the new generation in the species feeding on ear pests.

During the plant and pest population development on leaves and spikes, other predators gather in the crops. Most of them are polyphagous (tables 7, 8, 9, 10), feeding on diptera, coleoptera, aphids, thrips and others.

In May there are some adults belonging to the genus Cantharis, Malachius, Propylaea, Coccinella and others occurring in the crops to feed on eggs and *Oulema melanopus* L. larvae (table 8), aphids and thrips. In June, an intense concentration of predators (*Coccinellidae, Chrysopidae, Nabidae, Syrphidae, Araneae* and others)have been seen, feeding during the emergence of the new generation on aphids (table 10); they have been proved to destroy thrips, bug eggs, diptera etc. as well (fig. 5), (Malschi, 1997, 2007).

This entomophagous arthropod fauna on wheat spikes has been very efficient, achieving the natural biological pest control (aphids and thrips) and thus providing crop protection and increases of 15.6% in grain yields (table 11)

Plant-attracted auxiliary entomophags

In order to enrich the level of predator auxiliary populations for ear pests, the possibilities of attracting the *Chrysopidae, Coccinellidae, Syrphidae, Empididae* adults from the nature with the help of attractants made of plant flowers remarked as concentration banks (Malschi 1997, 2007), into the spontaneous crop border flora: *Daucus carota, Achillea millefolium, Sambucus nigra* and others have been studied. Researches have tested the increased attractiveness (3 to 4 times higher compared to experimental control) exerted by these flowers for the adults belonging to the active species of aphids and thrips' predators during the stage of grain formating and in milk-wax ripening of wheat (table 12).

The results have shown that cereal crop enrichment with useful fauna depends on the existence of neighboring environments favorable to auxiliary development. Protection and special cropping of these areas of ecological compensation may partially repair the unwanted effects of agricultural intensification and the open field agricultural system. Establishing quality, floristic structure, area size and placement will help gathering all information required for ensuring their compatibility with the dispersion and colonization capacity of the auxiliary entomophagous species (Derron, Guy, 1996).

The favorable measures for the protection, increase and use of polyphagous predators in the natural entomophags reserve in order to protect the crops against regional pests have referred to: scientific insecticide application and their limited use; conservation of flora diversity in agroecosystems; enrichment of crop borders with kairomonal attractiveness-endowed plants for the entomophagous predator concentration in the crops (such as *Daucus carota, Achillea millefolium, Sambucus nigra* and others); planting protective tree and shrub belts, grass belts used for entomophag conservation and growth to help their migration crop colonization.

Insecticide toxicity and selectiveness to auxiliaries

Closely correlated with the sequential activity of the entomophagous predators against crop pests is the study of the impact magnitude of some insecticide treatment. The abundance of auxiliary species in the crops has been influenced by insecticide applications. Thus, the wheat seed treatments applied to autumn with Lindan-based products have caused a significant decrease of useful epigeous fauna concentration during the crop colonization period (April-May (table 13).

The experimental treatment applied in April with different insecticides for phytophagous diptera attack prevention has an instant depressive effect on the aranea, staphylinids and carabids species (*Poecilus cupreus* L.), already found in the crop. In comparison with the untreated control carabid species have proved to rebuild their abundance in May-June (Board 11) by continuing their migration and concentration in the crops.

The experimental treatments applied in May and June to control ceral leaf beetle (*Oulema* sp.) and ear pests has strongly affected the useful fauna with the exception of a restricted range of pyrethroids, bensultap**,** fipronil**,** acetamiprid-based products (table 14). Due to the richness of natural entomophagous fauna in the cereal agroecosystems in Central Transylvania, the treated crops have been intensely re-colonized with entomophags. The insecticide impact can also be diminished by choosing the selective treatment time to protect the main predatory species taking into account their biology

Pesticide action mode can be of contact, ingestion and breathing; together with the duration of action they have a great importance in showing selectivity. The prolonged remanence has a reduced degree of selectiveness as opposed to the useful entomofauna. Short-term remanence may show selectiveness for some species and allow the launch of entomophags shortly after treatment application. By Baicu, Săvescu, 1978, pesticide selectiveness has been classified into 4 categories: *the physiological selectiveness* is determined by pesticide action mode; *the ecological selectiveness* manifests as the result of the gaps between the development cycles of auxiliary species and pest species, and may be achieved by using complex measures such as: planting melliferous plant belts which concentrate a large number of parasites and predators, the application of treatments using prognosis and warning elements in accordance with population density economic threshold; *the technological selectiveness* refers to the pesticide conditioning forms and their treatment application methods such as: marginal, into the attack focus, to the seed. *Behavior selectiveness* resides in the use of pesticides mixed with attractants for the pest species and repellents of the useful fauna.

The conclusions of the entomological researches performed during 1990-1997 at the ARDS in Turda on the cereal agrobiocenoses in Central Transylvania has revealed the presence and importance of a natural biotic factor complex represented by predatory entomophagous arthropods which act as auxiliaries in the cereal crops protection against pests. In the structure of auxiliary predatory entomophagous arthropod fauna the systematic studies have shown over 45 species belonging to different families such as: *Lycosidae, Araneidae (Aranea); Forficulidae (Dermaptera); Chrysopidae (Neuroptera); Nabidae (Heteroptera); Coccinellidae, Cantharidae, Malachiidae, Carabidae, Staphylinidae, Sylphidae, (Coleoptera); Empididae, Syrphidae, (Diptera)* and others. In the cereal agroecosystems of Central Transylvania the natural reserve of predatory entomophags colonizes every year wheat and barley crops, and actively intervenes by biological control in pest population decrease such as: *diptera, coleoptera, Aphididae, Thysanopterae* and others. The earlier activity of useful epigeous fauna confines development of the pests avoiding the exceeding of damaging economic thresholds, while the predatory on the wheat ears destroy the aphids and thrips thus proving significant yield increases, 15.6% higher than the experimental control.

3.2. Natural limitation of field crop pests

The phytophagous insects feeding tests of the main predatory species, regarding the feeding habits of the predators, prey composition and daily individual feeding rate under controlled laboratory conditions have revealed the importance of these species. They are polyphagous and perform a long activity over the vegetation period in the cereal agroecosystems of Transylvania. These tests have proved that under entomocenotic area conditions *Coccinella septempunctata (Coccinellidae*) may destroy *Oulema melanopus* larvae and eggs, diptera larvae and pupae (*Opomyza florum*, *Phorbia securis*, *Delia coarctata*), *Eurygaster* eggs, *Ostrinia* eggs, *Haplothrips tritici* larvae, aphids (*Sitobion avenae*, *Rhopalosiphum padi*) and others, passing from the small grain cereal crops to the corn, bean, alfalfa crops. *Malachius bipustulatus* (*Malachiidae*) is feeding on *Lema* larvae, aphids, *Haplothrips tritici* adults and larvae and others; *Cantharis fusca* (*Cantharidae*) is feeding on *Lema* eggs, aphids, *Haplothrips* adults, diptera larvae and pupae (*Opomyza*); *Syrphidele (Episyrphus*) is feeding mostly on aphids and thrips. *Chrysopa carnea (Chrysopidae*) and *Nabis* sp. (*Nabidae*) destroy since the beginning of spring until autumn several pests: *Lema* eggs and larvae, aphids, thrips, *Eurygaster* and *Ostrinia* eggs and others. The laboratory tests and investigations regarding the role of the main species of entomophagous predators as pest population limiters in the cereal agroecosystems have proved that many species are feeding mainly on cereal flies, aphids, thrips, bugs, *Oulema* etc. (table 15).

3.3. The importance of entomophagous arthropod fauna

In the last years the ecological researches performed at the ARDS Turda have determined the significant role of entomophagous arthropod fauna in the cereal agroecosystems in Transylvania. In table 16 a general presentation on the annual abundance and the structural interactions between the pests and useful arthropod fauna captured in wheat, spring barley, soybean, marginal grasses in two open field cereal agroecosystems in Turda and forestry belt-protected in Bolduţ has been made. Many of the collected arthropods comprised entomophags groups, recording 33% in the open field agroecosystem where the useful species averaged 41% in winter wheat, 19% in spring cereal crops, 52% in soybean. The forestry belt-protected field crops agroecosystem has shown a higher percentage of the entomophag groups, reaching 78%. Under these conditions the auxiliary species represented 82% in winter wheat, 73% in spring cereals, 79% in soybean and 75% in crop marginal grasses.

The researches have shown the efficiency of agroforestry belts in fighting against pests and their massive invasions by the protection, development and conservation effect of the natural entomophags reserve and the economic rate resulted from the avoidance of insecticide control (Malschi, Mustea, 1995, 1996, 1997, 1998, 1999. Malschi, 2003, 2005, 2007).

The farm has a rich reserve of active entomophags (table 17, 18), due to the conditions favoring the conservation of the existing useful fauna. The structure of agroforestry network, the wide diversity of the bordering flora and crop sizes (10 to 15 hectars) surrounded by forestry belts have proven optimal for the entomophags survival, conservation and fast concentration in the crop. The result is an efficient limitation activity, natural biological control of pests in cereal crops.

In the consolidated forestry belt farm, the natural biological control has been efficient and sufficient which does not require the application of insecticide control in the cereal crops (table 19). The antierosional agroforestry belt-based cereal farm is a model of biological and ecological pest control performed by entomophags (boards 12-17).

The yields achieved for the main crops in the cereal rotation, following the crop technology and without insecticide application, have reached the level of open field yields where insecticide treatments for the main pests have been used (table 20, 21).

The yields differences in the observed fields of the comparative study as experimental lots where the losses caused by the pest attack have also been recorded, does not cover the expenses with pest chemical control treatments, and show the economic and ecological efficiency of the consolidated forestry belt-based crop system 55 years after the planting of the antierosion network. The following mean yields have been recorded in the open field farm in Turda and the forestry belted farm at Bolduţ, respectively: for wheat, 3782 and 3719 kg/ha respectively; seed wheat 4655 and 4254 kg/ha, the Arieşan variety; soybean (the Agat breed), 1880 and 1822 kg/ha; corn (Turda hybrid 200), 3365 and 3274; spring wheat, Rubin variety, 2986 kg/ha, in Turda and spring barley, the Turdeana variety, 2561 kg/ha, in Bolduţ.

During 2000-2005, the agroecological conditions and the massive attack of the pests have revealed the protective role of the forestry belts as compared to the open field agricultural system.

3.4. Description of main regional predatory entomphagous arthropod species

The scientific literature of the domain (Baicu, Săvescu, 1978, Chambon, 1984, Cîndea,1986, Perju et al., 1988,1989, Wetzel, 1995) presents the numerous species of predatory arthropods belonging to several systematic units of the classes *Arachnida* and *Insecta.*

Class Arachnida

Order Aranea. Family Lycosidae, comprises species of the genus *Pardosa* spp., predatory spiders with sizes of 5-9 mm which can be seen walking on the ground in several crops. They feed on numerous species of pests on the ground and on the common red spider (*Tetranychus urticae* Koch) in different growing stages.

Pardosa agrestis Westring – the adults are 4.5-5 mm long, with brown cephalothorax and darker ventral side. The abdomen is brown, while the back part of the ventral side has a visible spearly spot. The stern is brown with a median yellow area, and yellow legs.

Pardosa agricola Thorell – the adults are 8-0 mm long with dark-brown cephalothorax and the back side having a special drawing with a long median broader strip from which side ray-like strips emerge and broken marginal strips. The abdomen is darker color and on the back side they have a characteristic drawing. Chelicerae are yellow, the stern is dark and legs are yellow.

Family Araneidae comprises the *Araneus* spp. spiders, which destroy aphids, cycads, diptera etc.

Order Acari comprises acarians of small sizes feeding on small insects and nematodes.

Family Phytoseiidae. *Phitoseiulus persimilis* At.-Hen is used to diminish some pest populations, phytophagous acarians especially the common red spider (*Tetranychus urticae* Koch).

Family Trombidiidae - *Trombidium holosericeum* L. – is frequently seen in crops.

Class Insecta

Order Thysanoptera, Family Aeolothripidae comprises small insects, with lengths varying from 0.5-5 mm, the feeding system adapted for stinging and sucking. *Aeolothrips intermedius* Bagn – the adults are 1.3-1.6 long (Knechtel W., 1951), brown-blackish or black color. There are two transverse grey strips. The adults feed on phytophagous thrips eggs, larvae and adults, and also aphids, bug eggs, cycads etc.

Order Heteroptera, Family Nabidae, *Nabis* spp. comprises a species feeding on aphids, defoliating larvae, spiders and thrips. They spend the winter as adults in hidden places. The *Nabis ferus* L adults are 7 mm long, gray-yellowish and light colored hemielytra.

Family Pentatomidae, comprises the species *Perillus bioculatus* Fabr. – a significant predator of the *Chrysomelide* pests. The larvae and adults feed on these pests in all their growth stages. The adults are 12-13 mm long, and hibernate as adults in different sheltered places.

Order Coleoptera, **Family Cicindelidae** – comprises insect species with slim body, long and thin legs, run-adapted. *Cicindela germanica* L. – the adults have slim green with metallic sparkles body, 9-12 mm in length. They have big head with yellowish front, and a well developed mastication-type oral parts with strong mandibles. The antenna are made of 11 items and reach half of body lengthiness. The large eyes are lateraly positioned. The legs are thin and long. It is seen in small crops with high humidity where they can run quickly on the ground and feeds on aphids.

Family Carabidae.

Calosoma sycophanta – is a widely spread predator in the crops cultivated in soil strongly infected with Gryllotalpa and Agriotes larvae. It is very efficient in diminishing the populations of several pests. Body length reaches 25-30 mm, dark blue head and pronotus while the elytra are green with metal-like sparkles. As an adult it hibernates into the ground and the retirement for hibernation is gradual. It feeds on soil pest larvae and larvae found on the plant leaf surface, both during the day and night.

Brachynus spp. – the adults are 7-10 mm long, reddish color body and dark bluish-black colored elytra**,** while antenna and legs are reddish. They proved important in diminishing the pest which attack plant roots and moving on the ground.

Pterostichus spp. – is known as an predator of soil ground pests, especially of theirs eggs.

Family Cantharidae. *Cantharis fusca* L. comprises species averaging 10-12 mm in size, head mostly covered by prothorax. The body is prolonged, parallel sides and soft skin elytra. The larvae and adults feed on *Orthoptera* eggs and other pests. They can be seen in spring crops until the end of summer where there is a severe aphid infestation.

Family Coccinellidae. *Coccinella septempunctata* L. – is the best known species, and can be found in all crops and spontaneous flora, where aphid infestation exists. It is relevant in diminishing these pest population. The adult body is hemispherical, ventrally flat and dorsally convex, 6-7 mm long and 5-6 mm wide.

Propylaea qutuordecimpunctata L.– the adults are 3.5-4.5 mm long, generally black. The species is characterized by strong sexual dimorphism. The males have yellow front, with a black triangular spot ventrally. The wider rather than long yellow pronot has a big black spot in the median posterior area. From this spot 2 fingerlike prolongations head towards the anterior side, while there are 2 lateraly black spots which sometimes meet the basal spot. The elytra are yellow, each having 7 black spots and yellow-orange legs. The females have all yellow front. There are 2 big trapezium spots on the posterior side of the pronot, and 4 small oval spots on the anterior and lateral side. There are 7 black spots on each elytra always separate.

Adalia bipunctata L. – the adults are 3.5-5 mm long and black. The head is black with two white-yellowish spots near the eyes. The pronot is black rather wider than long with 4 white-yellowish spots, 2 smaller and 2 bigger. Due to these spots the black color of the pronot is shaped. The legs are black and covered by short hairs while the elytra yellow-orange or red and cover the whole abdomen.

Ordinul Hymenoptera, Familia Formicidae. *Formica* sp. – are frequently seen in crops, especially aphid attacked ones, and represent their favorite food.

Ordinul Planipennia-Neuroptera, Familia Chrysopidae. *Chrysopa carnea* Stephens is the most widely spread species and has the highest polyphagy degree. They are most frequently seen on flowers where they feed on pollen and aphids. The adults have their body varying from 7-10 mm and it is light green or white-yellowish, sometimes reddish. The predatory larvae are 7-8 mm long.

Ordinul Diptera. Familia Syrphidae. *Episyrphus balteatus* De Geer, is 8-10 mm long and black. The front is vertical, yellow except for the area above the antenna which is black. The antenna are yellow-brownish, with agleam thorax and semicircular scuttle which is entirely yellow covered with yellow hairs. The wings are transparent, slightly brownish, and the legs are long and thin. *Metasyrphus corollae* Fabr. – is black, without metallic glitter, and 9-10 mm body length. The yellow-reddish front is lighter around the antenna and covered with black hairs. The eyes are touching on a certain area of the front and without hairs. Antennas are brownish. The mesonotus is black and with a metallic glitter covered with many brownish or yellow-golden hairs. The scuttle is semicircular and yellow with hairs of the same color. The wings are grayish. The larvae feed on aphids (boards 17-18).

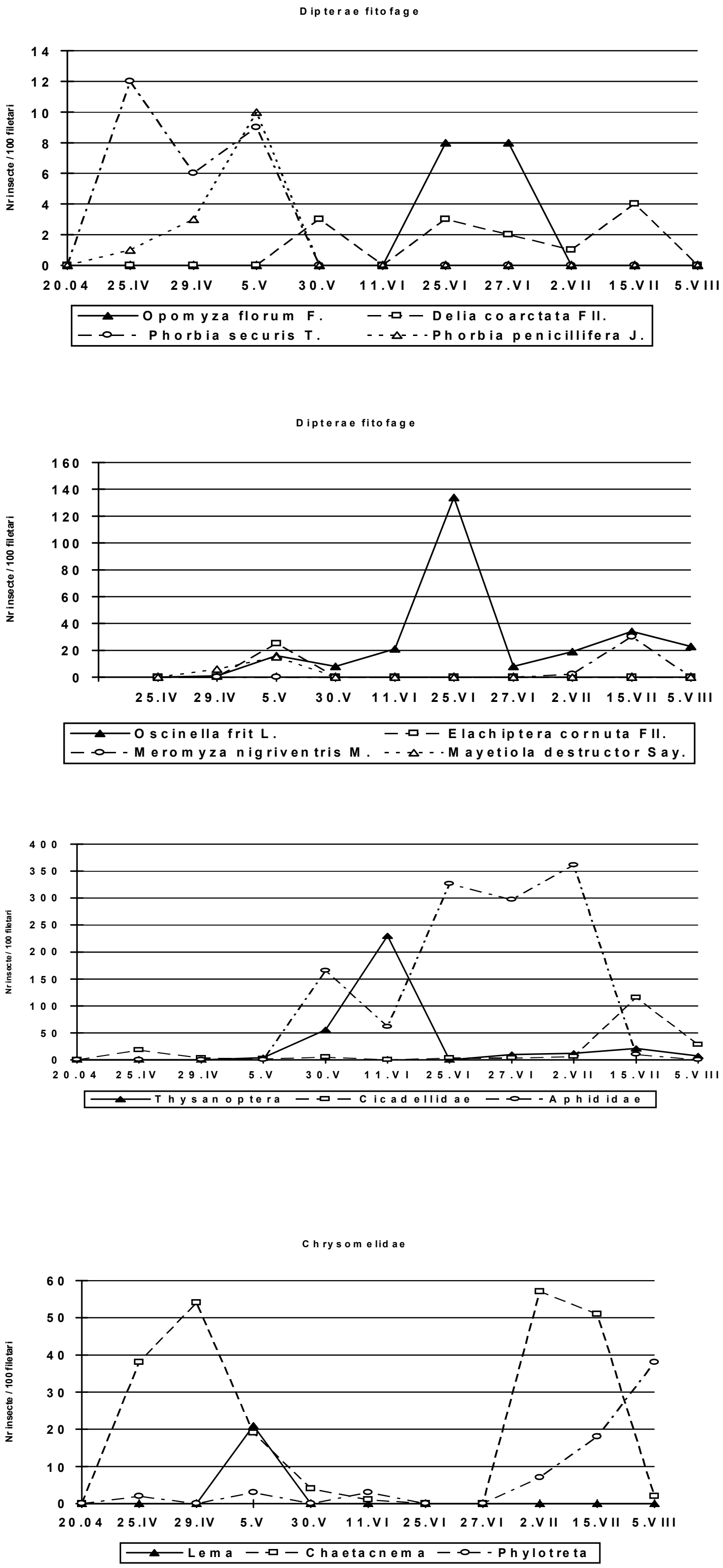


Fig. 3. Dynamics of wheat main pests (individuals number/100 sweep net catches) in 1997, at A.R.S.Turda.

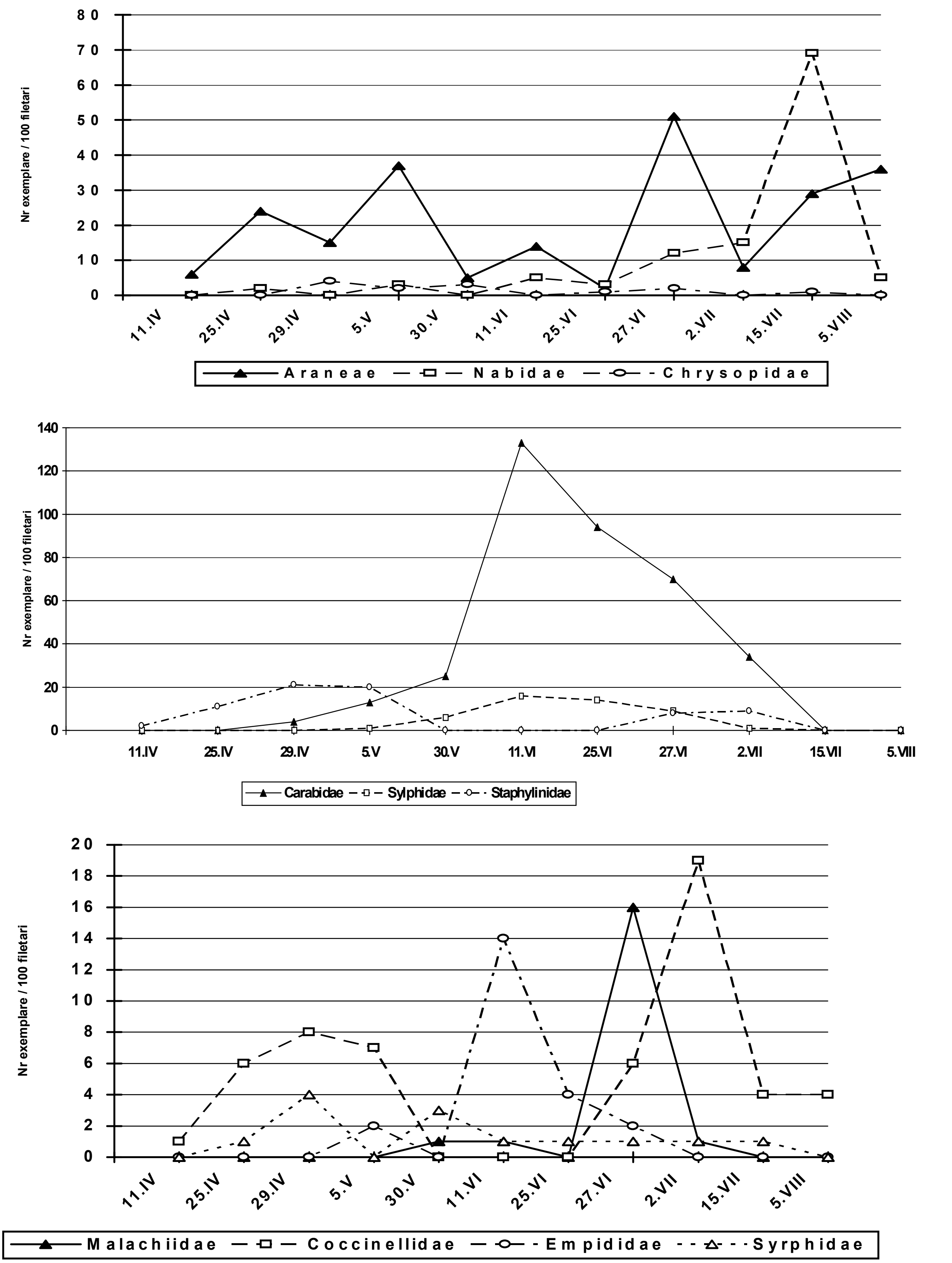


Fig. 4. Dynamics of wheat main active entomophagous predators (individuals number/100 sweep net catches) in 1997.

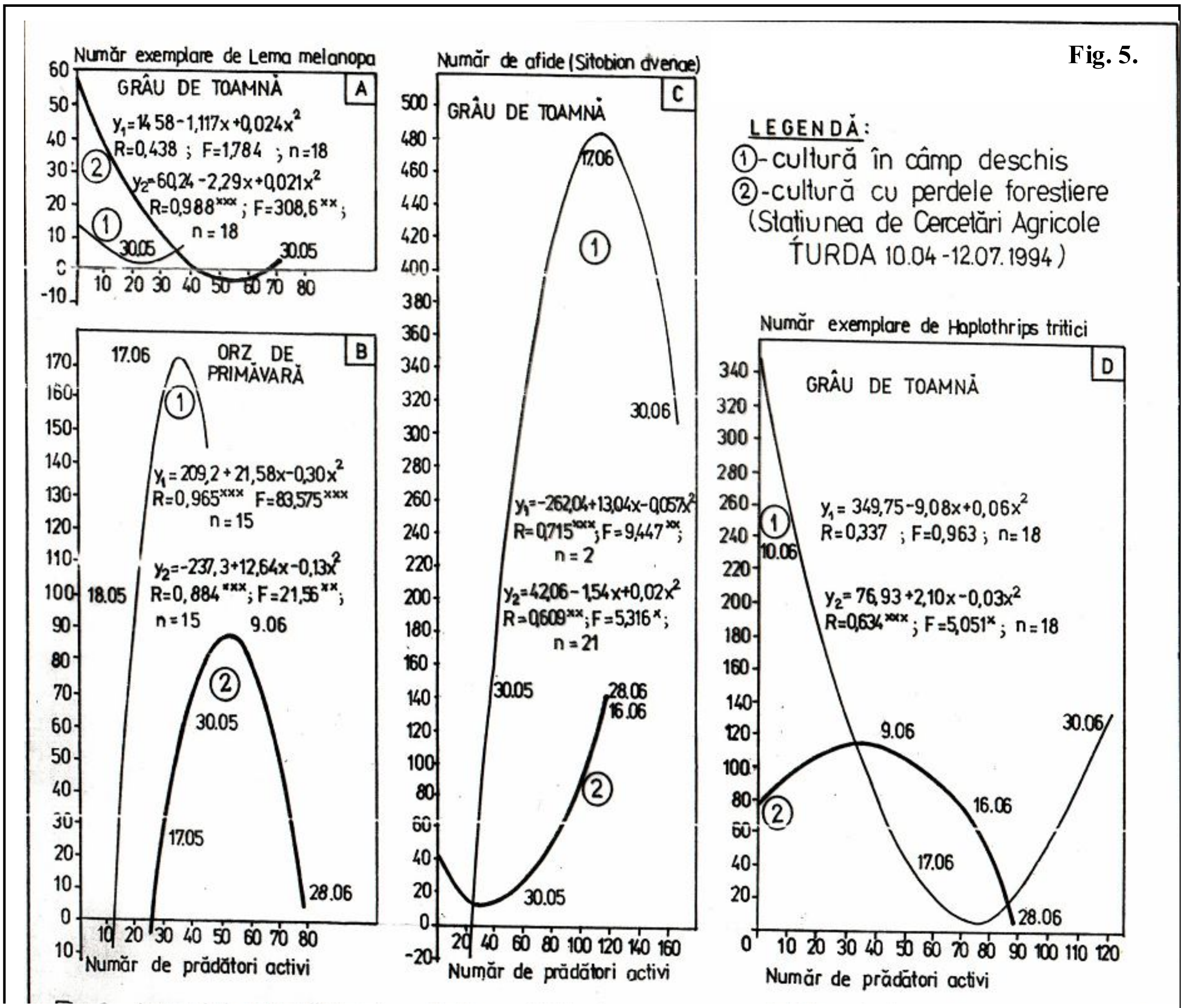


Fig. 5. The impact of entomophagous predators on the populations of *Oulema melanopus* L. (A, B), aphids (*Sitobion avenae* Fabr. etc.) (C) and *Haplothrips tritici* Kurdj. (D), in small grain cereal crops of Central Transylvania. (X axis-active predators number; Y axis–phytophagous individuals number; 1-crop in open field area; 2–crop with forestry belts, (Agricultural Reserch Station Turda, of 10.04.–12.07. 1994).

Tab. 6

Epigeal arthropods capturing by Barber-pitfall soil-traps in winter wheat crop at A.R.S. Turda

Individuals number and % structure of arthropods in the period of 25 April – 1 July of 1997.

Period.	25.04 - 27.05.	25.04 - 1.07.
Aranea	59 (20)	134 (23,1)
Sylphidae	17 (6)	32 (5,5)
Staphylinidae	41 (14)	44 (7,6)
Carabidae	176 (60)	370 (63,8)
Carabids structure.		
Poecilus cupreus	128 (43,7 %)	227 (39,1 %)
Harpalus distinguendus	40 (13,6 %)	49 (8,4 %)
Harpalus rufipes	4 (1,4 %)	18 (3,1 %)
Pterostichus melanarius	3 (1,0 %)	42 (7,2 %)
Alte carabide	1 (0,3 %)	34 (6,0 %)

Tab. 7

Pray composition and minimal feeding rate by day and individual of main entomophagous predators, in laboratory feeding trials with phytophagous diptera (1994-1996, A:R:S: Turda)

Entomophagous predators.	Number of phytophagous consumed / day / individual predator			
	A. ***Opomyza florum*** (larvae and pupae)	**B.** ***Phorbia securis*** (larvae and pupae)	**A** $\chi 2$	**B** $\chi 2$
Chrysopa carnea (larvae)	**3**	**2**	18,83 xxx	6,65 xx
Nabis sp. (adult)	**3**	**3**	18,83 xxx	11,26 xxx
Coccinella septempunctata	**5**	**5**	54,9 xxx	21,4 xxx
Malachius bipustulatus	–	**3**	-	11,26 xxx
Cantharis fusca	**2**	–	10,22 xx	-
Staphylinus sp.	**1**	**4**	3,58	16,1 xxx
Tachyporus hypnorum	**1**	**1**	3,58	2,46
Poecilus cupreus	**5**	**5**	54,9 xxx	21,4 xxx
Pseudophonus pubescens	**1**	**2**	3,58	6,65 xx
Harpalus distinguendus	–	**2**	-	6,65 xx
Harpalus aeneus	**2**	**4**	10,22 xx	16,1 xxx
Amara aenea	–	**8**	-	43,4 xxx
Sylpha obscura	**1**	**2**	3,58	6,65 xxx
Martor. Check.	**5**	**10**		

GL = 1; $\chi 2$ tabelar (p 5 %) = 3,84; (p 1%)=6,62; (p 0,1%) =10,8

Tab. 8

Pray composition and minimal feeding rate by day and individual of main entomophagous predators, in laboratory feeding trials with *Oulema melanopus* L. (1994-1996, A.R.S. Turda)

Entomophagous predators.	Number of phytophagous consumed / day / individual predator			
	A. Oulema melanopus (Eggs)	***B. Oulema melanopus*** (Larvae)	**A** **χ2**	**B** **χ2**
Chrysopa carnea (larva)	10	5	37,6 xxx	21,4 xxx
Nabis sp. (adult)	8	5	27,99 xxx	21,4 xxx
Coccinella septempunctata	10	3	37,6 xxx	11,26 xxx
Propylaea 14-punctata	7	3	23,74 xxx	11,26 xxx
Malachius bipustulatus	–	10	-	79,4 xxx
Cantharis fusca	6	–	19,9 xxx	-
Staphylinus sp.	10	–	37,6 xxx	-
Tachyporus hypnorum	8	–	27,99 xxx	-
Poecilus cupreus	9	6	32,41 xxx	27,4 xxx
Pseudophonus pubescens	8	9	27,99 xxx	55,9 xxx
Harpalus distinguendus	8	3	27,99 xxx	11,26 xxx
Harpalus aeneus	5	4	16,2 xxx	16,1 xxx
Amara aenea	9	5	32,41 xxx	21,4 xxx
Brachinus explodens	–	5	-	21,4 xxx
Sylpha obscura	14	3	71,26 xxx	11,26 xxx
Martor. Check.	15	10		
GL =1; χ^2 tabelar (p 0,1%)=10,8				

Tab. 9

Pray composition and minimal feeding rate by day and individual of main entomophagous predators, in laboratory feeding trials with aphids (1994-1996, A.R.S. Turda)

Entomophagous predators.	Number of aphids consumed / day / individual predator			
	Sitobion avenae	χ 2	***Rhopalosiphum padi***	χ 2
Chrysopa carnea Stephn	30	39,9 xxx	50	130,6 xxx
Nabis ferus L. (adult)	60	163,4 xxx	25	38,24 xxx
Nabis ferus L. (larva)	25	33,63 xxx	17	27,75 xxx
Cocinella septempunctata L.	50	74,22 xxx	25	38,24 xxx
Propylaea 14-puncatata L.	40	53,97 xxx	25	38,24 xxx
Malachius bipustulatus L.	40	53,97 xxx	-	-
Cantharis fusca L.	40	53,97 xxx	-	-
Staphylinus sp.	30	39,9 xxx	15	23,43 xxx
Tachyporus hypnorum L.	-	-	25	38,24 xxx
Poecilus cupreus L.	60	163,4 xxx	50	130,6 xxx
Pseudophonus pubescens	60	163,4 xxx	50	130,6 xxx
Harpalus distinguendus	-	-	50	130,6 xxx
Harpalus aeneus	-	-	50	130,6 xxx
Amara aenea De. Geer	-		50	130,6 xxx
Brachinus explodens Duft	25	33,63 xxx	30	46,1 xxx
Episyrphus balteatus Dg.	25	533,63 xxx	-	-
Martor. Check.	60		50	
GL=; χ 2 tabelar (p 0,1 %) = 10,8				

Tab. 10

Pray composition and minimal feeding rate by day and individual of main entomophagous predators, in laboratory feeding trials with *Haplothrips tritici* (1994-1996, A.R.S. Turda)

Entomophagous predators.	Number of *Haplothrips tritici* consumed / day / individual predator			
	A. Adults.	**B.** Larvae	A. χ2	B. χ2
Chrysopa carnea (larvă)	10	40	37,6 xxx	67,14 xxx
Nabis sp. (adult)	–	42	-	73,2 xxx
Nabis sp. (larvă)	–	30	-	46,1 xxx
Coccinella septempunctata	–	35	-	55,42 xxx
Propylaea 14-punctata	–	20	-	31,0 xxx
Malachius bipustulatus	15	30	93,6 xxx	46,1 xxx
Cantharis fusca	15	–	93,6 xxx	-
Episyrphus balteatus	10	-	37,6 xxx	
Martor. Check.	15	50		
GL = 1; χ 2 tabelar (p 0,1 %) = 10,8				

Tab. 11

The grains yeld (g grains/ear) to express the effect of entomophagous predators involved in the decreasing of wheat ear pests, in 10-30 June periode, 1994-1996, A.R.S. Turda.

Marked ears. (n1=n2=30)	1994	1995	1996	1997	Average
	x ± s x	x ± s x	x ± s x	x ± s x	x ± s x
1.With predators. 2.With out predators	2,13 ± 0,05 2,04 ± 0,08	2,43 ± 0,04 1,81 ± 0,04	2,59 ± 0,06 2,34 ± 0,13	2,12 ± 0,06 1,63 ± 0,04	2,12 ± 0,06 1,63 ± 0,04
d ± s d x	0,09 ± 0,06	0,52 ± 0,04	0,25± 0,095	0,49 ± 0,05	0,49 ± 0,05
t	1,38	15,5 xxx	2,631 x	9,8 xxx	9,8 xxx
Increasing yield	4,2 %	25,5 %	9,6 %	23,1 %	15,6 %

n1=n2=30 ears; t 58: p 5%=2,004; p 1%=2,669; p 0,1 = 3,476

The pests density: individuals number / ear.

The year	1994	1995	1996	1997	Average
Haplothrips tritici:	20	5	26	9	15,1
***Sitobion avenae*:**	10	25	20	2	14,3

Tab.12

The atractive action on the polyphagous entomophages determined by the flowering plants of spontaneus flora in wheat crops margins herbs (June-July, A.R.S. Turda)

Polyphagous entomophages	Number of captured insects (χ^2)					
	Collecting period.					
	24 June - 4 July 1997			**15 – 25 July 1997**		
	Check	***Sambucus***	***Achilea***	*Check*	***Daucus***	***Achillea***
Chrysopidae	2	7(16,7***)	8(21,1***)	-	-	-
Staphylinidae	-	-	-	7	11(2,9)	9(1,1)
Coccinellidae	1	0(3,1)	3(12,3***)	4	11(12,5***)	3(0,8)
Syrphidae	1	14(48,3***)	7(34,5***)	0	1(4,2*)	7(20,4***)
Emipidae	2	2(0,02)	1(8,8**)	4	6(2,4)	10(10,5***)
Dolichopodidae	1	1(0,02)	5(93,5***)	0	22(33,5***)	19(31,8***)
Tachinidae	1	4(18,5***)	2(8,8**)	1	25(56,5***)	11(44,1***)
TOTAL	8	27(14,7***)	6(13,9***)	16	76(26,3***)	59(19,8***)

GL=10; χ2 tabelar (p 0,1%=29,6(38,9***) χ2(p0,1%)=29,6(51,6***)
GL=1; χ2 tabelar (p 5%)=3,8; (p 1%)=6,6; (p0,1%)=10,8

Tab. 13

The effect of different products from seed treatments, with Lindan content, on the development of ground predator arthropod populations in winter wheat crops, in A.R.D.S. Turda, May 1997.

Seed treatments. The product and dose	CARABIDAE			Staphy-linidae	Syl-phi-dae	Aranea	Total	Efect toxic %	Nota 1-4 **
	Poecilus cupreus	H.distin-guedus	Alte specii						
Number of ground arthropods collected in soil traps.									
Check.	18	5	2	2	3	21	51	0	
Tirametox 90 PTS 3,0 kg/t	3	-	1	2	1	9	16	69	3
Tirametox 625 SC 4,0 kg/t	-	-	2	1	-	9	12	77	4
Supercarb 550 SC 3,0 kg/t	-	-	2	1	1	17	21	59	3
Gammavit 500 SC 5,0 kg/t	9	4	1	1	-	6	21	59	3
Lindan 400 SC 2,5 kg/t	-	-	-	-	-	-	0	100	4
Lindan 400 SC 2,0 kg/t	1	-	3	1	-	2	7	86	4
Lindan 666 SC 1,5 kg/t	1	-	-	3	-	5	9	82	4
Lindan 666 SC 1,35 kg/t	5	-	-	-	-	3	8	84	4
Lindan 666 SC 1,2 kg/t	2	1	-	-	1	6	10	80	4
Miclodan 45 PTS 2,5 kg/t	2	-	1	-	-	10	13	74	3

*other Carabidae:
Brachinus explodens, Pterostichus melanarius, Harpalus aeneus, Harpalus rufipes, Amara aenea.
**scale: 3=moderately harmful (51-75%); 4=harmful (>75 %), (Hassan & colab.1985).

Tab. 14 a.

Side-effect of insecticides on beneficial arthropods. Results of field and semi-field toxicity tests on the wheat pest control treatments, in Transylvania (1994-1996)

			A	B			C	D	E			F	G	H	I
Date of treatments.			02 05	02 05	31 05	20 06	31 05	20 06	02 05	20 06*	20 06*	20 06	20 06	20 06	20 06
Insecticides	**Products**	**Dose/ha**	**Initial toxicity on beneficial predators**												
Endosulfan	Thionex 35 EC	2,01	4	-	-	4	4	4	-	3	3	4	4	-	4
Dimethoate	Sinoratox 35 EC	1,51	-	-	4	3	-	1	-	4	-	-	-	-	-
Dimethoate	Sinoratox 35 EC	3,51	-	-	4	3	4	4	-	4	4	4	4	4	4
Diazinon	Basudine 600 EC	1,01	-	-	4	-	4	4	-	4	-	-	4	4	4
Diazinon	Diazol 48 EC	0,91	-	-	-	4	4	4	-	3	2	4	3	-	4
Chlorpiryphos	Pyrinex 50 EW	2,01	-	-	-	4	4	4	-	3	3	4	4	-	-
Cypermethrin	Polytrin 200 SC	0,11	2	1	2	1	4	4	4	1	2	3	4	-	-
Alphamethrin	Fastac 10 EC	0,11	1	-	-	1	4	4	2	3	2	4	3	4	4
Zetamethrin	Fury 10 EC	0,11	-	-	1	1	4	4	-	3	-	4	4	4	4
Deltamethrin	Decis 2,5 EC	0,31	-	-	-	2	4	4	-	4	2	2	3	4	1
Esfenvalerat	Sumi–Alpha 5EC	0,21	-	-	1	-	3	3	-	4	-	4	3	4	4
Bensultap	Victenon 50 WP	0,5 kg	-	-	1	-	4	4	-	4	-	-	4	4	4
Acetamiprid	Mospilan 20 SP	0,1 kg	-	-	1	-	4	4	-	-	2	4	-	-	4
Fipronil	Regent 80 WG	25 g	-	-	2	-	3	3	-	4	-	4	4	-	-

A–Harpalus distinguendus; B–Poecilus cupreus; C–Pseudophonus pubescens; D–Aranea; E– Coccinella 7-punctata; F–Chrysopa carnea; G–Nabis ferus; H–Tachyporus hypnorum; I–Malachius bipustulatus. *Larvae. Scale (percent mortality): 1=harmless(<25%); 2=slightly harmful(25-50%); 3=moderately harmful (51-75%); 4=harmful (>75 %), (Hassan & colab.1985).

Tab. 14 b.

The selectivity of some pesticides on the parasites and predators fauna.
(Baicu T. and Săvescu A., 1978)

The product	Selectivity or toxicity on the parasite and predator fauna
Insecticides.	
Carbaril	**Selectiv pentru** (selective for:) *Typhlodromus sp.* **Selectivitate oscilantă pentru** (oscilatory selectivity for:) *Hemiptera*. **Foarte toxic pentru** (very toxic:) *Neuroptera, Coccinellidae, Malachiidae, Hymenoptera*
Deltametrin	**Toxic pentru albine**. (Toxic for bees).
Diazinon	**Neselectiv pentru** (non selective for:) *Syrphidae,* **Toxiciate medie pentru** (medium toxic for:) *Anthocoridae*, *Coccinellidae*
Dimetoat	**Selectivitate medie pentru** (medium selective for:) *Cocinellidae*, **Neselectiv pentru** (non selective for:) *Anthocoridae, Syrphidae*
Disulfoton	**Slab selectiv pentru** (weak selective for:)*Chrysopa sp.*
Endosulfan	**Selectiv pentru albine** (selective for:) *bees, Syrphidae, Phytoseiidae, Carabidae, Chalcididae,* ouă de (eggs of) *Coccinellidae*
Fenitrotion	**Toxic pentru** (toxic for:) *Carabidae*, **Foarte toxic pentru** (very toxic for:) *Phytoseiidae*
Lindan	**Foarte toxic pentru** (very toxic for:) *Coccinellidae*
Malathion	**Toxic pentru prădători şi paraziţi** (toxic for predators and parasites:)
Paration	**Foarte toxic pentru fauna utilă** (very toxic for useful fauna:)
Pirimicarb	**Selectiv pentru majoritatea speciilor de paraziţi şi prădători** (selective for the most parasite and predator species:)
Triclorfon	**Selectiv pentru entomofagi** (selective for entomophagous:)
Acaricide	
Etion	**Selectiv pentru** (selective for:) *Typhlodromus,* **Mediu toxic pentru** (medium toxic for:) *Hymenoptera, Phytoseiuluis persimilis*
Fenbutalin	**Selectivitate medie pentru acarieni prădători şi insecte utile** (medium selective for predator aranea and beneficial useful insects)
Propargit	**Toxic pentru** (toxic for:) *Phytoseiidae*
Fungicide	
Benomil	**Slab selectiv pentru acarienii prădători** (weak selective for predator aranea:)
Captan	**Foarte selectiv pentru acarienii prădători şi entomofagi** (very selective for predator aranea and entomophagous:)
Mancozeb	**Selectiv pentru** (selective for:) *Encarsia formosa* Gahan, **Slab selectiv pentru** (weak selective for:) *Trichogramma sp.* **Acţiune variabilă pentru** (action variable for:) *Phytoseiulus persimilis*

Tab. 15

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*
Consumed phytophagous individuals number / day / individual predator											
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 and 11-pupae.*

Tab. 16

Structure and interactions between pests and entomophagous arthropod fauna in cereal agroecosystems in central Transylvania

Crops	**Winter wheat**		**Spring cereals**		**Soybean**		**Marginal herbs**		**Summarized fields**	
Annual abundance	**Nr.**	**%**	**Nr.**	**%**	**Nr.**	**%**	**Nr.**	**%**	**Nr.**	**%**
In open field area cereal agroecosystem, at Turda										
Pests	**1787**	**59**	**1928**	**81**	**205**	**48**	**-**	**-**	**3920**	**67**
Beneficials	**1230**	**41**	**462**	**19**	**219**	**52**	**-**	**-**	**1911**	**33**
Total	**3017**		**2390**		**424**		**-**	**-**	**5831**	**40**
In the cereal agroecosystem with protective forestry belts, at Cean-Bolduţ										
Pests	**715**	**18**	**485**	**27**	**115**	**21**	**609**	**25**	**1924**	**21**
Beneficials	**3357**	**82**	**1307**	**73**	**438**	**79**	**1846**	**75**	**6948**	**78**
Total	**4072**		**1792**		**553**		**2455**		**8872**	**60**
Total	**7089**		**4182**		**977**		**2455**		**14703**	

Tab. 17

Comparative abundance of pest and entomophagous arthropod fauna in the agroecosystem in open area (Turda) and with forestry belts (Bolduţ).

Cereal crops	Location	Winter wheat	Spring Cereals	Cereal crops	Location	Winter wheat	Spring Cereals
Pests		**Nr.**	**Nr.**	**Entomophagous**		**Nr.**	**Nr.**
Coleoptera-	Turda	571	1029	Heteroptera-	Turda	158	88
.Phylotreta, Chaetocnema	Bolduţ	136	215	Nabidae	Bolduţ	38	4
Col. *Oulema*	Turda	450	295	Neuroptera-	Turda	5	1
melanopus	Bolduţ	13	31	Chrysopidae	Bolduţ	6	11
Thysanoptera-	Turda	330	191	Coccinellidae	Turda	16	26
Haplothrips	Bolduţ	230	60		Bolduţ	13	5
Homoptera-	Turda	90	124	Malachiidae,	Turda	9	6
Aphidina	Bolduţ	111	25	Cantharidae	Bolduţ	9	21
Homoptera-	Turda	91	123	Carabidae	Turda	759	139
Cicadina	Bolduţ	68	38		Bolduţ	2814	938
Diptera-	Turda	6	9	Sylphidae	Turda	78	2
Anthomyidae	Bolduţ	6	18		Bolduţ	161	99
Diptera-	Turda	131	107	Dipt.Empididae,	Turda	45	15
Chloropidae	Bolduţ	65	35	Syrphidae ş.a.	Bolduţ	15	11
Heteroptera-	Turda	107	45	Hymenoptera	Turda	33	57
Aelia Eurygaster etc.	Bolduţ	79	49		Bolduţ	34	118
Hymenoptera etc.	Turda	11	5	Thysanoptera-	Turda	18	0
	Bolduţ	0	5	Aeolothripidae	Bolduţ	86	25
Ortoptera	Turda	0	0	Aranea	Turda	109	128
	Bolduţ	7	9		Bolduţ	171	75
Pests total	Turda	1787	1928	Entomophagous	Turda	1230	462
	Bolduţ	715	485		Bolduţ	3357	1307
Pests total		2502	2413	Entomophagous		4587	1769

Tab. 18

Annual abondance and structre of entomophagous carabidand sylphid in cereal agroecosystems in open area (Turda)and with forestry belts (Bolduţ)

Agroecosystems	**Turda**	**Bolduţ**
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**

Tab. 19

The average attack of main cereal pests (2000-2002), in cereal agroecosystems in open area in Turda and with forestry belts in Bolduţ

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

Tab. 20

Economic efficyency of natural pests control, due to entomophagous, at the farm with forestry belts, in Boldut, by comparison with the insecticides pests control of the farm in open area, at Turda (A.R.D.S. Turda).

Producţia de boabe kg/ha. Grain yield (kg/ha)

Crops field / year	**Winter wheat (ARIEŞAN)** (a: consum-bread, b: sămânţă-seed)				**Spring cereals**		**Soybean (AGAT)**		**Maize (TURDA 200)**	
The farm	Turda		Bolduţ		Turda	Bolduţ	Turda	Bolduţ	Turda	Bolduţ
	a.	b.	a.	b.						
2001	3136	4921	3055	3408	2821	2173	2239	1643	3324	3272
2002	4428	4390	4383	5100	3150	2950	1520	2000	3405	3276
Average	**3782**	**4655**	**3719**	**4254**	**2986**	**2561**	**1880**	**1822**	**3365**	**3274**
Difference	**63**	**401**			**425**		**58**		**91**	

Tab. 21

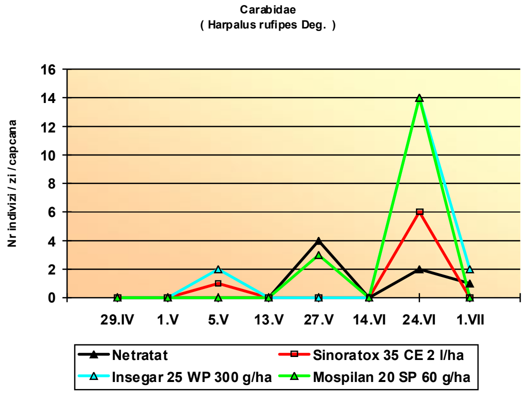
Efficacity and economic efficiency of some insecticides for pests control in winter wheat.

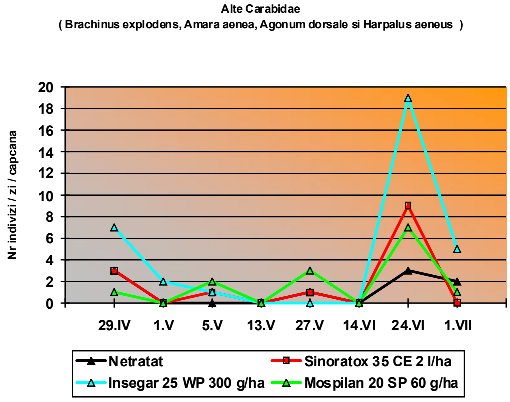
1. Efficacity and economic efficiency of some applied insecticides for the control of diptera larvae in winter wheat, at the 10-20 april periode (at tillering, 25-33 DC faze).

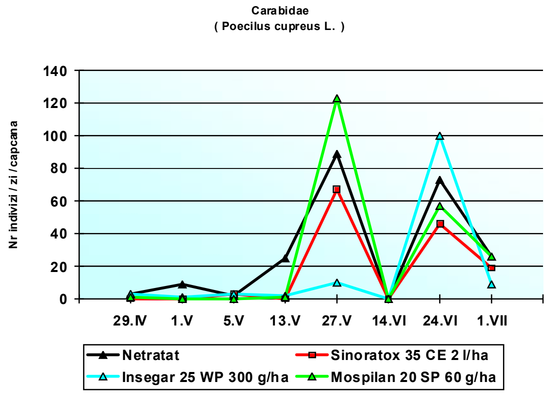
Different insecticides	**Efficiency %**	**Grain yield**			**Profit (Kg grain / ha)**
		Kg/ha	**%**	**Diference**	
Average	**46**	**4842**	**111,5**	**499**	**352 - 270**

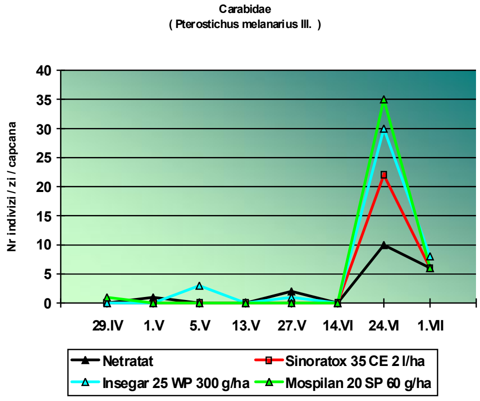
2. The effect of control treatment of wheat thrips, at flag leaf-heading, 45-59 DC faze, in 15-25 May.

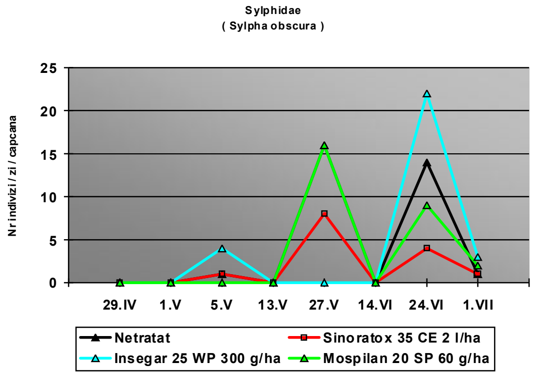
Different insecticides	**Efficiency %**	**Grain yield**			**Profit (Kg grain / ha)**
		Kg/ha	**%**	**Diferenţa**	
Media. Average	**63-83**	**5805**	**114**	**724**	**607 - 524**

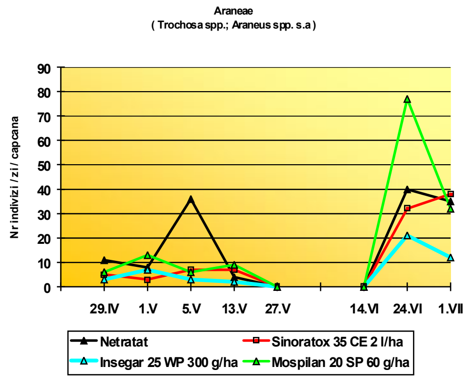


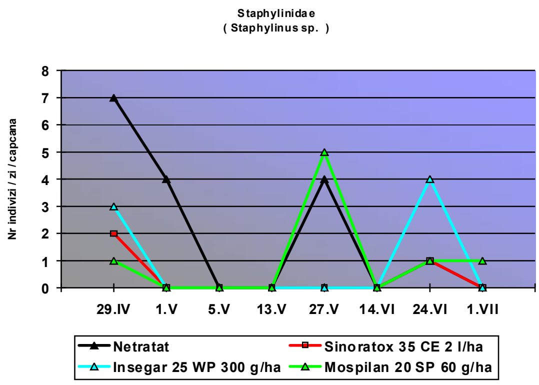


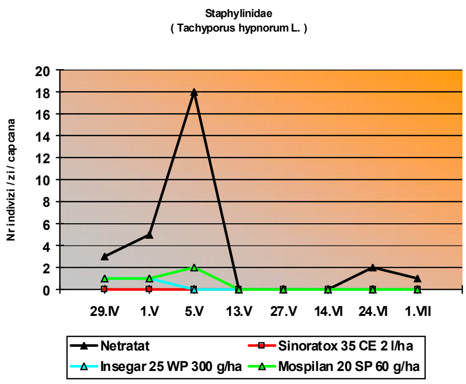








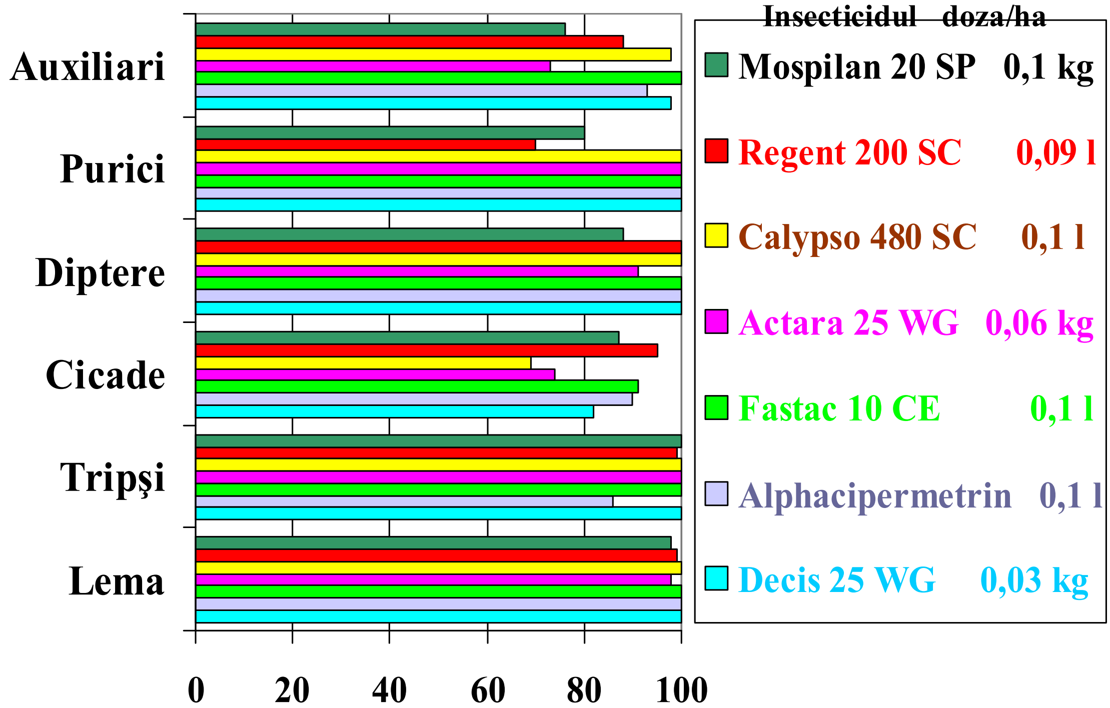




Effect of some insecticides applied at the 25th April 1997 on the epigeal entomophagous predator arthropods species , in wheat crops (Agricultural Research-Development Station Turda).

Plate 11 b

Efficiency (%) of the insecticides for the Oulema adults, diptera, fleas etc. applied at the weeds control time / the 12th May 2003, notation after 7 days.



Efficiency (%) of the insecticides for the Oulema larvae and other pests, applied at the flag-leaf phase / the 24th May 2003, notation after 7 days.

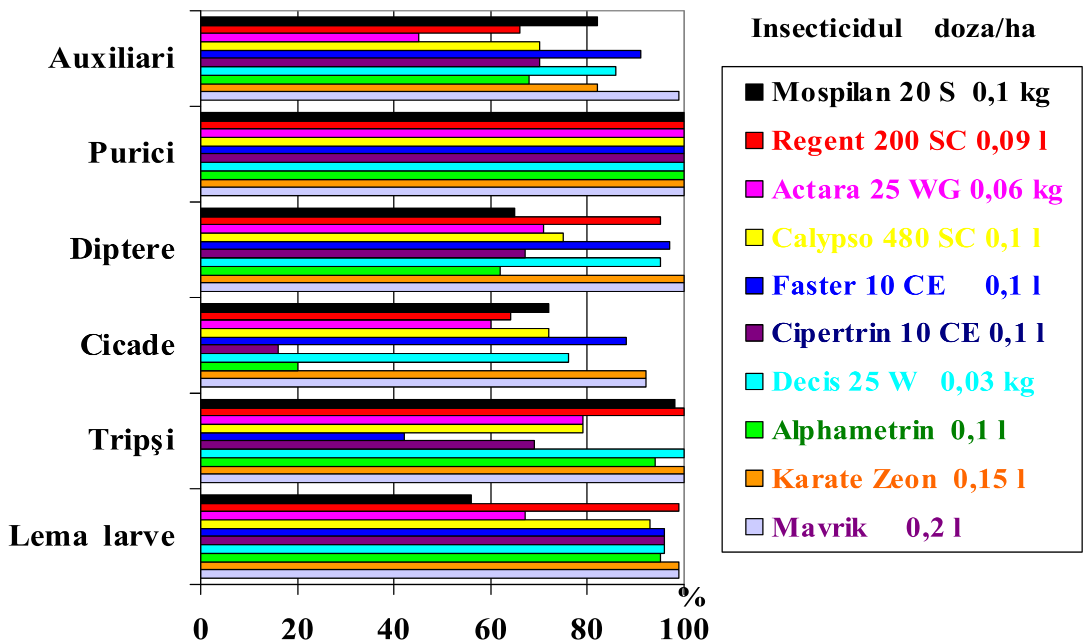
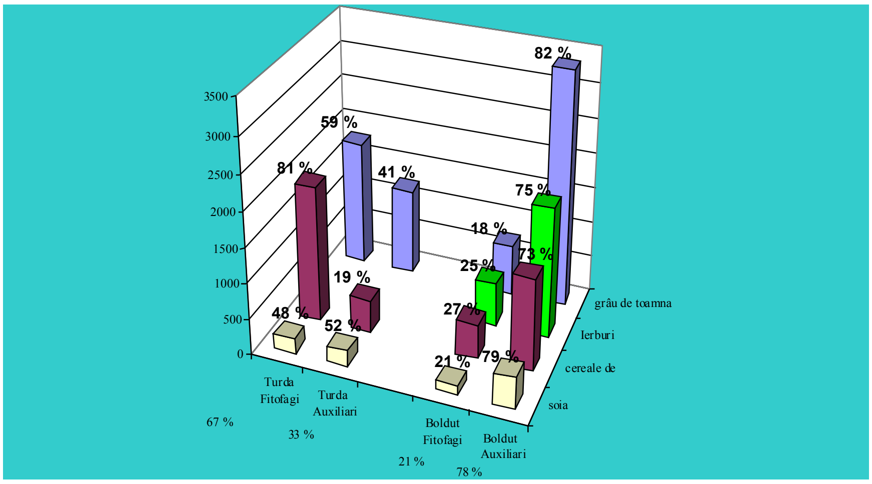


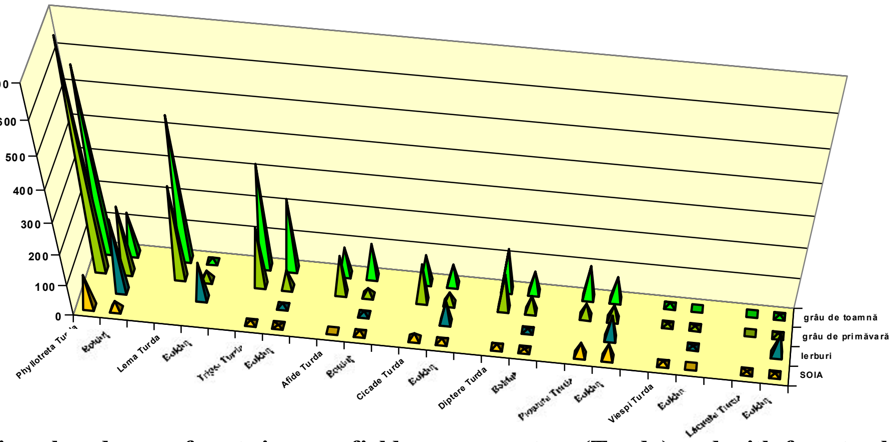
Plate 12

Antierosional agroforestry belts and protected field crops at the Cean-Bolduţ farm, Cluj Country, Agricultural Research –Development Station Turda

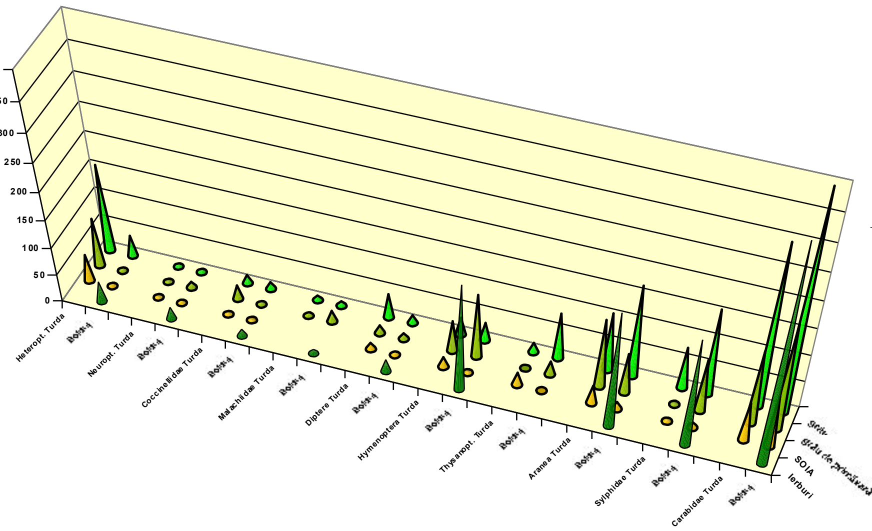
Plate 13



Abundance and stucture interrelations of entomophagous arthropod fauna in the open field area (Turda) and with forestry belts (Bolduţ) agroecosystems, in winter and spring small grains cereal crops, soybean and marginal grasses (A.R.D.S.Turda).



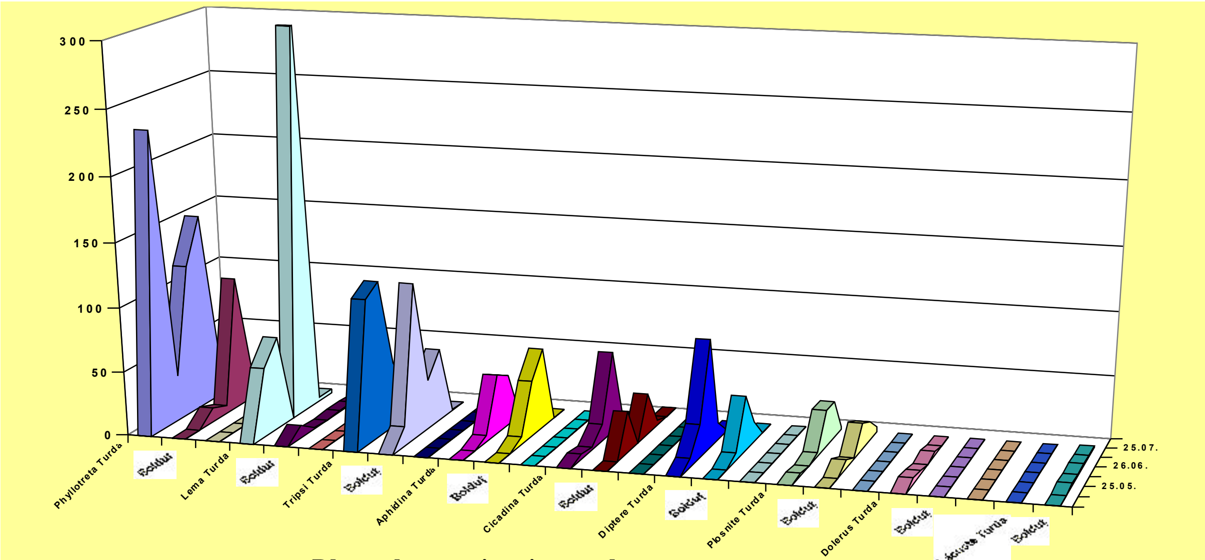
Comparative abundance of pests in open field agroecosystem (Turda) and with forestry belts agroecosystem (Bolduţ), in winter and spring small grains cereal crops, soybean and marginal grasses.



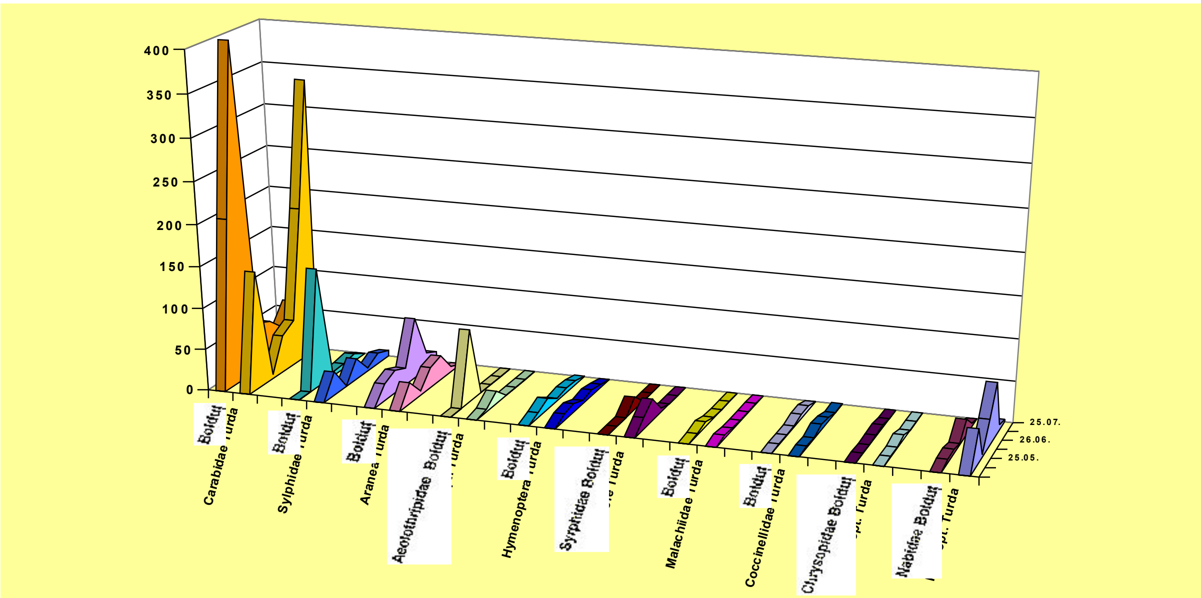
Plansa 13

Comparative abundance of entomophagous fauna in open field agroecosystem (Turda) and with forestry belts agroecosystem (Bolduţ), in winter and spring small grains cereal crops, soybean and marginal grasses.

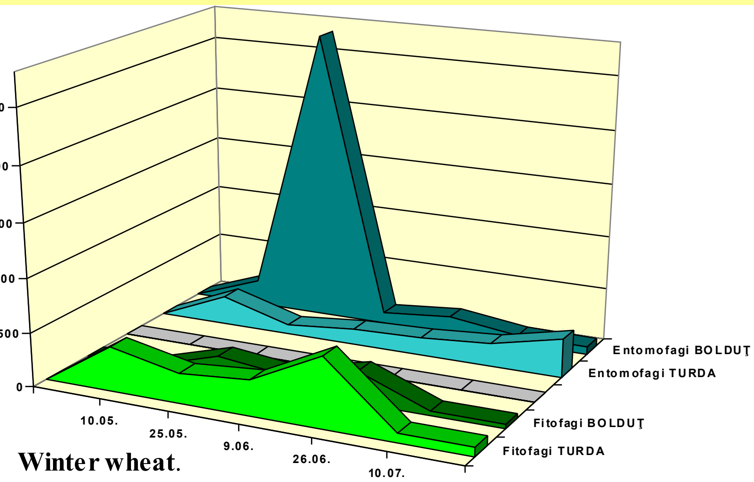
Plate 14 a.



Phytophagous in winter wheat



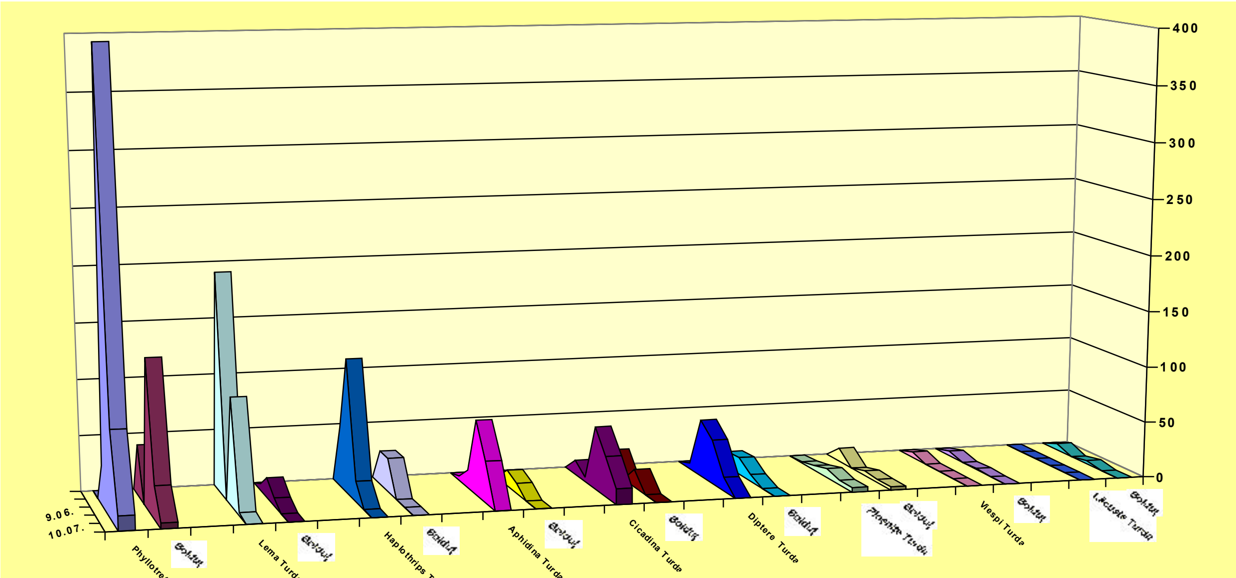
Entomophagous in winter wheat.



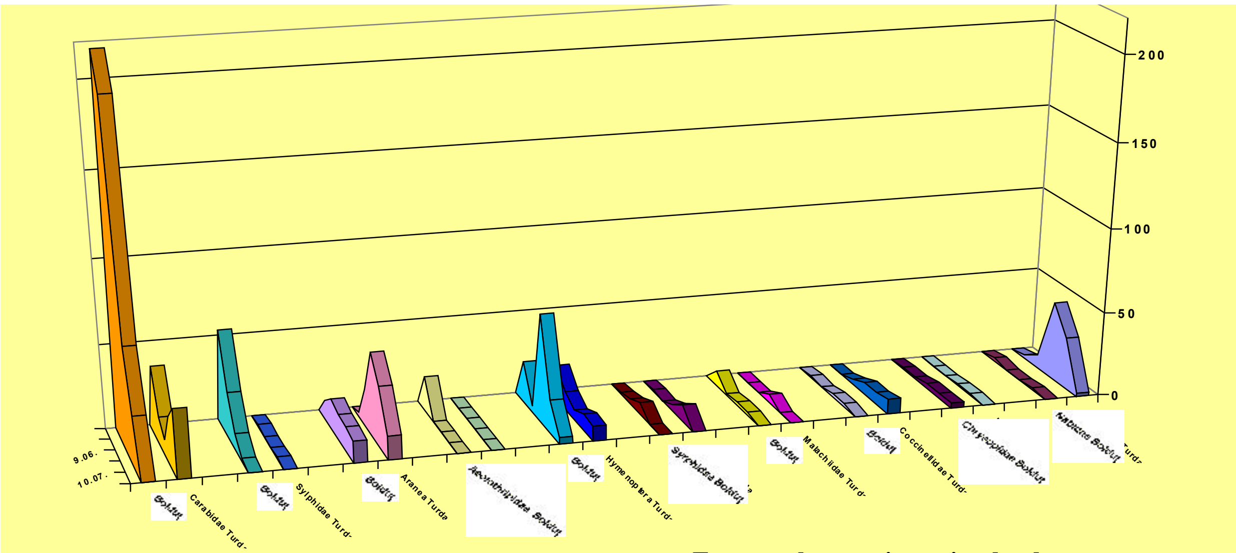
Winter wheat.

Comparative dynamics and abundance of pests and entomophagous fauna in open fields (Turda) and with forestry belts agroecosystems (Bolduţ), in winter wheat (2000-2002).

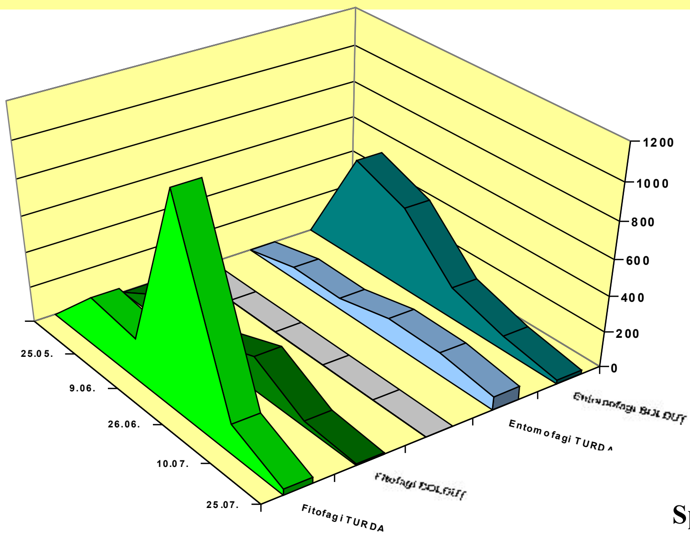
Plate 14 b



Phytophagous in spring barley

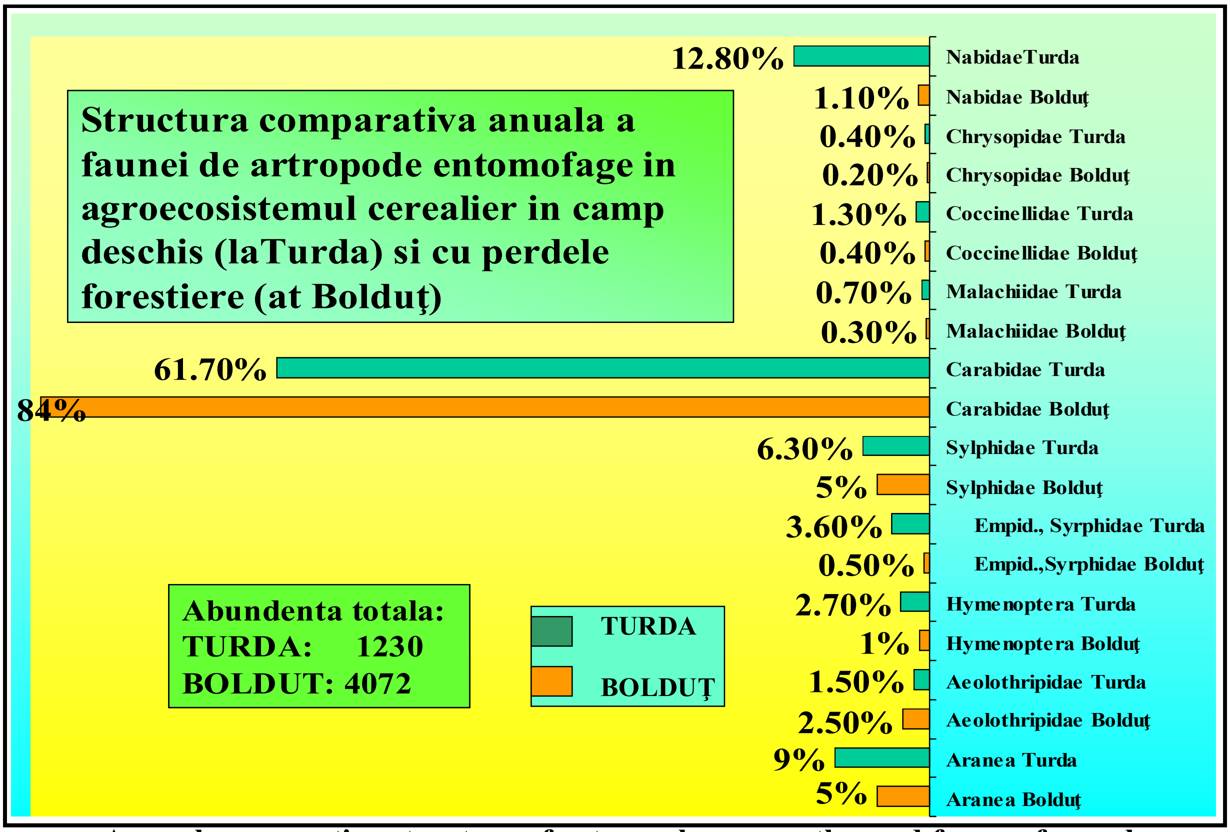


Entomophagous in spring barley.

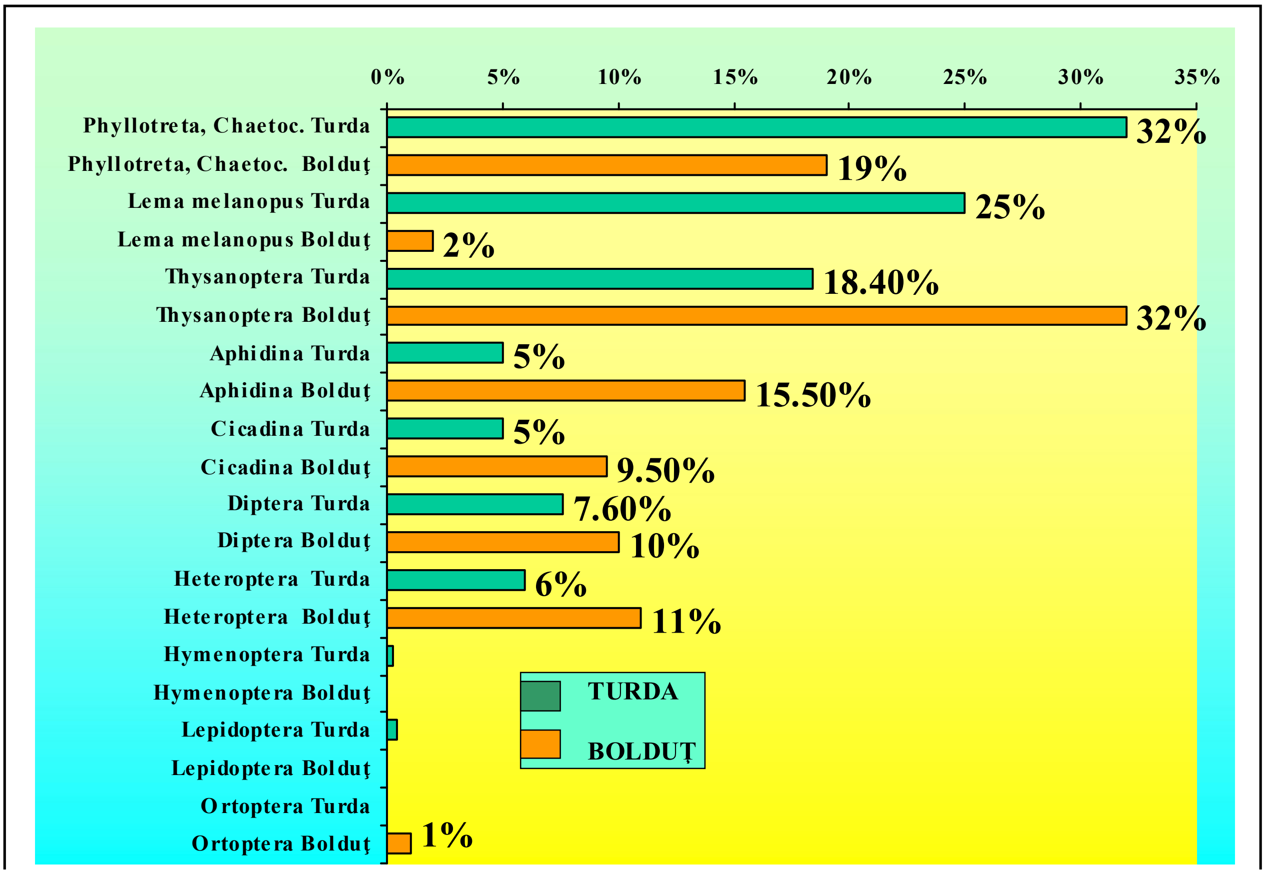


Spring barley.

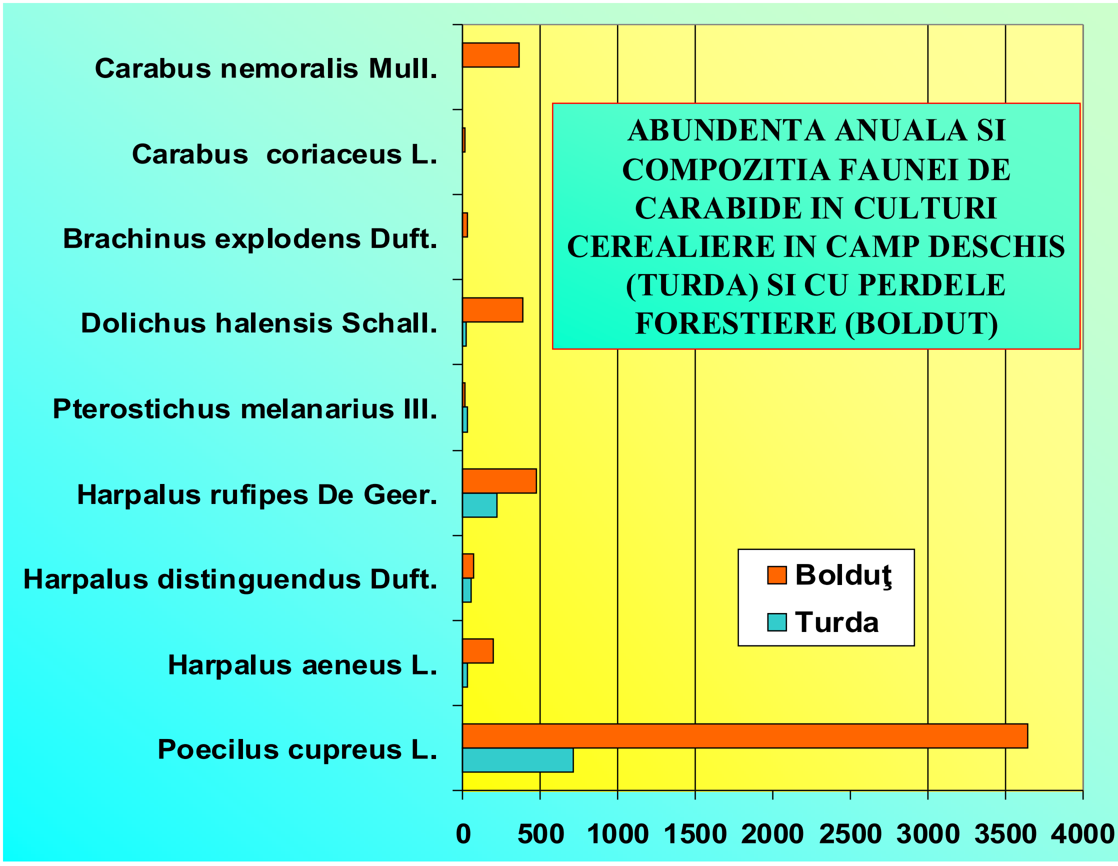
Comparative dynamics and abundance of pests and entomophagous fauna in open fields (Turda) and with forestry belts agroecosystems (Bolduţ), in spring small grain cereals (2000-2002).



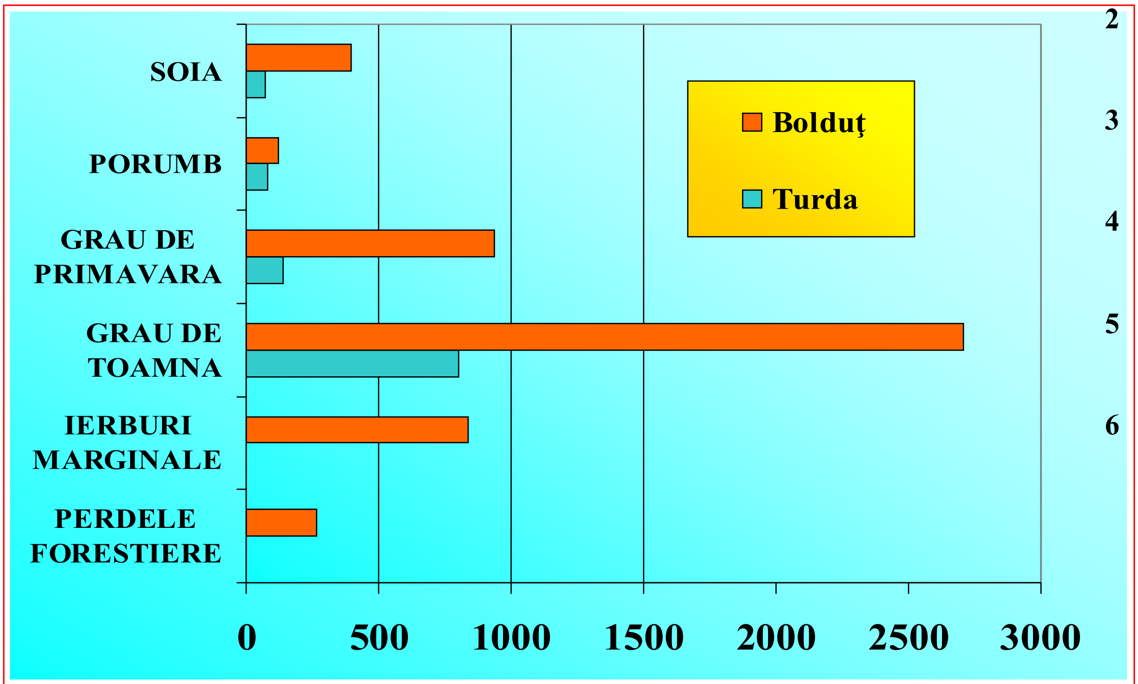
Annual comparative structure of entomophagous arthropod fauna of cereal agroecosystems in open field area (Turda) and with forestry belts (Bolduţ).



Annual comparative structure of pests in cereal agroecosystems in open field area (Turda) and with forestry belts (Bolduţ).



ABUNDENTA ANUALA A CARABIDELOR IN AGROECOSISTEM IN CAMP DESCHIS (TURDA) SI CU PERDELE FORESTIERE (BOLDUT) 1



2
3
4
5
6

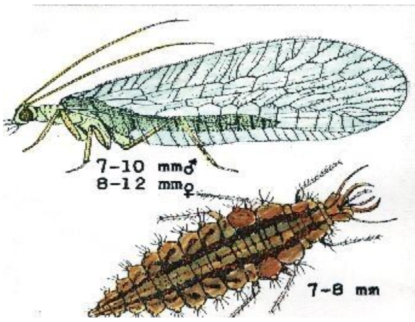
Annual comparative abundance of Carabid beetles in open field area (Turda) and with forestry belts (Bolduţ) agroecosystems, in soybean crops-1, maize-2, spring wheat-3, winter wheat-4, marginal grasses-5, forestry belts-6.

Plate 17

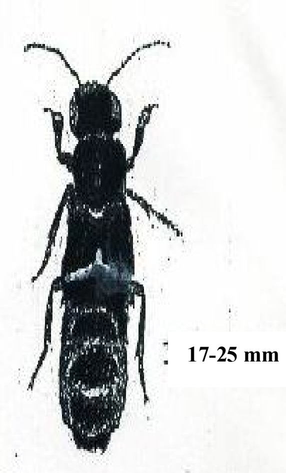
Araneus diadematus Clerck. (Araneidae)

Trocosa sp. Lycosidae

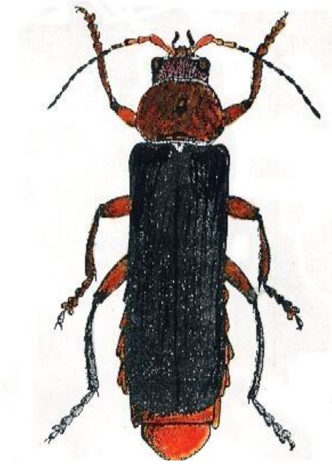
Trombidium holosericeum (Trombidiidae)



Chrysopa carnea Stephens (Neuroptera-Chrysopidae)



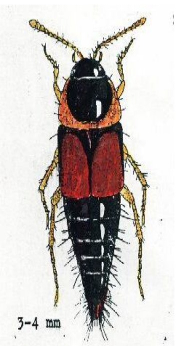
Staphylinus sp. (Staphylinidae)



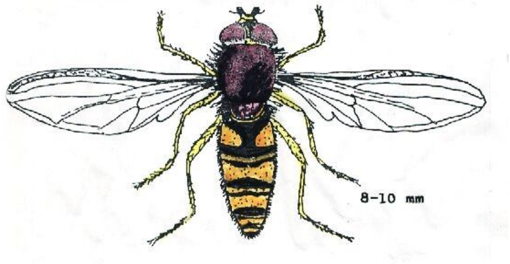
Cantharis fusca (Cantharidae)
10-12 cm

Malachius bipustulatus L (Malachiidae)

6 mm



Tachyporus hypnorum L. (Staphylinidae)



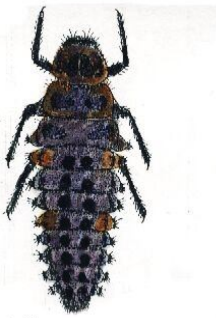
Episyrphus balteatus De Geer. (Diptera, Syrphidae)

Nabis ferus L. (Heteroptera, Nabidae)

Coccinella septempunctata L.
adult

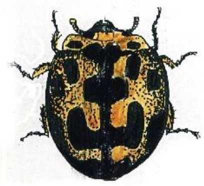
6 - 7 mm

10 - 11 mm



Coccinella septempunctata L.
larva

Propylaea quatuordecimpunctata L. (Coccinellidae)
Mascul



3 - 4 mm

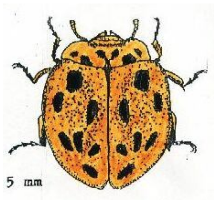
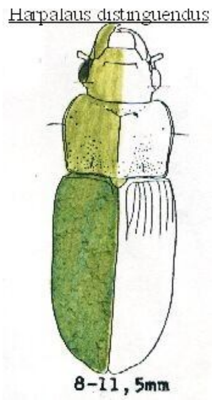


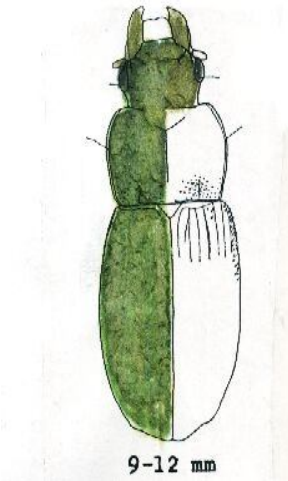
Plate 18

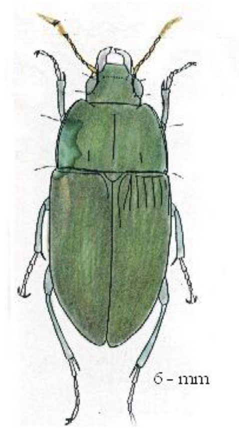
CARABIDAE

Poecilus cupreus L



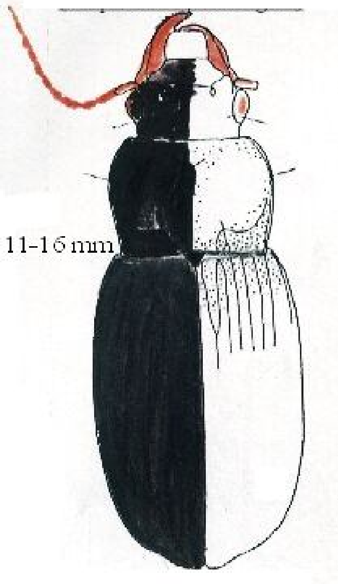
Harpalus aeneus F.



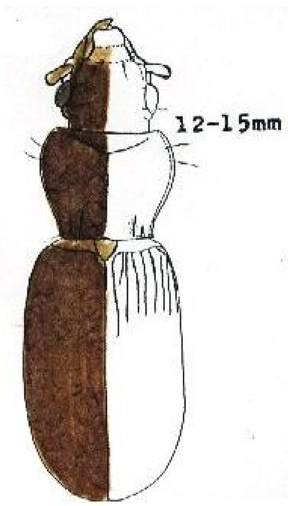


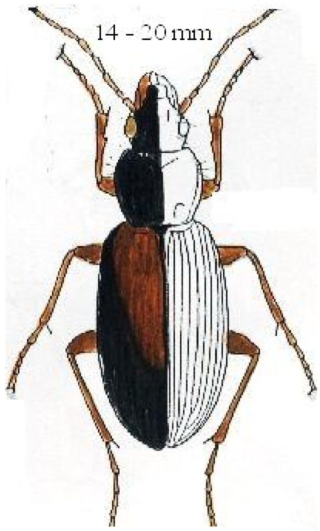
Amara aenea Deg.

Pseudophonus pubescens Mulle.
(Harpalus rufipes De Geer.)

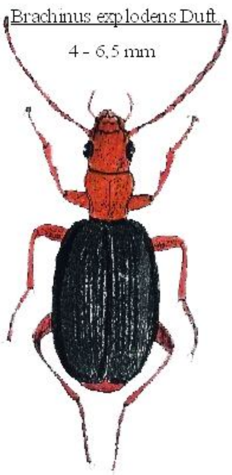


Pterostychus macer Marsh.

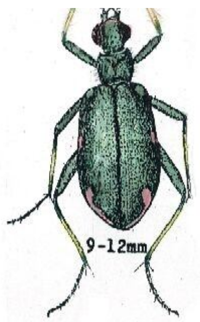




Dolichus halensis Schall.



Cicindella germanica L.
(Cicindelidae)



Sylpha obscura L
(Sylphidae)

4. The integrated pest management of cereal agroecosystems

4.1. Species inventory, understanding the characteristics of pest control biology, ecology, dynamics and control under the conditions of cereal agroecosystems in Central Transylvania

In order to optimize the environment-agriculture-sustainable development relationship, scientific and technological knowledge regarding the modernization of pest control management needs complex research approaches in a systemic, agroecologically integrated manner.

Agricultural entomology and applied ecology researches conducted at the Agricultural Research and Development Station in Turda have proposed the elaboration of cereal agroecologically integrated pest control strategy, meeting the economically important and scientifically challenging problems, especially under the conditions of profound agroecological changes caused by climate warming and aridization, and also under the new technological and economical conditions in regional agricultural exploitations. In the last years the increase of pest densities in the crops and some unexpectedly strong attacks have been the result of specific regional factors such as: - continuous multi annual increase a pest biological reserve; - enhancement of microclimate aridization and aggressiveness of pest attacks; - decrease of small grain cereal crop areas; - incomplete or incorrect technology system (Malschi, Mustea, 1992, 1995, 1997, 1998, 1999).

The study conducted during 1989-2008 has shown the evolution of main cereal pest attack evolution such as: Diptera, Homoptera, Thysanoptera, Coleoptera Chrysomelidae, as well as the optimization of the technological control system by insecticide application with high biological efficiency, crop measures by using the activity of natural predatory entomophags, elements involved in the present strategy of integrated pest control as a part of the technological system for the sustainable development of cereal crops in Transylvania.

In accordance with the research methodology applied, the data regarding species composition, pest control biology and technology have been recorded by comparative researches performed in the cereal agroecosystems in two types of cereal-based farms: the open field farm in Turda, and the protective forestry belt-based farm in Cean-Bolduţ, using optimal crop regional technology. Comparative researches regarding the useful arthropod populations in field crops in cereal rotation, including winter wheat, spring barley, soybean, corn, bordering grasses have been conducted in the two agroecosystems, in open field and antierosion forestry belts, respectively.

The increased control efficiency of the main pests and yield increases achieved in the open field crops have been experimental results which recommend the integrated management using modern, adequate insecticide application. Used in treatments on vegetation at the optimal application time a series of insecticides such as: thiacloprid, thiametoxam, fipronil, bensultap, acetamiprid, dimethoate, clorpirifos-metil, deltametrin, lambda-cihalotrin, novaluron, lufenuron, amestecurile de fenitrotion şi fenvalerat, oxidemeton metil şi betaciflutrin, clorpirifos şi cipermetrin, dimethoate şi cipermetrin etc. have had very good efficiency, especially in wheat flies, cycads, aphids, thrips, cerealleaf beetle control, achieving a mean grain yield increase by 7-24%, and protecting the useful entomophagous fauna activity.

The study has revealed data on arthropod fauna, biology and agroecology, experimental field tests regarding pest control and preventive measures for the elaboration of the integrated control system of the main pest species in wheat crops. The data have been statistically processed using the methods of regression, correlation, variant analysis. The analyzed samples have been obtained by the method of complex traps, including ground recipients, adhesive glue traps and captures in 100 double sweep-net catches in 3 repetitions for each crop lot.

4.1.1. Aphids and cycads monitoring as vectors of wheat yellow dwarf, present biology, ecology and strategy of their integrated control in Transylvania

4.1.1.1. The importance of aphid and cycad populations in transmitting and spreading small grain cereals yellowing and dwarfing

The damages caused by wheat dwarfing and yellowing related to the attack caused by aphids and cycads have been recorded several times and also at present in Transylvania. The changes in the level o regional climate, represented by warming and excessive draught, ample alternation of temperatures and the presence of extremely warm periods especially in winter an spring have caused the burst of aphid and cycad populations which may cause unexpectedly huge damages to wheat crops. These damages have been direct and indirect according to aphid and cycad virulence as vector of the pathogens (viruses, mycoplasms) which cause plant diseases and the presence of yellowing, dwarfing and sterility phenomena in wheat, according to plant growth stages, technological and regional agroecological factors.

Global warming has also been manifested by the increase of daily mean temperatures recorded in autumn-winter-spring months with repercussions on the homoptera-aphid and cycad populations development.

The extreme situation recorded as a result of aphid and cycad population increase in 2001 – when the wheat yellowing-dwarfing phenomenon has been recorded in Transylvania on wide areas – as well as the increasing biological reserve recorded in the spring of 2002-2005 has required a more thorough research regarding the importance and present aphid and cycad population virulence, and the modernization of their agroecologically integrated control system.

In the regional cereal agrobiocenoses, homoptera have been recorded as pests with increasing abundant populations. Showing extremely regional importance, the cycad species such as: *Psammotettix alienus, Macrosteles laevis, M. sexnotatus, Javesella pellucida*; and aphids such as: *Sitobion avenae, Schizaphis graminum, Metopolophium dirhodum, Ropalosiphum padi* and other pests which feed by injecting the plants, inoculating saliva contaminated with viruses or phytopatogenous mycoplasma and sucking the sap (insects such as the thrips-*Haplothrips aculeatus*, mites etc), have been known in Europe as vectors in carrying and spreading cereal dwarfing, yellowing and reddening Beliaev 1965, Benada 1967; Tanasijevici 1965, Tanskii 1981, Tsitsipis et al. 1995; Dedryver 1985; Holz, Wetzel 1989, Wetzel 1995; Robert 1987, Remane 1993, Ossianilsson 1978, 1981, 1983, Thieme, Heimbach 1992).

The importance of the damages caused by wheat yellowing, dwarfing and sterility phenomenon induced by mycoplasma or viruses carried by aphids and cycads have been revealed by previous researches in Romania (Boguleanu 1994, Munteanu 1973, Munteanu et al. 1973, 1983; Ploaie 1973, 1983, Pop 1975, Hondru 1985, Balaj, Cantoreanu 1982, Bărbulescu 1984, Malschi, Mustea 1984, 1992, 1997, Malschi, Perju, 1999, Malschi 2001, Nagy 2001, Puşcaşu 2001, Jilăveanu, Vacke, 1995, Baniţă et al. 1996, Vilău 2000 and others), showing varying periods of strong attack, bio-ecology and dynamics of the mentioned pests.

The establishment of abundant aphid and cycad population virulence, as vectors of the pathogens causing wheat yellowing and dwarfing; being aware of the danger of attack expansion with increased potential every year, together with the need of elaborating an integrated control system adapted to the present situation and updated, require special researches of national and world impact.

Research topics are extremely important, the damages affecting wheat yields or leading to crop compromising, especially consecutive wheat crops and early sown crops of September.

The studies and experiments steadily conducted at the ARDS in Turda have aimed at preventing and limiting the damages caused to wheat crops in Transylvania due to yellowing, dwarfing and sterility phenomena induced by pathogenic agents (viruses, mycoplasms carried by aphids and cycads), the elaboration of integrated aphid and cycad species control system.

Present research and study objectives have comprised aspects of interest such as:

♦ the systematic and bio-ecological study of cycad, aphid and other pest species –vectors dangerous for their attack potential in the cereal areas of Transylvania; the understanding of cycad and aphid species importance as direct pests and as vectors;

♦ the understanding of present virulence of abundant cycad, aphid populations as pathogen vectors (viruses, mycoplasma) which cause wheat yellowing and dwarfing on wide areas

♦ follow-up and awareness of the danger of attack expansion observed at present in increasing quotas and affecting wheat crop yields in accordance with the agroecological conditions, and leading to crop compromising.

♦ testing the adequate and updated technological methods of integrated management, which comprise preventive and curing modern control in accordance with the new control techniques, through accuracy and profitability methods based on reduced economic input and good efficiency, showing reduced side effects regarding the development of resistance to insecticide of the studied species populations, and a diminished negative impact on environment and useful entomophagous fauna;

♦ elaboration of agroecologically integrated control strategy of these insects by interdisciplinary researches on the modern methods of attack diminishing in accordance with **technological factors**: - selective, efficient insecticides, agrotechnical methods, and **biotic factors**: - natural entomophags, tolerant varieties, vector resistance to insecticides; **environment protection factors**.

4.1.1.2. The importance of wheat aphid and cycad study

The Homoptera Aphidina, Cicadina represent an interesting field of the fundamental researches of entomology due to the challenging aspects of species morphology, biology and ecology. They develop in agroecosystems based on very complex biocenotic interactions, depending on climate, vegetal host species diversity and abundance factors, natural limiters' activity, especially the entomophags.

The dominant species in wheat crops in Transylvania such as: *Schizaphis graminum* Rond., *Macrosiphum avenae* Farb., *Rhopalosiphum padi* L., *Metopolophium dirhodum* Walk. (***Aphididae)*** şi P*sammotettix alienus* Dahl., *Macrosteles laevis* Rib., *M. sexnotatus* Fall. ***(Cicadellidae),*** *Javesella pellucida* Fabr. ***(Delphacidae),*** have been revealed as pathogen vectors (viruses, mycoplasms) for wheat yellowing and dwarfing in Transylvania (Malschi, 2002, 2004; Malschi, Mustea, Perju, 2003; Nagy, 2001, 2003, Perju, Dănulescu, Malschi, Oltean, 2002; Munteanu, Munteanu, 2004, Perju, Mureşanu, Malschi, 2004).

These species have been intensely studied worldwide nowadays Afonina et al., 2002, Sweets, 2004, Tsitsipis et al., 2001, Watkins, Lane, 2005). In 19 countries of Europe the network of observing aphid dynamics under the impact of global changes has been active (Denholm et al., 2002, Tsitsipis et al., 2001, 2004). The expanding species in Western and Central Europe and USA - *Diuraphis noxia* Kurdj. (Aphidina) – has been also reported in Serbia (Tomavic et al., 2004) as a potential danger.

The researches on the evolution and importance of these pest populations show a strong motivation due to the presence of more acute direct damages and indirect damages caused by aphids and cycads related especially to present climate and agroecological changes (Malschi, 2002, 2003, 2004, 2005). Under normal conditions these species have been constantly present and performed a generalized attack in wheat crops, being abundant in the marginal areas of the crops, where there are frequent symptoms of yellowing and dwarfing of the attacked plants. The virulence of these insects which act as invasive species under favorable conditions can cause generalized symptoms of wheat viral and mycoplasmatic yellowing diminishing wheat yields and even causing crop calamities, which required laborious research activities worldwide. The studies on damage limitation have been complex by approaching the factors that can narrow vector population growth such as: destruction of volunteer wheat, avoiding early autumn sowing in order to minimize the incidence of plant emergence with the vector insects, maintaining plant vigor by adequate fertilization, the use of good quality seeds of resistant varieties, weed control, insecticide treatments within an integrated agroecological system (Katis et al, 2004, Sweets Laura,2004, Tsitsipis et al., 2001). Modern researches are focusing on entomophagous limiters (Afonina et al., 2002, Margaritopoulos et al., 2004, Tomavic et al., 2004), on the impact of genetically modified plants on aphids (Bienko et al.,2002, Leszczynski et al.2002), on the development of insecticide resistance (Tsitsipis, Blackman, 2004).

The agroecological aphid and cycad study of the cereal crops in Central Transylvania at the Agricultural Research Station in Turda have revealed the importance of homoptera in order to control and elaboration of their integrated control management methods. The synthesis on the researches performed and presented below have revealed significant data for the specification of the adequate integrated cycad and aphid control system: homoptera structure, biology and dynamics in the cereal agrobiocenoses; the importance of homoptera under regional climate, technological and phenological conditions; preventive control through crop, agrotechnical measures; natural biological control performed by predatory insects; experimental chemical control; the strategy of integrated agroecological control.

4.1.1.3. Homoptera structure, biology and dynamics in cereal-based agrobiocenoses

In the regional cereal agrobiocenoses homoptera have become important as abundant populations and damages caused by aphids such as: *Schizaphis graminum* Rondani 1847, *Macrosiphum (Sitobion) avenae* Fabricius 1775, *Rhopalosiphum padi* Linne, 1758, *Metopolophium dirhodum* Walker 1849 and cycads such as: *Psammotettix alienus* Dahlbom 1850, *Macrosteles laevis* Ribaut 1927, *M. sexnotatus* Fallen 1806, *Javesella pellucida* Fabricius 1794.

The mentioned dominant species, their population dynamics and biology, especially on wheat but also on alternative hosts are seen in several cereal regions in Europe (Balaj; Cantoreanu 1982; Bărbulescu 1982; Benada 1967; Boguleanu 1994; Ciochia, Boeriu 1996; Hondru et al. 1985; Malschi 1995; Ossiannilsson 1978, 1981, 1983; Remane, Wachman 1993; Tanasijevici 1965; Thieme, Heimbach 1992).

According to the climate, agrotechnical and phenological conditions their biological reserve and attack potential may be extremely important, the signalled species being dangerous due to direct and indirect damages, especially as vectors of viruses and mycoplasma. The crop and agrotechnical measures which provide the adequate emergence of the crop and good plant growth have been important in the preventive control of these pests (Bărbulescu 1984; Beliaev 1965; Dedryver et al. 1985; Holz, Wetzel 1989; Jilăveanu, Vacke 1995; Malschi, Mustea 1992, 1997; Munteanu 1973; Munteanu et al. 1973, 1983; Ploaie 1973, 1983; Pop 1975; Robert 1987; Tanskii 1981; Tsitsipis et al 1995; Wetzel 1995).

In Central Transylvania, the cereal biocenoses have a rich natural patrimony of entomophags, with significant relevance in the structure of the recorded arthropod fauna. A major contribution in homoptera population limitation in cereal crops has been achieved by their predators which perform a continuous basic activity regarding the maintenance of homoptera at balanced levels and a special, intense activity during the maximum growing period of the pests. The natural biological control of homoptera performed by predatory arthropods (*Chrysopidae, Nabidae, Coccinellidae, Cantharidae, Malachiidae, Staphylinidae, Carabidae, Sylphidae, Cicindellidae, Empididae, Syrphidae, Scatophagidae, Aeolothripidae, Formicidae, Forficulidae, Aranea*, and others) is a modern objective of agroecological researches approached in the study of cereal-based entomocenoses (Ciochia, Boieriu, 1996; Holz, Wetzel 1989; Malschi, Mustea 1997; Dedryver et al.1985; Iperti et al. 1989; Sunderland et al. 1987; Voicu 1990; Wetzel 1995) in order to elaborate the systems of integrated homoptera control. In Central Transylvania, the structure of aphid and cycad species in the regional cereal agrobiocenoses has been strongly influenced by climate factors and the presence of the host plant.

In the case of cereal crops, the aphids and cycads manifest every year abundantly, sometimes reaching significant densities and exceeding the values of the economic damaging threshold. In consecutive wheat crops and emerged plantlets in September, the populations of these vectors are very abundant an dangerous in autumn, the yellowing symptoms of the plants being obvious.

Species determination has been achieved based on the abundant reserve collected during 1989-1998 with the entomological sweepnet catches for the arthropod fauna at the plant level, and with the Barber traps for the epigeous arthropod fauna. The structure and dynamics of the aphid and cycad species populations interacting with predatory arthropod fauna in wheat crops, in the marginal grasses, lawns and pastures. Most of the samples collected have come from the probing performed every 10 days in open field cereal agrobiocenoses (in Turda), and in the forestry belt-based agricultural system (in Cean-Bolduţ). The aphidiphagous capacity of the predatory species in the crops has been studied in micro isolators and tests in order to establish daily individual feeding rate on species *Sitobion avenae* sau *Rhopalosiphum padi*, in laboratory conditions.

Result analyses have shown that between 1989-1998 densities of 5-10 cycads/10 sweep net catches/m^2 have been recorded in winter wheat crops only in the years when crops have emerged until mid October. Aphids have very rarely developed the colonies on autumn crop leaves (1992), the climate and vegetation conditions being unfavorable. On the other hand, the level of aphid populations increased during the spring months, reaching values exceeding the EDT – 25 aphids/spike in June – during the milky-wax grain ripening phenophase (Tanskii 1981), (table 22).

During May-June when the reserve of aphids increases in the crops, wheat yellowing and dwarfing phenomena have been recorded in different degrees related to the aphid and cycad population development. The attack of these pests and the presence of yellowing have been recorded since autumn, intensifying towards spring under the conditions of the present climate warming and due to the agroecological particularities of the regional wheat crops, especially those related to single crop practice.

During 2000-2005, an abundant increase of aphid and cycad populations have been recorded every year, together with a massive appearance and spreading of wheat and other cereals yellow dwarf and sterility symptoms. These abundant aphid colonies which have developed on leaves, continued their evolution and reached the ears. When the temperatures reached over 25^0C and the grain milky-wax ripening phenophase began, the aphid populations moved on to corn and other crops, being virulent and infectious for the autumn sowing.

Eleven species of cycads and 4 species of aphids have been recorded **in homoptera structure,** being known as vectors of virosis and mycoplasma (table 23).

The structure of wheat cycad species captured annually with the entomological is stable, comprising dominant species which represent 20-30% such as: *Psammotettix alienus, Javesella pellucida, Macrosteles sexnotatus, M. laevis* and only 2% other species. Wheat cycad species dynamics has revealed population increases until crop harvesting. During summer months these species migrate on several cereals from meadows and crop bordering grasses, and the crops in cereal rotation as well. *M. laevis* has been captured during summer from *Avena fatua; M. sexnotatus, P. allienus* and *J. pellucida* spreading on *Hordeum distichum, Lolium perene, Dactylis glomerata* and others (board 19).

Regional characteristics have been reported in **the biology of the cycad species** already mentioned. *P. alienus* is concentrating in autumn on the emerged crops and winter as egg. The first adults come out in June, and the larvae grow on wheat until its harvesting when the new adults migrate on several cereals and corn, going through the second and third generation until fall. *M. laevis* and *M. sexnotatus* winter as adults and eggs. From the eggs laid on the leaves parenchymum the larvae will grow on wheat and other cereals. After harvesting, the second generation will grow on spontaneous gramineae, while the third generation will grown on autumn cereals. *J. pellucida* winters as mature adult on the ground or on winter wheat. In spring, the adults and the first generation emerge growing on wheat in May and June, being supported by moderate humidity and temperature. The second generation grow on several graminaceae.

During June and July a massive growth of cycads has been recorded on wheat until harvesting, supported by regional climate conditions. Cycad species populations increase in August and September by aestival generation increases, while in autumn this biological reserve is concentrating on autumn cereal seedlings.

The following **aphid species** have been captured annually on wheat: *Macrosiphum (Sitobion) avenae* averaging 47% and being eudominant, *Schizaphis graminum* (12%), *Metopolophium dirhodum* (31%) and *Rhopalosihum padi* (10%), which are dominant (board 19).

Aphid populations have shown a gradual increase, more intense in May and June, the continuity of the biological cycle being supported by the abundance of the sown and spontaneous gramineae, and winter host plants on which they winter as eggs under the conditions of Transylvania.

In Europe, the low temperatures during fall and winter are narrowing the areas of anholocyclic growth and aphid parthenogenetic continuous reproduction on successive hosts.

According to Dedryver et al., 1985, *M. dirhodum* and *S. avenae* start dying at -6°C while at -9°C -12°C 100 % of the aphids belonging to these species die. *R. padi* is more vulnerable to lower temperatures, 80 % of the aphids die at -2°C, while 100% of the aphids die at -6°C. The more aggressive cold is, or the higher the frequency of temperature variations, the higher aphid mortality due to cold will be noticed (table 24). Consequently, *S. avenae* is holocyclic in Transylvania, it winters as eggs on *Rubus* (blackberries) as primary host, and is dioecical growing on *Rosa*, *Fragaria, Agrimonia, Carex, Iris* in Spring especially on several gramineae, on stalky cereals and corn. *M. dirhodum* develops holocyclically wintering on Rosa. *R. padi* is also dioecical and winters holocyclically on the bird cherry tree (*Padus*). In spring, it grows on *Prunus, Padus, Cerasus* and gramineae. *Schizaphis graminum* is monooecical, but winters holocyclically, the eggs being laid on gramineae leaves on which they continue their growth during spring, being supported by warm and humid conditions.

Secondary host plants (cereals) and plant age (phenophase) differentiate the evolution of aphid colonies (Dedryver et al. 1985). Thus, the wheat aphids show maximum fecundity before the end of blossoming. The milky ripening phenophase there are already unfavorable conditions for the *R. padi* species, and the winged forms emerge. In the milky-wax phenophase the conditions become unfavorable for the *S. avenae* species and winged forms emerge.

During July-October corn crops, forage gramineae, samulastra, and the vegetal remains represent aphid summer reserves and shelter the main species especially *R. padi*. Autumn cereals sown early are also an important reservoir for aphid populations, especially *R. padi* which cause anti-hibernal infestation of early sowings with yellow dwarfing viruses thus causing significant damages.

4.1.1.4. The ecological importance of homopters natural limiters in Transylvania

The scientific works and original contributions have revealed regional, particular aspects regarding the ecological importance of homoptera natural limiters, in accordance with the data published (Ciochia, Boieriu 1996; Holz, Wetzel 1989; Malschi, Mustea 1997, 1998, 1999; Dedryver et al. 1985; Iperti et al. 1985; Sunderland et al. 1987; Voicu 1990; Wetzel 1995, Margaritopoulos et al., 2002, 2004., Tsitsipis, 2002, Tsitsipis et al., 2004). Thus, the evolution of homoptera populations has been influenced by the limiting role of the auxiliaries in the regional cereal crops. Significant decreases caused by the pathogens of the genre *Entomophthora* and parasitic hymenoptera have been recorded. On the other hand, the activity of entomophagous predators has been extremely important. Every year there are abundant populations of predatory arthropods interacting with their prey made of aphids and cycads.

The significance of these species in diminishing aphid populations in the cereal agrobiocenoses has been laboratory tested by replicating the structured interactions observed in nature in prey-predator micro isolators (Malschi, Mustea 1997, Malschi, 2003), (boards 19, 20).

During 10 years, between 1989-1998, the annual abundance of wheat aphids has been strongly influenced by the complex of their predators, the determination coefficient being 36,5% (fig. 6). During the vegetation period of winter wheat crop, the presence of a significant basic activity of homoptera population limitation carried out in spring (April-May) by the complex of crop auxiliary predators has been recorded. They actively feed on aphids and cycad eggs in spring. The maximum interactions have been recorded during wheat blossoming and grain formation – the milky-wax phase, when predator concentration causes a 28% decrease of aphid abundance on ears (fig.7). The determination coefficient of 24.5% for the influence of aphid abundance on the level of predator populations has also been recorded (fig. 8).

Every year the predators of homoptera represent 48.5% in the structure of these interactions. Since wheat blossoming period and during the month of June the polyphagous predators concentrate and grow on wheat, representing 92,7% of the aphidiphagous auxiliary complex (Carabidae - 46,8%, Aranea – 19,5%, Nabidae - 11,4%, Empididae –7,6%, Staphylinidae – 4,3%, Malachiidae – 3,1% and others.), and also specific aphidiphagous predators representing 7,3% (Coccinellidae – 4,3%, Chrysopidae – 1,8%, Syrphidae – 1,2%) actively involved in the destruction of aphid colonies on wheat spikes. In this stage, most of the predator species mentioned have been in the larvae stage.

An extremely significant role is played by carabide beetles – known as nocturnal aphids predators – and also by predatory diptera: Empididae (*Platypalpus)* and thrips (*Aeolothrips intermedius*), which feed on aphids and cycad eggs. The impact of the increase of carabide beetles population levels and other predators on the diminishing of aphid colonies during spring has been recorded, together with the sudden decrease of aphid population curve under the cumulated effect of specific polyphagous predators during the milky-wax ripening phase (boards 21, 22).

In Central Transylvania, starting with the milky-wax phase recording, in the second half of June there is a slow growth of wheat during the following month, the natural decrease of aphid populations being important in wheat yield development. The experimental data have shown that due to the activity of the natural reserve of presators of wheat ear pests, especially of aphids, ear yield usually visited by aphidiphagous predators has been significantly higher (18%) as compared to grain yield of the ears isolated by a glue band at the ear base (Malschi, Mustea 1999).

The effect of aphidiphagous predators limiting activity in wheat ears has been stronger in the case of phenologically delayed wheat. Positive significant differences have been recorded at TGM value of the sears visited by the predators of the agrobiocenoses natural reserve.

The ecological laboratory researches regarding the natural biological aphid control have been enriched by controlled feeding tests with *M. avenae* şi *R. padi* by which daily and individual feeding ratios reached by predatory species have been studied. Laboratory tests have revealed the destruction capacity of the main predatory species on aphids (*Sitobion avenae* Fabr. and *Rhopalosiphum padi* L.). Thus, the number of aphids eaten daily by each individual has been as follow: 30 aphids in *Chrysopa carnea* Stephn.; 60 aphids in the *Nabis ferus* L. adult and 17, 25 aphids in *Nabis*-larvae, respectively; 25 aphids in *Episyrphus balteatus* Dg.; 25-50 aphids in *Coccinella septempunctata* L. and 25-40 aphids in *Propylaea quatuordecimpunctata* L.; 40 aphids in *Chantaris fusca* L.; 25 aphids in *Tachyporus hypnorum* L.; 60 aphids in *Poecilus cupreus* L.; 50-60 aphids in *Pseudophonus pubescens* Mull. (*Harpalus rufipes* De Geer.); 50 aphids in *Harpalus distinguendus* Duft. şi *H. aeneus* L.; 25-30 aphids in *Brachinus explodens* Duft. Beside these predators other active entomophags in wheat crops acting also as homoptera limiters such as the species Coleoptera-Coccinellidae, Carabidae, Sylphidae; Thysanoptera – Aeolothripidae; Hymenoptera-Formicidae; Diptera-Syrphidae, Empididae, Dolicopodidae; Aranea and others have been recorded in accordance with the scientific literature and present concerns in Europe (board 19).

In the open field agricultural system, the study of predatory species dynamics in the border of cropped lots and their concentration inside the fields (Malschi, Mustea 1999, Malschi, 2003) has shown the kairomonal attractiveness of some aromatic flowering plants such as: *Achillea millefolium, Daucus carota, Sambucus nigra* and others. There are also plants which favor the entomophag concentration on wheat ears; they are plants belonging to the spontaneous marginal flora such as: *Matricaria, Myosotis, Viola, Papaver, Cichorium, Pastinaca, Hypericum, Sinapis, Soncus, Veronica* and others. These are preferred by entomophags for feeding and support the concentration of the adults attracted from the border towards inside where they lay their eggs, while their larvae perform aphid control and other pests of wheat ear (Rupert, Molthan, 1991, Welling, 1990, Malschi, 1997). Significant observations have been carried out in the comparative study regarding pest population development under the impact of predatory entomophag natural reserve in two wheat crop systems: in open field crops and in agroforestry belt-protected crops. In the latter case, aphids have recorded small populations (table 25). Antierosion protective forestry belt system has been reported from the test data to support the development and conservation of useful entomophagous arthropods (board 23).

The abundance of useful epigeous entomophags (Carabidae, Sylphidae) especially the abundance of several species of Carabidae has been a lot bigger in agroforestry belt farm, the main species being captured in all crops in the cereal rotation (winter wheat, spring barley, corn, beans, meadows, marginal grasses and forage crops), during the seasonal circuit, starting in May until September (table 26).

The protection of spontaneous flora diversity at field borders and the controlled enrichment with flowered herbaceous plants plays a positive role in the conservation and use of useful entomophagous arthropod fauna in the crops. Grass belts or bordering agroforestry belts supports the presence and development of auxiliary species, fast crop colonization and the efficient natural biological pest control.

Due to regional agroecological conditions including the natural reserve of auxiliary entomophags, the level of wheat aphid populations has been limited to values of 12-32 aphids/ear (in June), while the biological cycad reserve resulted from the development of their populations on wheat until harvesting averages 5-10 cycads/m^2 or by 10 sweep net catches (in July). These multiannual mean values have been kept within balanced limits, except for the extremely homoptera-favorable years when the economic damaging threshold (EDT) of 5 aphids/plant, 5-10 cycads/m^2 in autumn after crop emergence or 25 aphids/ear has been exceeded.

These balanced values of aphid and cycad populations have required special consideration regarding the use of entomophags protection and support measures within the agroecologically integrated pest control system.

4.1.1.5. Elaboration of homoptera integrated control strategy (Aphidina, Cicadina)

The integrated management system of aphid and cycad control has been achieved on the basis of the experimental data synthesis which covered complex aspects regarding **preventive control** by relevant technological crop measures supporting the adequate crop emergence and good plant growth (Bărbulescu 1984; Beliaev 1965; Dedryver et al. 1985; Holz, Wetzel 1989; Jilăveanu, Vacke 1995; Malschi, Mustea 1992, 1997; Munteanu 1973; Munteanu et al. 1973, 1983; Ploaie 1973, 1983; Pop 1975; Robert 1987; Tanskii 1981; Tsitsipis et al. 1995; Wetzel 1995); **the natural biological control** performed by the predatory insects Holz, Wetzel 1989; Malschi, Mustea 1997; Dedryver et al.1985; Iperti et al. 1989; Sunderland et al. 1987; Voicu 1990; Wetzel 1995.); **experimental chemical control**.

The researches on the pest attack prevention and control have revealed practical information regarding the need for investigations such as: -the analysis of zone and crop clymate; - the periodical observation of attack potential (at emergence and in the 2nd decade of May);

- the use of technological crop measures (the volontiers wheat destruction, the sowing in the second half of Octomber, the balanced fertilization, herbicide treatment and others); - insecticide treatment on seeds or vegetation in the areas with significant biological reserves of these entomophags and under attack-favorable conditions; - periodical multiannual 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.

As preventive measures, the destruction of samulastra of stalky crops after harvesting restrains colony development and autumn crop infestation. Attack base occurring in winter wheat and barley needs to be treated (with organic-phosphorous products) to diminish the biological pest reserve.

The chemical treatments on vegetation should be applied using insecticides such as dimethoate, malathion, fention, fenitrotion, endosulfan, esfenvalerate and others. Insecticide application should be carried out taking into account the activity of the natural reserve of predatory and parasite aphidiphagous entomophags (Malschi, Mustea, 1995, Malschi, Perju, 1999, Perju et al. 1988, Voicu and Mureşan, 1989). Especially, the polyphagous predators diminish actively the aphids in the crops. Abundant populations of many aphidiphagous species have been reported in cereal-based agroecosystems (Voicu et al. 1993).

Many chemical control methods by seed treatment, aspersions in vegetation have been tested on wheat, among which some systemic organophosphorous products proved to be efficient such as dimethoate, disulfoton, diazinone. In the second half of May and June, when aphid colonies reach the highest number of individuals, aspersions with oragnophosphorous products, pyrethroids can be carried out (tables 27, 28).

Insecticide control using the variety of modern products (pyrethroids, neonicotinoids, plant penetrating systemic products such as: fipronil, thiametoxam, acetamiprid, carbamate, organophosphorous, metamorphosis and chitin inhibitors) has been studies in order to test the biological efficiency of the treatments against aphids and cycads, insecticide remnant capacity, the negative effects on plants and useful entomophag fauna with the purpose of using in practice products such as: Actara, Calypso, Alpha-Combi, Sinoratox Plus, Reldan, Mospilan, Regent, Victenon, Sumithion, Sinoratox, Rimon, Decis, Karate Zeon, Alphacipermetrin etc., and also some insecticides for seed treatment: Cosmos, Mospilan, Gaucho, Yunta, Tonic, Signal etc.

Within the testing experiements of economically and ecologically efficient insecticides, optimal application time in an integrated technological system has been studied, including complex herbicide treatments for leaves and ear disease control, other wheat pest control, fertilizers applications etc. (tables 29, 30, 31). Significant results have been obtained for practice both for normal year situations and also for special, excessively hot years, such as 2003-2004. In this respect, the open field crops on insecticide treatments have been carried out at the moment of herbicide treatment and at the flag-leaf stage have achieved significantly higher yields than the untreated ones, in which case the lots have been destroyed (table 32). Under the conditions of heat and draught, manifesting in 2003, pest structure was characterized by the abundance of some pest groups, among which homoptera averaged 20%, and the input of the natural reserve entomophagous limiters was drastically diminished as compared to normal, representing only 18% of the arthropod fauna in wheat crops (table 33, 34).

4.1.1.6. Optimization of environment-agriculture-sustainable development relations by integrated management system for the control of aphids and cicades pests - vectors of wheat yellow dwarf in Transylvania.

The researches during 2007-2008 carried out in accordance with the objectives on *The optimization of environment-agriculture-sustainable development relation for the control of aphid and cycad pests as vectors of wheat yellowdwarf in Transylvania* were motivated by the accumulation of knowledge regarding the optimization of agricultural technologies as part of the integrated management of wheat pest control, the management of the biological resources in the agroecosystems, the increase of agricultural yield level and quality, environment protection according to the concept of sustainable development. The knowledge required for the achievement of the integrated management of aphid and cycad control in the cereal-based agroecosystems has a special importance because the use of an adequate integrated pest control system has been crucial for achieving crop yield increase potentials and yield objectives as well as to respect the Integrated Environment Management plan of the agricultural farms.

The research results comprise agroecological and biotechnological studies on the fauna of wheat damaging *Homopterae (Aphidina-Cicadina)* in Central Transylvania under the conditions of agroecological changes characterized by climate warming and the technological and economic conditions of the regional agricultural exploitations.

Species identification has been performed based on the abundant material captured with the entomological net in the case of arthropod fauna in plants and with the Barber traps in the case of epigeous arthropod fauna.

The structure and dynamics of the aphid and cycad species populations has been studied in interaction with arthropod pest fauna in wheat crops, marginal grasses, grass ramping etc. The complex structure, dynamics and biology of the damaging entomofauna and the auxiliary entomophagous arthropod fauna in wheat crops have been recorded through identification and counting from the collected material. Most of the captured samples came from the samplings performed weekly in open field cereal agrobiocenoses. These samplings, records and analyses have been performed at the Agricultural Research and Development Station in Turda, in different experimental variants for the study of effect of pest control technology and the study of the complex impact of on wheat crop and agroecosystem in accordance with different crop systems, insecticides applied and treatment times (tab.36-44). Present virulence and importance of aphid and cycad species have been shown within the agroecosystems and recorded under laboratory conditions based on the living material captured in the field in isolators (Plate 37). The aphidiphagous capacity of the pest species has been studied in laboratory in microisolators and tests to establish daily individual food intake in the nursery.

Studying the present importance of vector populations (aphids and cycads) and wheat yellowing in Transylvania comprised activities of data and field sample collecting, their analyses and interpretation in 2007-2008.

The study of the structure, biology and dynamics of vector populations revealed the increase of cycad and aphid attack, their importance in the spreading of pathogenic agents causing wheat yellow dwarf, as well **as the importance of the attack coming from the other pest groups**: cereal flies, thrips, cereal bugs, cereal leaf beetles, requiring systemic, integrated crop and agroecosystem protection by chemical methods – efficient insecticides, crop technological measures, and biological measures – using natural resources of biodiversity, especially predatory entomophags etc. (Tab. 36-38).

In the time of the present agroecological and technological changes the importance of cycads and aphids as vectors of pathogenic agents (viruses, micoplasma) causing wheat yellowing has been reported. It required preventive control measures.

In spring, pest increased abundance and aggressiveness has been reported, the attack occurring 3 to 4 weeks earlier than normal. This required preventive control treatments, especially in the case of cereal flies with their species complex, and flea beetles, both groups being important for larvae attack inside the stem in April-May, calling for preventive seed treatments and sprinkles on vegetation with systemic insecticides applied in spring or at the time of herbicide treatment the latest, **at the end of tillering phase (13-33 DC stage).**

The attack coming from the **diptera species complex** with mean intensities of 60-64% destroyed stems has been recorded in the experimental lots of classical-ploughing and conservative ploughless technology in May 2008. Even in the case of seed treated variants using Yunta 246 FS insectofungicide, an attack of 57.5% destroyed stems has been recorded. The species encountered in April-May were: cereal flies *Delia coarctata, Opomyza florum, Phorbia securis,* flea beetles *Chaetocnema aridula,* ground pests *(Agriotes, Opatrum)* etc.

Preventive treatments applied **in flagleaf-heading and ear appearance phase (45-59 DC stage),** for wheat aphids and thrips control provided significant yield increases in 2008, the efficiency of shock-effected insecticides being noticed (pyrethroids). They ensure the control of the entire spike pest complex (adult thrips, aphids, cycads, bugs, chlopide diptera etc.; it is also important to emphasize that at the treatment time the insecticides have a moderate side effect on the evolution of auxiliary entomophagous populations in the crops).

After earing in June, significant densities of ear peste have bee reported ((10-15 thrips adults/ spike/at spike emergence, 4-21 thrips larvae /spike; 4-7 aphids/leaf, 2 aphids/spike; 2-3 bugs/m^2 and their evolution in July, (Table 35).

During June and July abundant cycad populations have been reported (especially *Psammotettix aliaenus* and *Javesella pellucida*) developing on wheat, which later on – after wheat harvesting – occurred on samulastra and spontaneous gramineae where they developed a new generation dangerous for winter sowing as they are virulent vectors of wheat yellowing. The aphids – especially *Rhopalosiphum padi* – have been reported as dangerous vectors through the colonis grown on samulstra and spontaneous gramineae (Table 33).

The study of vectors' (aphids and cycads) entomophags structure, biology and dynamics in the regional cereal-based agroecosystems. The researches on the main groups of predators of aphids and cycads have shown their role in the natural limitation of pahid and cycad populations in the cereral agroecosystems. Active species belonging to notorious groups have been captured and studied, such as: *Chrysopidae; Carabidae, Coccinellidae, Cantharidae etc; Diptera; Hymenoptera (Formicidae); Heteroptera; Thysanoptera; Aranea; etc.* (Table 37-38).

The evaluation of wheat yellowing symptom occurrence. In accordance with the biology and ecology of species studied under the conditions of Transylvania, **two significant infestation moments** have been reported: in autumn, right after plant emergence, and later, in May after the tilling phenophase, until the emergence of flagleaf and the spike, when the generalized symptoms of field diseases, leaf yellowing, dwarf plants have also been reported.

The intensity of attack in the crops was low, and more severe in the ecoton areas of the crops, characterized by the higher stress of the border effect, vectors; abundance and plant lower density, increased sunburn and draught. The danger of vector populations increased a lot in the summer of 2008 because of their increase during summer months and in September, on volontier and spontaneous cereals at the crop border and the banks between the cultivated embankments, especially in the case of ploughless technological system of conservative agriculture and other cereal crops, thus becoming economically important for winter crops (wheat, barley, triticale, rye). High temperatures were favorable to the extension of aphid and cycad colony growth, especially the significant increase of cycad occurrence on cereals (Tab. 39-41)

Establishing present virulence of the dominant species of wheat yellowing vectors, the importance of natural entomophags in laboratory experiments has been performed by capturing cycad and aphid samples from the experimental field, and their growth in isolators with uncontaminated wheat plants, the disease symptoms being revealed.

Laboratory tests on the present infectious potential of aphid and cycad populations and the appearance of wheat yellowing phenomena conducted at the ARDS in Turda have proved that out of the dominant cycad species *Psammotettix alienus, Javesella pellucida, Macrosteles laevis, M. sexnotatus*, ***Psammotettix alienus şiJavesella pellucida*** have been recorded as virulent vectors, while out of aphid dominant species *Sitobion avenae, Schizaphis graminum, Metopolophium dirhodum, Rhopalosiphum padi,* ***Rhopalosiphum padi*** has been recorded as virulent vector. These species have been strongly involved in the emergence and extension of wheat yellowing phenomena, as known recognized vectors of virosis and micoplasmosis unde regional agroecological conditions (Board 37).

Laboratory tests on the natural predators of aphids and cycads have shown the important role of the active species captured in wheat crops: *Poecilus cupreus L., Harpalus rufipes De Geer., Harpalus distinguendus Duft., Pterostichus melanarius Ill., Brachinus explodens Duft., Cocinella septempunctata L., Malachius bipustulatus L., Cantharis fusca L., Tachyporus hypnorum L., Episyrphus balteatus Dg., Chrysopa carnea Stephn., Nabis ferus L.etc.*

Testing the efficiency of the integrated control system (ICS) methods, the vector species of wheat yellowing through new methods in accordance with the technological factors: economically and ecologically efficient insecticides, agrotechnical and phytosanitary methods, and in accordance with biotic factors: natural entomophags, tolerant species, environment protection, preservation and sustainable use of biodiversity has been carried out under different technological crop systems in open field, classical system and conservative system, ploughless-protective against draught, in crops on antierosional banks, anf in the agroforestry belted farm.

Identification of efficient insecticides in vector control (aphids and cycads) on vegetation, the assessment of optimal application time, the evaluation of insecticide side effects on the auxiliary entiomophags in the crops, the emergence of resistance to insecticide; have been conducted in 2008, 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 researches has been showed the value of some quality insecticides adequate to the present high temperatures and abundance of pests and the overlap of attack of several phytophag groups (tab. 39-44).

Identification of adequate, quality seed-applied insecticides, biologically, economically and ecologically efficient has been conducted in experiments using the Yunta 246 FS insectofungicide (Tab.40, 41, 44).

The integrated control of the vector species and the attack of wheat yellowing by optimizing the technological factors such as: sowing time, insecto-fungicide seed treatments, insecticide vegetation treatments, fertilization, and by optimizing the biotic factors: natural entomophags, environment protection, preservation and sustainable use of biodiversity has been studied in experimental lots where the optimized technological system has been used in the vegetation year 2007-2008 (complex phytosanitary treatments with insecticides, fingicides, fertilizers, including preventive seed treatments with the Yunta 246 FS, 2 l/t insecto-fungicide) (Tab.41, 44).

. Yield results have shown that the technological system provided the control of risk factors in 2008, and the harvest results at the level of breed yielding capacity (the best variants yielding 6800, 7100 kg grains/ha), (Table 42). Also, has been performed the monitoring and control of yield quality resulted from the use the ICS (Table 43).

Conclusions. The researches have been concluded in 2008 by optimizing the integrated wheat aphid and cycad management. This 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 in the integrated technological crop systems.

In 2008, aphids (39%) and thrips (41%) were dominant in the structure of wheat pests, with abundante populations, well efficiency redused by the applied insecticides on the ear pests control. The development of biological reserve of aphids and cicads by the grasses, marginal herbs and volontier wheat was well pointed out in the collected samplings and the importance of the pests attack potential in the autumn sowing wheat crops was proofed.

The virulence of gathering aphids and cicads from wheat crops, volontier wheat and spontaneous cereals was established in laboratory trials with izolated wheat plants by the controled attack of ***Rhopalosiphum padi, Psammottetixs aliaenus*** or ***Javesella pellucida,*** demonstrating the virulence of aphids and cicads species from the natural rezervoir and the emergency of these vectors of wheat yellow dwarf. At the izolated plants, the symptoms causing by pathogenous agents of wheat yellow dwarf were yielded. In autumn, the symptoms were observed at volontier wheat and at emergent plants of wheat crops, in the attack fields and in the crop edges.

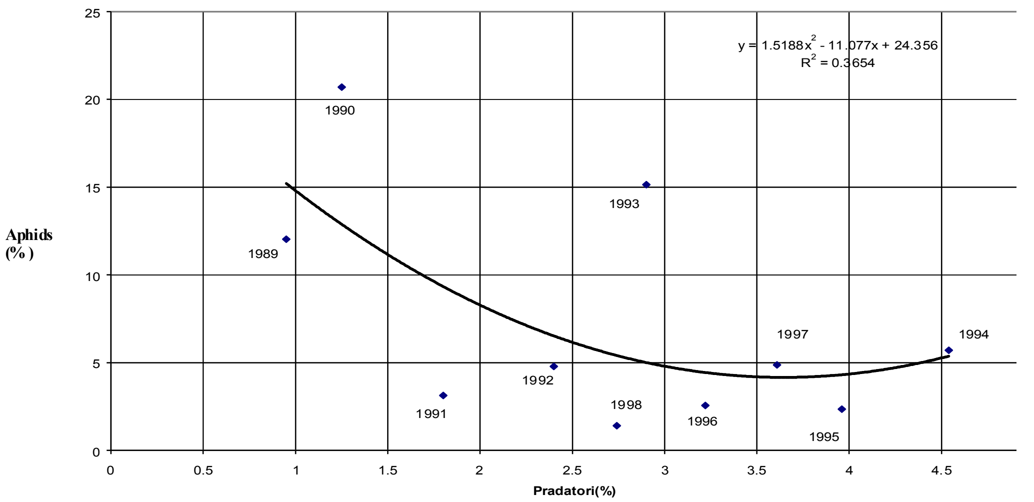


Fig.6. Yearly abundance of wheat aphids in interrelation with aphidophagous predators in 1995-1998 period, at ARS Turda (percentual repartition).

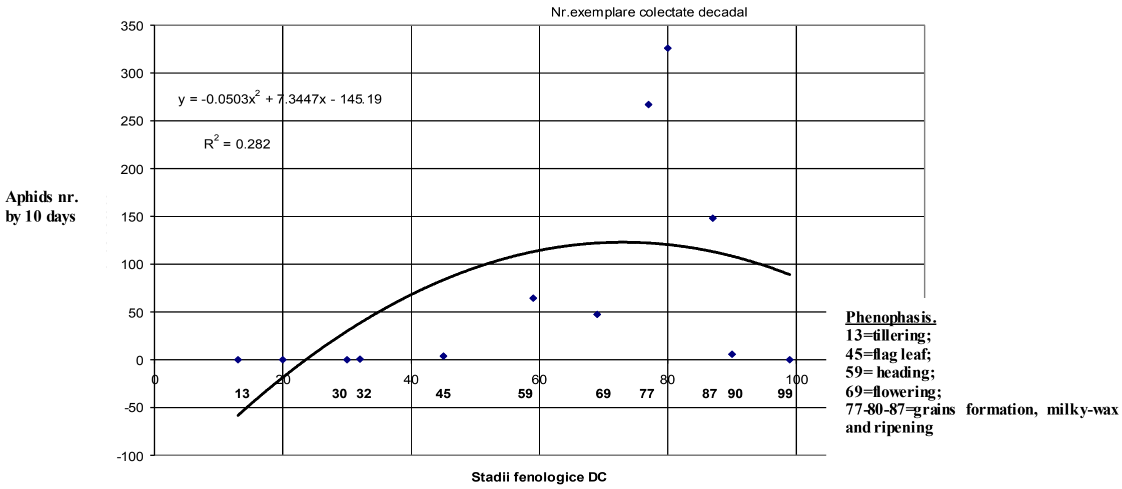


Fig.7. Evolution of aphids populations depending on aphidophagous predators and wheat phenophasis (1995-1998, ARS Turda).

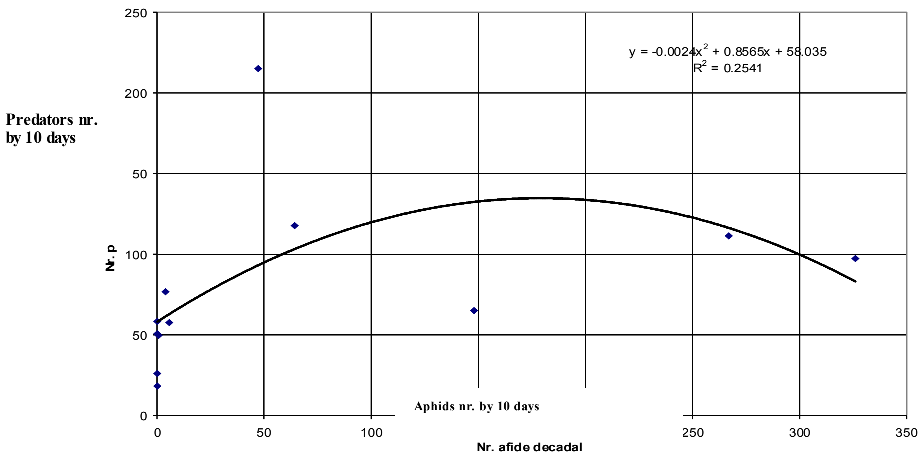


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Fig.8. Aphids dynamcs depending on aphidophagous predators and wheat phenophasis (1995-1998, ARS Turda).

Tab. 22.

The density of Homoptera pests in winter wheat crops () A.R.S. Turda, 1989-1998)

	Annual average values.									
The year.	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Temperature °**C**	9,5	9,5	9,1	9,0	7,9	10,5	9,4	8,2	8,6	9,2
Precipitations/mm	544,3	331,8	463,8	452,8	414,2	530,5	424,4	482,9	498,2	563,2
Cicads (nr.)	**Abondance (nr.)**									
	188	1178	266	450	700	714	220	210	183	94
Cicads / m²	**At soil, autumn / m²**									
	6	70	200	200	80	100	65	75	50	10
Cicads / 20 Oct.	**Cicads /10 sweep net catches** (20 Oct.)									
	5,6	10,0	-	4,5	-	7,0	-	-	-	-
Cicads /	**Cicads** / **10 sweep net**. (10 iulie-July)									
10 iulie-July	1,4	13,0	10,0	14,0	10,0	12	9,0	10,0	8,0	11,5
Aphids (nr.)	**Abondance (nr.)**									
	3020	5197	784	1200	3800	1428	590	640	1220	350
Aphids / 20 Oct.	**Aphids / plant.** (20 Oct.)									
	0,4	-	0,3	35	-	-	-	-	-	-
Aphids	**Aphids / ear.** (20 iunie-June)									
/ 20 iunie-June	25	14	5	10	8	10	25	20	2	1

Annual values of temperature (°C) and precipitations sume (mm) and the normal values 8,6°C, 509,2 mm.

Tab. 23

Influence of thermal factor on the annual dynamics of wheat aphids populations in Central Transylvania (1989-1998, Agricultural Research Station Turda)

Aphids aboundance (Y) by correlation with monthly average temperatures (X).

Temperaturi medii lunare 1989 - 1998	Ecuaţia de regresie	Coeficientul de corelaţie	Coeficientul de determinaţie
Din luna MAI în anul notării	$y = -13,699 + 1,594\ x$ $y = -46,32 + 6,097\ x - 0,153\ x^2$	r= + 0,276 R= 0,282	D % = 7,3 % D % = 7,8 %
Din luna AUGUST în anul precedent	$y = -36,05 + 2,316\ x$ $y = 50,59 - 5,954\ x + 0,19\ x^2$	r= + 0,429 R= 0,434	D % = 18,4 % D % = 18,8 %
Din luna NOIEMBRIE în anul precedent	$y = 13,468 - 1,13\ x$ $y = 12,149 - 3,09\ x \div 0,46\ x^2$	r = - 0,337 R= 0,387	D % = 11,4 % D % = 15,0 %
Din luna DECEMBRIE în anul precedent	$y = 9,47 - 0,238\ x$ $y = 8,50 - 1,95\ x - 0,26\ x^2$	r= - 0,067 R= 0,20	D % = 0,45 % D % = 4,0 %
Din luna IANUARIE în anul notării	$y = 6,28 - 1,78\ x$ $y = 7,368 + 2,369\ x + 1,108\ x^2$	r= - 0.33 R= 0,482 *	D % = 10,9 % D % = 23,2 %

Tab. 24

Liste of Homoptera species from small grain cereals in central Transylvania (Turda)

AUCHENORRHYNCHA (C I C A D I N A)

Fam. Delphacidae

- Subfam. Delphacinae

1. *Javesella pellucida* Fabr. (**Dominant sp., viroses vector**)

Fam. Cicadellidae

- Subfam. Thyphlocybinae

2. *Zyginidia scutellaris* H.-Sch.

- Subfam. Deltocephalinae

3. *Psammotettix allienus* Dahlb. (**Dominant sp., viroses and mycoplasma vector**)
4. *Macrosteles laevis* Rib. (**Dominant sp., viroses and mycoplasma vectors**)
5. *Macrosteles sexnotatus* Fall. (**Eudominant sp., viroses vector**)
6. *Macrosteles septemnotatus* Fallen
7. *Cicadula albigensis* W.
8. *Cicadula quadrinotata* Fabr.

- Subfam. Cicadellidae

9. *Cicadella viridis* L. (**Sporadic viroses vector**)

Fam. Cercopidae

- Subfam. Aphrophorinae

10. *Philaenus spumarius* L.

Fam. Tettigometridae

11. *Tettigometra* sp. (**Sporadic sp.**)

STERNORRHYNCHA (A P H I D I N A

Fam. Aphididae

1. *Schizaphis graminum* Rond. (**Dominant, viroses vector**)
2. *Sitobion avenae* Fabr. (**Eudominant, viroses vector**)
3. *Rhopalosiphum padi* L. (**Underdominant, viroses vector**)
4. *Metopolophium dirhodum* Walk. (**Dominant, viroses vector**)

Dominant classes in the % species structure (Wetzel, 1995): Eudominant: 32-100%; Dominant: 10-31,9%; Underdominant: 3,2-9,9 %; Signalized: 1-3,1%; Feeble signalized: 0,32-0,99%; Sporadic: < 0,32%.

Tab. 25

Average aboundance of aphids and theirs predators of wheat in open field area, at Turda and with agroforestry belts in Boldut (1997-1999, A.R.S Turda)

Annual average aboundance.			
Location.	Turda	Bolduţ	$\chi 2$
Aphids	346,6	154	120,54 xxx
Prredators total	519,0	971,8	26,37 xxx
Aranea	49,6	56,9	5,89 xx
Nabidae	28,0	28,9	5,26 x
Aeolothripidae	4,0	11,6	9,97 xxx
Carabidae	320,4	515,7	23,41 xxx
Staphylinidae	10,7	4,4	0,169
Sylphidae	33,7	283,7	125,65 xxx
Cantharidae	1,3	4,3	3,41
Malachiidae	7,3	5,0	0,17
Coccinellidae	22,3	11,6	0,04
Chrysopidae	3,3	4,3	1,22
Syrphidae	3,4	6,7	4,05 x
Empididae	35,0	38,7	9,44 xx
Total	865,6	112,6	

$\chi 2$ tabelar: (p 5%=3,84), (p 1%= 6,62), (p 0,1%=10,8)

Tab. 26

Structure, dynamics and dispersal of Carabids in cereal agroecosystems in open field area at Turda and with agroforestry belts in Boldut (1997-1999, A.R.S Turda)

Comparative structure and aboundance of Carabids					
Place of gathering.	**TURDA**		**BOLDUȚ**		**χ 2**
Carabidae:	**Nr.**	**%**	**Nr.**	**%**	
Total	688	-	2362	-	-
Poecilus cupreus L.	231	34,0	447	19,0	26,39 xxx
Harlpalus rufipes Deg.	83	12,1	606	25,6	26,46 xxx
H. distinguendus Duft.	41	6,0	72	3,0	10,07 xx
H. aeneus F.	5	0,7	46	2,0	3,82
Amara aenea Deg.	1	0,1	-	-	9,80 xx
Pterostichus melanarius Ill.	221	32,3	72	3,0	291,79 xxx
Pterostichus macer Marsh.	49	7,2	3	0,1	132,72 xx
Dolichus halensis Schall.	3	0,4	35	1,5	5,38 x
Brachinus explodens Duft.	3	0,4	1024	43,3	191,19 xxx
Agonum dorsalis Pont.	9	1,3	46	2,0	0,83
Agonum muelleri Hbst.	30	4,4	-	-	100,43 xxx
Anisodactylus sygnatus F.	7	1,0	-	-	28,34 xxx
Carabus coriaceus L.	-	-	11	0,5	2,01
Cicindella germanica L.	1	0,1	-	-	9,80 xxx

Comparative dynamics and dispersal of Carabids.						
Place of gathering.		**TURDA**		**BOLDUȚ**		**χ 2**
		Nr.	%	Nr	%	
May.	Forestry belts.	-	-	50	2,1	12,85 xxx
	Marginal grasses.	-	-	366	15,5	88,24 xxx
	Wheat.	22	3,2	206	8,7	17,66 xxx
	Barley.	19	3,0	6	0,3	33,43 xxx
June.	Forestry belts.	-	-	56	2,4	14,49 xxx
	Marginal grasses.	-	-	134	5,7	35,02 xxx
	Wheat.	49	7,2	228	9,6	2,62
	Barley.	15	2,2	88	3,7	2,96
	Maize.	-	-	30	1,3	7,31 xx
	Bean.	-	-	135	5,7	35,27 xxx
	Clover.	3	-	0,4	-	15,18 xxx
July.	Forestry belts.	-	-	41	1,7	10,56 xxx
	Marginal grasses.	-	-	166	7,1	42,77 xxx
	Wheat.	157	23,0	41	1,7	260,76 xxx
	Barley.	57	8,3	330	14,0	4,88 x
	Maize.	31	4,5	91	3,8	0,71
	Bean.	14	2,1	232	9,8	33,30 xxx
	Clover.	317	46,3	-	-	624,71 xxx
AUGUST.	Forestry belts.	-	-	-	-	-
	Marginal grasses.	-	-	102	4,3	26,78 xxx
	Maize	-	-	39	1,6	9,81 xx
	Bean.	-	-	21	1,0	4,64 x
TOTAL.	May.	41	6,0	628	26,6	123,69 xxx
	June.	67	9,8	671	28,4	47,60 xxx
	July.	576	84,2	901	38,1	65,78 xxx
	August	-	-	162	6,9	42,03 xxx
	Annual.	684	-	2362	-	-

χ2 tabelar GL=1: p 5%=3,84; p 1%=6,62; p 0,1%=10,8

Tab. 27

Influence of insecticidal seed treatments on wheat aphids and grain yield. A.R.D.S. Turda.

Insecticid	Product	**Doze /t / seed**	Aphids/plant	Difference	% grain yield	Difference. **(Kg/ha)**
Furatiocarb	PROMET 400 CS	25,0 l	15,5	- 19 ooo	106 %	+ 450
Carbofuran	FURADAN 35 ST	14,2 l	9,8	- 25 ooo	113 %	+ 1171 ***
Carbosulfan	MARSHAL	2,3 l	28,0	- 7	94 %	- 382
Bifentrin	TALSTAR 20 ST	2,0 l	25,2	- 11 o	108 %	+ 566 *
Netratat	MARTOR	-	34,8	0	100 %	0
DLp5%, DLp1%, DLp0,1		9,0, 13,0, 17,0			488, 670, 912.	

Tab. 28

Insecticides efficiency (%) for aphids control in wheat crops (A.R.D.S. Turda)

Treatment period (June 20-25)			**Efficiency. %**	
Insecticides.	**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	-
Clorpirifos etil	PYRINEX 50 EW	1500 ml	91	-
Clorpirifos etil	PYRINEX 25 MF	3000 ml	-	85
Oxidemetonmetil+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
Cipermetrin	POLYTRIN 200SC	100 ml	80	-
Cipermetrin	CIPERTRIN 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
Average density of aphids in untreated plots = 62 (in 100 entomological sweepnet catches)				

Tab. 29

Immediate effect of treatment at wheat ear to the aphids and cicads control and on the useful entomophagous fauna.

Date of treatment:25.06.2001; Date of note:27.06.2001

Number of insects and percentual limmitation of populations after treatment

Variante. Doze/ha	Check.	**Regent 200 SC 90 ml**		**AlphaCombi 26,25 CE 500 ml**		**Enduro 258 EC 1000 ml**		**Reldan 40 EC 1250 ml**		**Nurelle D 50/500 400 ml**		**Actara 25 Wg 60 g**	
Aphids	**10**	2	80 %	1	90 %	3	70 %	-	100%	0	100%	0	100 %
Cicads	**39**	20	49 %	-	100 %	1	97 %	2	95%	4	90%	0	100 %
Entomophags	**55**	11	80%	6	89%	5	91%	10	82%	5	91%	4	93%

Variante. doze/ha	**Victenon 50 Wp 500 g**		**Mospilan 20 SP 100 g**		**Rimon 10 EC 250 ml**		**Calypso 480 EC 100 ml**		**Karate Zeon 150 ml**		**Decis 25 WG 30 g**		**Match 300 ml**	
Aphids	5	50%	0	100%	2	80%	7	30%	0	100%	2	80%	2	80%
Cicads	6	85%	11	72%	4	90%	10	74%	1	97%	0	100%	7	82%
Entomophags	9	84%	9	84%	20	64%	22	60%	7	87%	3	94%	9	84%

Tab. 30

The effect of some insecticides on aphids and winter wheat grain yield.

		Efficiency (%)	Grains yield		
Insecticid	Doze/ha	Afide. Aphids	Kg/ha	%	Diferenţa
Martor. Check.	-	-	5501	100	-
Polytrin 200 SC	100 ml	100 %	7082	129	1581
Sinoratox PLUS	1800 ml	99 %	6962	127	1460
Sinoratox PLUS	1600 ml	100 %	6974	127	1472
Insegar 25 WP	300 g	71 %	7813	142	2311
Regent 200 SC	90 ml	58 %	7049	128	1548
Enduro 258 EC	1000 ml	97 %	6697	122	1196
Enduro 258 EC	1500 ml	99 %	6890	125	1389
Rimon 10 EC	250 ml	98 %	6849	124	1348
Pest density : 8/ear, 123/100 sweepnet catches.					

Tab. 31

Insecticides effect on the wheat cicads control in 2003 conditions (A.R.D.S. Turda)

1. The effect of cicads insecticidal treatment applied at weed control time / May 12 2003

Variante, doze/ha	Insecticides effect at 7 days after treatment	
	% cicads efficiency	% Mortality / entomophagous
Decis 25 WG 0,03 kg	82	98
Alphacipermetrin 0,1 l	90	93
Fastac 10 CE 0,1 l	91	100
Actara 25 WG 0,06 kg	74	73
Calypso 480 SC 0,1 l	69	98
Regent 200 SC 0,09 l	95	88
Mospilan 20 SP 0,1 kg	87	76

2. The effect of insecticides applied at flag leaf fase / in May 24 2003, against cicads, marked: a. at 2 days and b. at 7 days after treatment				
Variante, doze/ha	% cicads efficiency		% Mortality / entomophagous	
	a	**b**	**a**	**b**
Mavrik 2 F 0,2 l	98	92	97	99
Karate Zeon 0,15 l	100	92	92	82
Alphametrin 0,1 l	88	20	96	68
Decis 25 WG 0,03 kg	88	76	90	86
Cipertrin 10 CE 0,1 l	84	16	89	70
Faster 10 CE 0,1 l	92	88	93	91
Calypso 480 SC 0,1 l	98	72	94	70
Actara 25 WG 0,06 kg	100	60	94	45
Fenitrotion500g/l 0,5 l	82	84	76	73
Regent 200 SC 0,09 l	100	64	93	66
Mospilan 20 S 0,1 kg	92	72	93	82

Tab. 32

Effect of insecticides treatment on the ears density and on wheat grain yield in 2003 conditions (A.R.D.S. Turda)

1. Effect of insecticides treatment applied at the weed control time (variety Transylvania)				
Variante, doze/ha	Ears	Grains yield		
Application date the 12 th May	Ears/m^2	Kg/ha	Dif	%
Untreated	347	1949	-	100
Victenon 50WP 0,5 kg	380	2173	224	112
Decis 25 WG 0,03 kg	320	2380	431*	122
Calypso 480 SC 0,1 l	312	2201	252	113
Actara 25 WG 0,06 kg	304	2110	161	108
Mospilan 20 SP 0,1 kg	281	2306	357	118
Regent 200 SC 0,09 l	296	2210	261	113
Fenitrotion500g/l 0,5 l	308	1930	-19	99
Pyrinex 26 ME 3,0 l	332	2039	90	105
Alpha-Combi 0,5 l	296	2218	269	114
DLp5%=405; DLp1%=555; DLp0,1%=755; Ft=1,14; F=2,46*				

2. The effect of treatment for ear pests control, applied at flag leaf fase (variety Ariesan)				
Variante, doze/ha	Density	Grains yield		
Application date: the 24 th May	ears/m^2	kg/ha	Dif.	%
Untreated	339	3250	-	100
Decis 25 WG 0,03 kg	485	4105	855	126
Alphametrin 0,1 l	416	4320	1070	133
Fastac 10 CE 0,1 l	397	3705	453	114
Sumi-Alpha 5% 0,2 l	441	3390	140	104
Calypso 480 SC 0,1 l	307	3310	60	102
Mospilan 20 SP 0,1 kg	411	3460	210	106
Regent 200 SC 0,09 l	393	3220	-30	99
Victenon 50WP 0,5 kg	403	3125	-125	96

Tab. 33.

% pests structure of winter wheat in the year 2003 (A.R.D.S. Turda)

The pest.	%
Wheat trips: *Haplothrips tritici*	35,1
Cereal leaf beetle: *Lema melanopus*	3,2
Chaetocnema aridula	15,2
Phylotreta vitulla	5,1
Cereal flies: *Phorbia, Delia, Oscinella ş.a.*	13,7
Wheat leafhoppers: ***Psammotettixs, Javesella ş.a.***	**12,7**
Cereal aphids**:** ***Sitobion, Schizaphis ş.a.***	**7,2**
Cereal bugs: *Eurygaster, Aelia ş.a.*	6,4
Other pests.	1,4

Tab. 34

The dynamics of pests and entomophagous auxiliary in winter wheat (A.R.D.S. Turda)

Phenofase	TILLERING		FLAG LEAF HEADING FLOWERING					MILKY-RIPENING			
Individuals number by 100 sweepnet catches / 10 m^2											
Data	**21.04**	**6.05**	**12.05**	**22.05**	**26.05**	**30.05**	**10.06**	**12.06**	**18.06**	**29.06**	**Total**	**%**
Pests	50	399	392	273	159	213	246	241	287	127	2387	82
Beneficials	16	87	57	39	22	65	126	69	26	31	538	18

Tab.35.

Attack frequency and pests density in wheat crops conservative technological system, in 2008 (ARDS Turda)

Dăunătorul		**Frecvenţa atacului %**	**Densitate larve/mp, larve/planta**
AFIDE	***Sitobion avenae, Rhopalosiphum padi* etc.**	**48 frunze ingălbenite/ m^2 /11.06.2008**	**2-5 afide / spic / 11.06.2008 8 afide / frunză / 11.06.2008**
	Rhopalosiphum padi		**3-5 afide/frunză / 20.10.2008**
CICADE	***Psammotettix alienus, Javesella pellucida etc.***	**50 -100 exemplare / 100 filetări,iunie-iulie 2008 pe grâu şi august-octombrie 2008 pe samulastră de grîu**	
DIPTERE	***Opomyza, Delia, Phorbia, Oscinella* etc.)**	**60-64 % tulpini distruse de larve / 8. 05.2008**	
TRIPŞI	***Haplothrips tritici***	**12 spice /m^2**	**10-15 adulţi/ spic / 28.05.08**
		30 % spiculeţe	**4-21 larve / spic / 24.06.2008**
PLOŞNIŢE	***Eurygaster, Aelia .***	**3 spice / m^2**	**2-3 ploşniţe/m^2 / 4.06.08**

Tab. 36.

Structure of wheat entomofauna in 2007-2008, ARSD Turda

Number/100 sweepnet catches.	**2007 / no-ploughing, conservative soil minimum tillage**		**2008 / Plowed, conventional soil tillage system**	
PESTS	**Nr.**	**%**	**Nr.**	**%**
Thrips (*Haplothrips tritici)*	**519**	**63.8**	**493**	**41.0**
Diptera (*Meromyza, Oscinella, Opomyza, Delia, Phorbia, etc.)*	**69**	**8.5**	**85**	**7.0**
Leaf beetle (*Oulema melanopus)*	**8**	**1.0**	**10**	**1.0**
Chaetocnema aridula, Phyllotreta vitulla	**89**	**11.0**	**88**	**7.1**
Aphids (*Sitobion avenae etc.)*	**87**	**10.7**	**474**	**39.0**
Cicads *(Macrosteles, Psammottetix, Javesella*)	**26**	**3.0**	**21**	**1.7**
Bugs *(Eurygaster, Aelia, Trygonothylus)*	**16**	**2.0**	**29**	**2.4**
Cephus, Trachelus and other pests			**10**	**0.9**
ENTOMOPHAGOUS	**Nr.**	**%**	**Nr.**	**%**
Aranea	**91**	**48,0**	**72**	**28.0**
Hymenoptera	**66**	**35,0**	**88**	**34.2**
Nabidae	**17**	**9,0**	**3**	**1.2**
Cantharidae	**4**	**2.0**	**17**	**6.6**
Malachiidae	**5**	**3,0**	**6**	**2.3**
Coccinellidae	**3**	**1,5**	**2**	**1.0**
Chrysopidae	**2**	**1.0**	**8**	**3.1**
Syrphidae si alte diptere (Platipalpus, Thaumatomyia	**1**	**0,5**	**35**	**13.5**
Aeolothripidae			**26**	**10.1**
Total phytophagous	**814**	**81%**	**1210**	**82.5%**
Total entomophagous	**189**	**19%**	**257**	**17.5%**
Total entomofauna	**1003**		**1467**	

.

Tabelul 37.

Dynamics of wheat pests and entomophagous in no-ploughing,conservative minimum tillage technology2007

Nr./100 sweepnet catches/Data	13.04	16.04	23.04	14.05	28.05	4.06	11.06	**Total**	%
PHYTOPHAGOUS									
Chloropidae	**10**	**9**	**16**	**16**	**5**	**5**	**8**	**69**	**8.5**
Oulema melanopus	**6**	**1**	**1**					**8**	**1.0**
Chaetocnema aridula	**24**	**4**	**9**	**3**	**4**	**3**	**42**	**89**	**11.0**
Cicads (Javesella,Psammottetix)	**3**	**7**	**3**	**6**	**3**	**3**	**1**	**26**	**3.0**
Aphids (Sitobion avenae etc.)	**2**	**1**	**13**	**10**	**32**	**26**	**3**	**87**	**10.7**
Thrips (Haplothrips tritici)	**0**	**0**	**3**	**335**	**68**	**96**	**17**	**519**	**63.8**
Bugs (Eurygaster, Aelia)	**2**	**0**	**3**	**3**	**3**	**2**	**3**	**16**	**2.0**
ENTOMOPHAGOUS									
Aranea	**2**	**4**	**16**	**2**	**25**	**13**	**19**	**91**	**48,0**
Hymenoptera	**3**	**10**	**10**	**16**	**16**	**12**	**2**	**66**	**35,0**
Nabidae		**1**	**1**	**2**	**11**	**1**	**0**	**17**	**9,0**
Cantharidae				**2**	**2**			**4**	**2.0**
Malachiidae				**3**	**2**			**5**	**3,0**
Coccinellidae				**1**	**2**			**3**	**1,5**
Chrysopidae				**1**	**1**			**2**	**1.0**
Syrphidae					**1**			**1**	**0,5**

Tab. 38.1.

Dynamics of wheat pests and entomophagous in ploughing, conventional soil tillage technology. ARSD Turda 2008

Nr. /100 filetari duble/ Data. Nr./100 sweepnet catches	**24. 03**	**31. 03**	**14. 04**	**14. 05**	**27. 05**	**30. 05**	**03. 06**	**11. 06**	**25. 06**	**03. 07**	**Total**	**%**
PHYTOPHAGOUS												
Haplothrips tritici				23	183	106	6	17.	84.	74	493	41.0
Meromyza				2			4	2			85	7.0
Oscinella, etc	2	1		3		2	2	4				
Opomyza, Delia						1		5				
Phorbia	1	6	20	27	3							
Oulema melanopus						6				4	10	1.0
Chaetocnema aridula	3	2	2	9	2					37	55	4.5
Phyllotreta vitulla	5	10		18							33	2.6
Sitobion avenae etc.				4	70	119	158	78	22	23	474	39.0
Macrosteles	1	1	1	4					1.		21	1.7
Psammottetix						1	1	8				
Javesella										3		
Eurygaste, Aelia				3	5	12	1	5			29	2.4
Trygonothylus				1	2							
Cephus, Trachelus					1	2		1			4	0.3
Curculionidae etc.				4	1	1					6	0.5
ENTOMOPHGOUS												
Aeolothripidae									6	20	26	10.0
Coccinellide				1	1						2	1.0
Cantharidae				17							17	7.0
Malachiidae					3	1	2				6	2.3
Nabidae						2				1	3	1.2
Chrysopidae							2	6			8	3.0
Syrphidae					1			4			5	2.0
Empididae (Platypalpus)					2	7	9	7	1		26	10.0
Thaumatomyia								4			4	1.5
Hymenoptere-paraziti				13	8	6	3	8	2	4	44	17.0
Formicidae				2	3	4			3	32	44	17.0
Aranea				3	3		2		36	28	72	28.0

Tab. 38.2.

Dynamics of aphids and cicads of spontaneous grasses from terrases embankment soil (T) and of volontier wheat fields (M), in the 2008 summer time, in no-ploughing, conservative minimum tillage technology (a-adults, l.-larvae)

Data	**6. 08.**		**13.08**		**26.08**		**1.09**		**9.09**		**25.09**		**1.10**		**20.10**	
Variante	**M**	**T**	**M**	**T**	**M**	**T**	**M**	**T**	**M**	**T**	**M**	**T**	**M**	**T**	**M**	**T**
Schizaphis graminum	13	3		3	-	1										
Rhopalosiphum padi	2		6		4	12	18	6	14	10					15	2
Macrosteles laevis	1	2			2		5	3			16		24	1	1	1
M. sexnotatus									15	15			23	1	4	1
Psammottetix aliaenus	13	3	11a	9	10a 3.l.		32	1	120 7 l.	10	40a 10.l		20a 4.l.	8	8	3
Phylaenus spumarius	2						2		6		2					
Javesella pellucida	8 a		18 a	1	9 a 7 l.	1.	16		14	4	6 a					
Cicads (Other species)	3	2					3	13	6		2		36	23	13	

Tab. 39.

Dynamics of wheat pests after insecticides treatments, in ploughing-conventional soil tillage technology.
ARSD Turda 2008

Treatment application:30.05.2008	Treatment immediate side effect/after 4days							Insecticide side effect after 12 days.						
Nr./100 sweepnet catches.	**3.06.2008**							**11.06.2008**						
	Mt.	**V3**	**V4**	**V5**	**V6**	**V7**	**V8**	**V1**	**V3**	**V4**	**V5**	**V6**	**V7**	**V8**
PHYTOPHAGOUS														
Tripşi (*Haplothrips tritici)* *adulţi*	**183**	**1**	**5**			**9**	**2**	**17**	**5**		**5**	**3**	**1**	**5**
Diptere (*Meromyza, Oscinella, Opomyza, Delia, Phorbia)*	**34**			**2**	**4**	**7**	**5**	**11**			**1**	**1**	**5**	
Oulema melanopus	**6**		**1**											
Chaetocnema aridula	**9**													
Phyllotreta vitulla	**18**													
Afide (*Sitobion avenae etc.)*	**286**	**8**	**30**	**54**	**40**	**31**	**13**	**78**	**31**	**62**	**85**	**28**	**56**	**17**
Cicade: *Macrosteles, Psammottetix, Javesella*	**5**		**1**			**1**		**8**		**4**	**1**	**1**	**4**	
Eurygaster/Aelia/Trygonothylus	**17**			**1**	**1**	**4**		**5**	**6**	**3**	**4**		**1**	
Cephus/Trachelus	**2**				**1**			**1**						
Lepidoptere si alti daunatori	**4**	**2**	**1**			**1**	**1**	**1**		**2**		**2**		
Total fitofagi	**564**	**11**	**38**	**57**	**46**	**53**	**21**	**121**	**42**	**71**	**96**	**35**	**67**	**22**
Eficacitatea / Efficiency / **%**		**98**	**93**	**90**	**92**	**91**	**96**		**65**	**41**	**21**	**71**	**46**	**82**
Treatment application:30.05.2008	Insecticide side effect after 26 days.							Insecticide side effect after 34 days.						
Nr./100 sweepnet catches.	**25.06.2008**							**3.07.2008**						
	Mt.	**V3**	**V4**	**V5**	**V6**	**V7**	**V8**	**Mt**	**V3**	**V4**	**V5**	**V6**	**V7**	**V8**
PHYTOPHAGOUS														
Thrips(*Haplothrips tritici)larvae*	**84**					**31**	**1**	**74**		**6**			**29**	**4**
Diptera (*Meromyza, Oscinella, Opomyza, Delia, Phorbia)*		**2**	**1**						**4**	**3**	**3**		**4**	
Chaetocnema aridula		**1**	**3**	**2**				**4**	**6**	**4**	**4**	**3**	**8**	**1**
Phyllotreta vitulla				**1**				**37**	**30**	**46**	**36**	**43**	**36**	**13**
Aphids (*Sitobion avenae etc.)*	**22**	**20**	**24**	**8**	**40**	**32**	**7**	**23**	**10**	**32**	**30**	**21**	**25**	**18**
Cicads: *Macrosteles, Psammottetix, Javesella*	**5**	**5**	**2**	**3**		**4**	**4**		**2**	**7**		**5**	**16**	**5**
Eurygaster/Aelia/ Trygonothylus)						**3.**		**3**	**5**	**2**	**7**	**5**	**5**	**3**
Lepidoptera and other pests									**1**	**1**				
Total phytophagous	**111**	**28**	**30**	**14**	**40**	**70**	**12**	**141**	**58**	**101**	**80**	**77**	**107**	**44**
Efficiency **%**		**75**	**73**	**87**	**64**	**37**	**89**		**59**	**28**	**43**	**45**	**24**	**69**

Variante : Mt. (untreated)=V1= (seed whithout insecticidal 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.

Tab. 40.

The side effect of Yunta 246 FS insecticide against auxiliary fauna in wheat classical system. Turda 2008

Variante: V1 - Netratat cu insecticid; V2 –Tratat cu Yunta 246 FS, 2 l/t. (Suma capturilor cu capcane Barber).
V1- untreated; V2-Yunta 246 FS 2 l/t seed treated. (Summe of Barber traps catches).

Data colectării	**29.05**			**24.06**		
Varianta	**V 1**	**V 2**	**Impact negativ %**	**V 1**	**V 2**	**Impact negativ %**
Brachinus explodens	**3**	**1**	**66.7**	**25**	**15**	**40.0**
Poecilus cupreus	**84**	**28**	**66.7**	**250**	**150**	**40.0**
Pseudophonus rufipes				**50**	**30**	**40.0**
Pterostichus melanarius	**12**	**1**	**91.7**	**125**	**75**	**40.0**
Harpalus distinguendus	**2**		**100.0**	**15**	**9**	**40.0**
Dolichus halensis	**17**	**3**	**82.3**			
Sylpha obscura	**10**	**2**	**80.0**	**25**	**15**	**40.0**
Necrophorus vespillo				**10**	**6**	**40.0**
Scarabeus	**2**		**100.0**			
Aranea	**13**	**2**	**84.6**			
Total	**145**	**37**	**74.5**	**500**	**300**	**40.0**

Entomophagous dynamics at wheat plants level, in classical system after Yunta 246 FS treatment, ARDS Turda, 2008.

Variante: V1 - Netratat cu insecticid; V2 –Tratat cu Yunta 246 FS, 2 l/t. (Nr exemplare colectate la 100 filetari-nr./100 sweepnet catches)

Data colectarii	**14.05**		**27.05**	
Varianta	**V 1**	**V 2**	**V 1**	**V 2**
Coccinellide (P. 14- punctata)	**1**		**1**	**1**
Cantharidae	**17**	**2**		
Malachiidae			**2**	**2**
Syrphidae			**1**	
Empididae (Platypalpus)			**2**	
Hymenoptere - paraziti	**13**	**6**	**8**	
Furmicidae	**2**	**3**	**3**	**1**
Aranea	**3**		**2**	**3**
Total entomofagi	**36**	**11**	**19**	**8**
Mortalitatea %		**69**		**42**

Tab. 41.

Wheat entomophagous dynamics after insecticides treatments, in ploughing-conventional soil tillage. ARSD Turda 2008

Treatment:30.05.2008	Treatment immediate side effect/after 4days							Insecticide side effect after 12 days.						
Nr./100 sweepnet catches.	**3.06.2008**							**11.06.2008**						
	Mt.	**V3**		**Mt.**	**V3**		**Mt.**	**V3**		**Mt.**	**V3**		**Mt.**	**V3**
Cantharidae								**4**			**4**			
Malachiidae	**2**				**1**									
Nabidae	**2**													
Chrysopidae	**2**	**1**						**6**						
Syrphidae	**1**		**1**					**4**	**2**					
Empididae (Platypalpus)	**9**	**3**	**4**	**4**	**4**	**6**		**1**	**5**	**9**	**1**	**5**	**8**	
Hymenoptere	**5**	**1**	**5**	**1**		**3**	**2**	**19**	**4**	**5**	**16**	**2**	**4**	**9**
Aranea	**2**	**1**	**1**		**1**	**2**								
Total entomofagi	**23**	**6**	**11**	**5**	**6**	**11**	**2**	**44**	**11**	**14**	**31**	**7**	**12**	**9**
Mortalitatea %		**74**	**52**	**78**	**74**	**52**	**91**		**75**	**68**	**30**	**84**	**80**	**80**
Treatment:30.05.2008	Insecticide side effect after 26 days.							Insecticide side effect after 34 days.						
Nr./100 sweepnet catches.	**25.06.2008**							**3.07.2008**						
	Mt.	**V3**		**Mt.**	**V3**		**Mt.**	**V3**		**Mt.**	**V3**		**Mt.**	**V3**
Aeolothripidae	**6**					**1**		**20**	**29**	**21**	**12**	**6**	**4**	**40**
Coccinellidae	**2**			**1**	**1**	**1**		**1**		**1**			**1**	
Cantharidae	**1**				**1**	**1**		**1**			**1**			
Malachiidae								**3**		**3**				
Nabidae	**1**			**1**		**1**		**1**						
Chrysopidae									**1**	**3**	**3**	**1**	**1**	
Syrphidae	**2**				**2**	**1**		**2**		**2**				
Empididae (Platypalpus)	**1**		**4**	**2**	**4**	**4**	**1**	**3**		**3**			**2**	**1**
Hymenoptere	**5**	**5**	**15**	**13**	**3**	**8**	**10**	**37**	**48**	**39**	**40**	**21**	**21**	**22**
Aranea	**30**	**10**	**7**	**9**	**7**	**22**	**10**	**28**	**22**	**33**	**33**	**38**	**46**	**39**
Total entomofagi	**48**	**15**	**26**	**26**	**18**	**39**	**21**	**96**	**110**	**103**	**89**	**66**	**75**	**82**
Mortalitate %		**69**	**46**	**46**	**63**	**19**	**56**		**/**	**/**	**7**	**31**	**22**	**15**

Variantele : Mt. **netratat** (untreated)=V1=**fără tratament cu insecticid la sământă** (seed whithout insecticidal treatment); V2=**Sământă tratată cu insectofungicidul** (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. SCDA Turda, 2008.***

Tab. 42.

Effect of insecticide treatments in the wheat flag-leaf stage application (Ariesan variety),AESD Turda, 2008

	Aphids/ear. /11.06.2008			**Kg / ha**			TGM		
Treatments.	**Media**	**%**	**Difer.**	**Media**	**%**	**Difer.**	**Media**	**%**	**Difer.**
Netratat. Untreated.	**2.50**	**100**	**martor**	**5456**	**100**	**martor**	**45.100**	**100.0**	**martor**
Yunta 246 FS, 2 l/t TS	**2.50**	**100**	**0.00**	**5650**	**104**	**194**	**45.800**	**101.5**	**0.700**
Cylothrin 60 CS 80 ml/ha	**0.20**	**8**	**- 2.30**	**6850**	**126**	**1394 *****	**50.167**	**111.2**	**5.067 *****
Alphamethrin 10CE 100ml/ha	**0.60**	**24**	**- 1.90**	**7170**	**131**	**1714 *****	**48.567**	**107.7**	**3.467 *****
Decis 25 WG 0,030 Kg/ha	**0.40**	**18**	**- 2.05**	**6793**	**125**	**1337 *****	**48.000**	**106.4**	**2.900 *****
Proteus OD 110 400 ml/ha	**0.50**	**20**	**- 2.00**	**5990**	**110**	**534 ***	**50.377**	**111.7**	**5.277 *****
Calypso 480 SC 100 ml/ha	**5.35**	**214**	**2.85**	**6150**	**113**	**694 ***	**45.067**	**99.9**	**-0.033**
Grenade SYN 75 ml/ha	**0.05**	**2**	**- 2.45**	**5540**	**102**	**84**	**49.267**	**109.2**	**4.167*****
DL p 5%			3.171		9.2	503.5		2.7	1.237
DL p 1%			4.396		12.8	687.9		3.8	1.715
DL p 0.5%			6.107		17.7	969.5		5.3	2.383
270 l solutie/ha	F= 3.09(2.76)			F= 15.9 (2.76)			F=29.13 (2.76)		

Tab. 43

Gluten, protein and cinder content of wheat grains of Ariesan variety by the insecticide treatments in flag-leaf stage application/ May the 30-th 2008, ARDS Turda.

	Gluten	**Protein**	**Cinder**
Treatments.	%	%	%
Untreated.	**19.40**	**9.45**	**1.67**
Yunta 246 FS, 2 l/t TS	**21.50**	**9.85**	**1.81**
Cylothrin 60 CS 80 ml/ha	**18.00**	**9.00**	**1.64**
Alphamethrin 10 CE 100 ml/ha	**18.15**	**8.90**	**1.65**
Decis 25 WG 0,030 Kg/ha	**21.10**	**9.45**	**1.79**
Proteus OD 110 400 ml/ha	**18.95**	**10.65**	**1.15**
Calypso 480 SC 100 ml/ha	**18.55**	**10.50**	**1.16**
Grenade SYN 75 ml/ha	**17.80**	**10.30**	**1.13**

Tab. 44.

Abundance of wheat pests and entomophagous after insecticides and application moments in comparative system, ploughing and un ploughing, in 2008.

application moments: **1 (la desprimăvărare**-early spring/28.03.2008-Calypso 480 SC 100 ml/ha; **2 (la erbicidare**7 end of tillering) /14.04.2008 - Calypso 480 SC 100 ml/ha; **3 (la burduf**-flagleaf) /21.05.08-Proteus OD 110 400 ml/ha; **4 (la înflorit)**-flowering /11.06.2008-Proteus OD110 400 ml/ha. ***(nr.exemplare/50 filetări duble).***

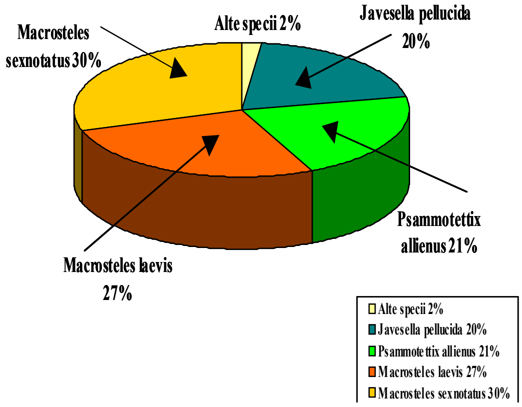
Data colectarii/ collecting data	**1. 28.052008**							
Sistemul tehnologic/ technology	***Cu arătură/*** ploughing system				***Fără arătură/ un*** ploughing system			
Momentul de tratare/data	**Mt.**	**1 / 28.03**	**2 / 14.04**	**3 / 21.05**	**Mt.**	**1 / 28.03**	**2 / 14.04**	**3 /21.05**
FITOFAGI								
Tripşi (Haplothrips tritici-adulti)	**62**	**27**	**14**	**33**	**111**	**76**	**64**	**84**
Diptere total	**2**	**2**				**2**	**2**	**2**
Chrysomelide (Oulema, Chaetocnema, Phyllotreta)	**1**	**1**		**2**		**1**	**4**	
Afide(Sitobion avenae etc.)	**35**	**3**	**4**	**3**	**16**	**6**	**16**	**20**
Cicade (Psammottetix)					**1**		**1**	
Heteroptere (Eurygaster, Aelia)	**4**		**1**		**5**	**1**	**1**	
Hymenoptere (Cephus).								
Total fitofagi	**102**	**33**	**19**	**38**	**133**	**86**	**88**	**106**
Eficacitatea %		**67.6**	**81.4**	**62.7**		**35.3**	**33.8**	**20.3**
ENTOMOFAGI								
Coccinellide	**1**				**1**			
Cantharide			**1**		**0**			
Malachiide	**2**	**1**	**2**	**1**	**1**	**2**		**2**
Nabide		**1**			**2**			
Syrphide	**1**				**2**	**1**		
Empidide (Platypalpus)	**1**	**3**	**1**		**1**	**1**	**2**	**2**
Hymenoptere parazite	**4**				**12**		**1**	**6**
Hym. Formicidae	**2**				**3**			
Chrysopidae					**1**			
Aranee	**2**	**3**			**1**	**3**		**2**
Total entomofagi	**13**	**8**	**4**	**1**	**24**	**7**	**3**	**12**
Mortalitatea %		**38.5**	**69.2**	**92.3**		**70.8**	**87.5**	**50.0**

Tab. 44 continuare

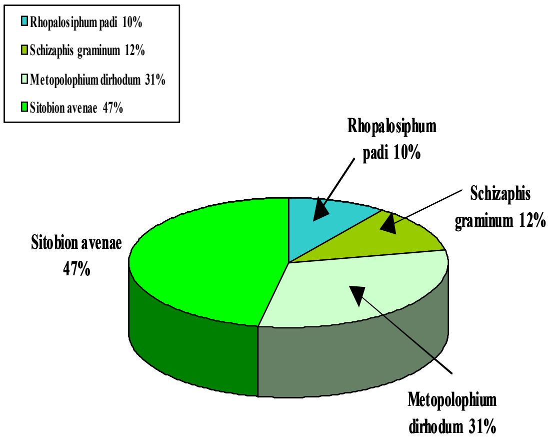
Abundance of wheat pests and entomophagous after insecticides and application moments in comparative system, ploughing and un ploughing, in 2008.

Momente de aplicare-application moments**: 1 (la desprimăvărare**-earlz spring/28.03.2008-Calypso 480 SC 100 ml/ha; **2 (la erbicidare**7 end of tillering**)** /14.04.2008 - Calypso 480 SC 100 ml/ha; **3 (la burduf**-flagleaf**)** /21.05.08-Proteus OD 110 400 ml/ha; **4 (la înflorit)**-flowering /11.06.2008-Proteus OD110 400 ml/ha. ***(nr.exemplare/50 filetări duble).***

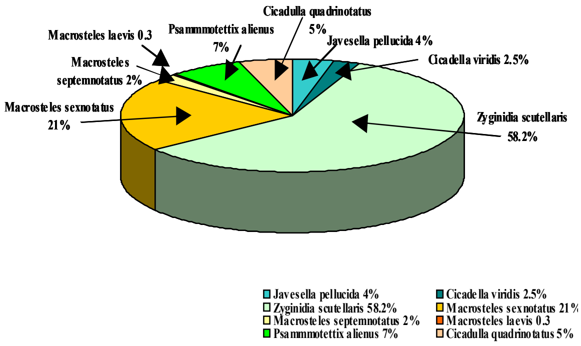
2. Data colectarii / collecting data	**4.06.2008**									
Sistemul tehnologic / technology	**Cu arătură**/ ploughing system					**Fără arătură** / un ploughing system				
Moment de tratare/ insecticid/ data	**Mt.**	**1 /28.03**	**2 /14.04**	**3 /21.05**		**Mt.**	**1 /28.03**	**2 /14.04**	**3 /21.05**	
FITOFAGI										
Tripşi (Haplothrips tritici)	**3**	**7**	**6**	**3**		**0**	**10**	**6**	**30**	
Diptere total	**3**					**7**				
Chrysomelide (Oulema, Chaetocnema, Phyllotreta)						**2**				
Afide(Sitobion avenae etc.)	**80**	**2**	**36**			**72**	**6**	**8**	**40**	
Cicade (Psammottetix)	**1**	**1**	**2**	**1**		**1**	**2**			
Heteroptere (Eurygaster, Aelia)	**1**	**1**	**1**			**4**	**4**	**1**	**2**	
Hymenoptere (Cephus).						**1**	**1**			
Total fitofagi	**88**	**101**	**45**	**4**		**87**	**23**	**15**	**72**	
Eficacitatea %		**-**	**49**	**95.5**			**73.6**	**82.8**	**17.2**	
ENTOMOFAGI										
Malachiide	**1**	**1**	**2**			**1**			**1**	
Nabide						**2**				
Syrphide									**1**	
Empidide (Platypalpus)	**5**	**2**	**5**			**4**		**2**	**8**	
Hymenoptere parazite	**2**						**2**	**2**	**1**	
Hym. Formicidae						**11**				
Chrysopidae	**1**					**1**				
Aranee	**1**	**3**	**1**			**1**				
Total entomofagi	**10**	**6**	**8**	**0**		**20**	**2**	**4**	**11**	
Mortalitatea %		**40.0**	**20.0**	**100.0**			**90.0**	**80.0**	**45.0**	
3. Data colectarii	**26.06.2008**									
Sistemul tehnologic	**Cu arătură**					**Fără arătură**				
Momentul de tratare/ insecticide/data	**Mt.**	**1 /28.03**	**2 /14.04**	**3 /21.05**	**4 /11.06**	**Mt.**	**1 /28.03**	**2 /14.04**	**3 /21.05**	**4 /11.06**
FITOFAGI										
Tripşi (Haplothrips tritici-larve)	**42**	**2**	**5**	**22**	**1**	**59**	**5**	**5**	**36**	**8**
Diptere total										
Chrysomelide (Oulema, Chaetocnema, Phyllotreta)	**20**									
Afide(Sitobion avenae etc.)	**11**	**2**	**7**	**2**	**14**	**8**	**15**	**10**	**3**	**1**
Cicade (Psammottetix)	**2**				**1**				**1**	**1**
Heteroptere (Eurygaster, Aelia)		**1**								
Hymenoptere (Cephus).										
Total fitofagi	**75**	**5**	**12**	**24**	**16**	**67**	**20**	**15**	**40**	**10**
Eficacitatea %		**93.3**	**84.0**	**68.0**	**78.7**		**70.1**	**77.6**	**40.3**	**85.1**
ENTOMOFAGI										
Coccinellide								**1**		
Nabide	**1**				**1**					
Syrphide										**1**
Empidide (Platypalpus)	**1**				**2**		**2**	**4**	**1**	**1**
Hymenoptere parazite	**3**	**4**		**3**			**10**			
Hym. Formicidae	**17**					**8**				
Chrysopidae										
Aranee	**18**			**8**	**3**	**8**	**4**	**2**	**5**	**6**
Total entomofagi	**40**	**4**	**0**	**11**	**6**	**16**	**16**	**7**	**6**	**8**
Mortalitatea %		**90.0**	**100.0**	**72.4**	**85.0**		**+**	**56.3**	**62.5**	**50.0**



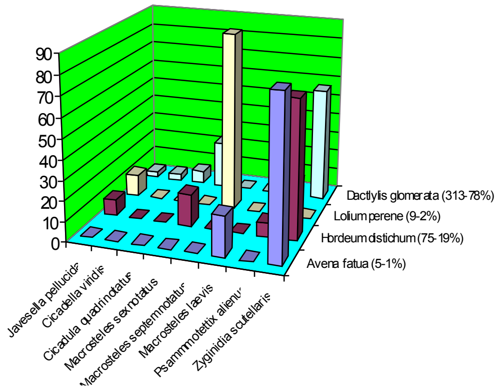
Structure of cicads species
in winter wheat crops, A.R.D.S.Turda



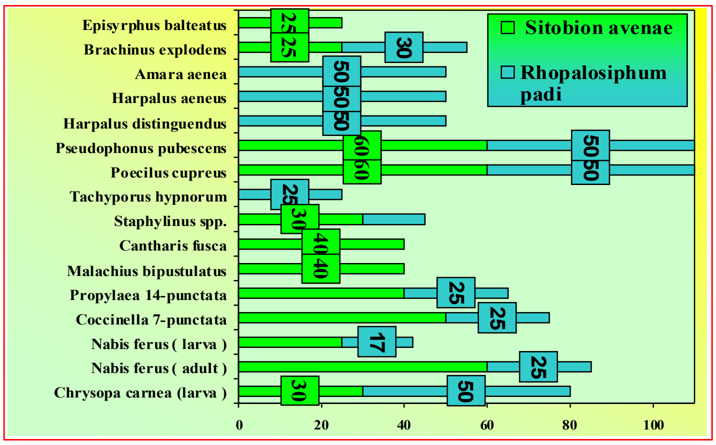
Structure of aphids species
in winter wheat crops, A.R.D.S.Turda



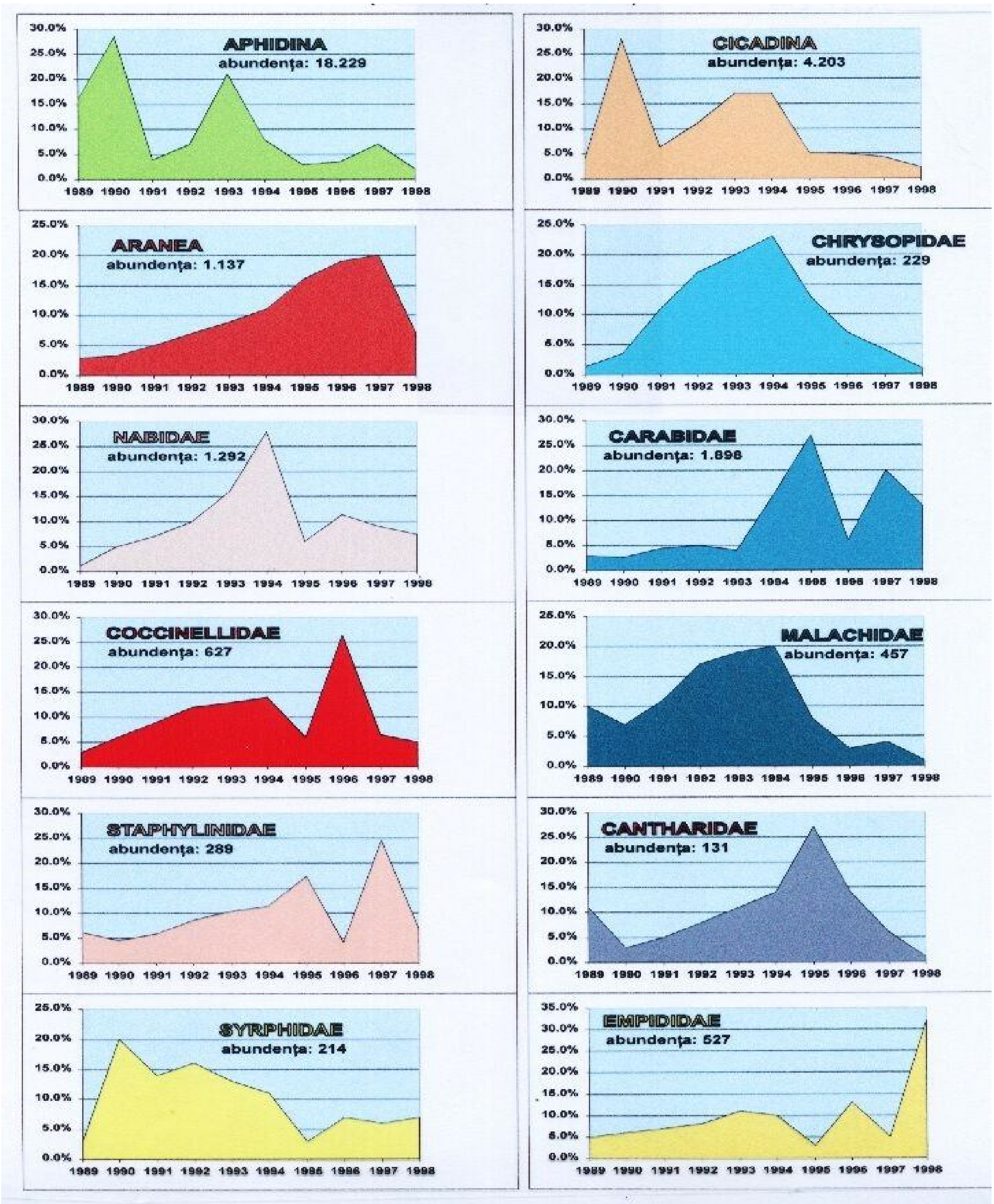
Structure of cicads species
of gramineae, meadows, marginale herbs
(Turda, Cluj).



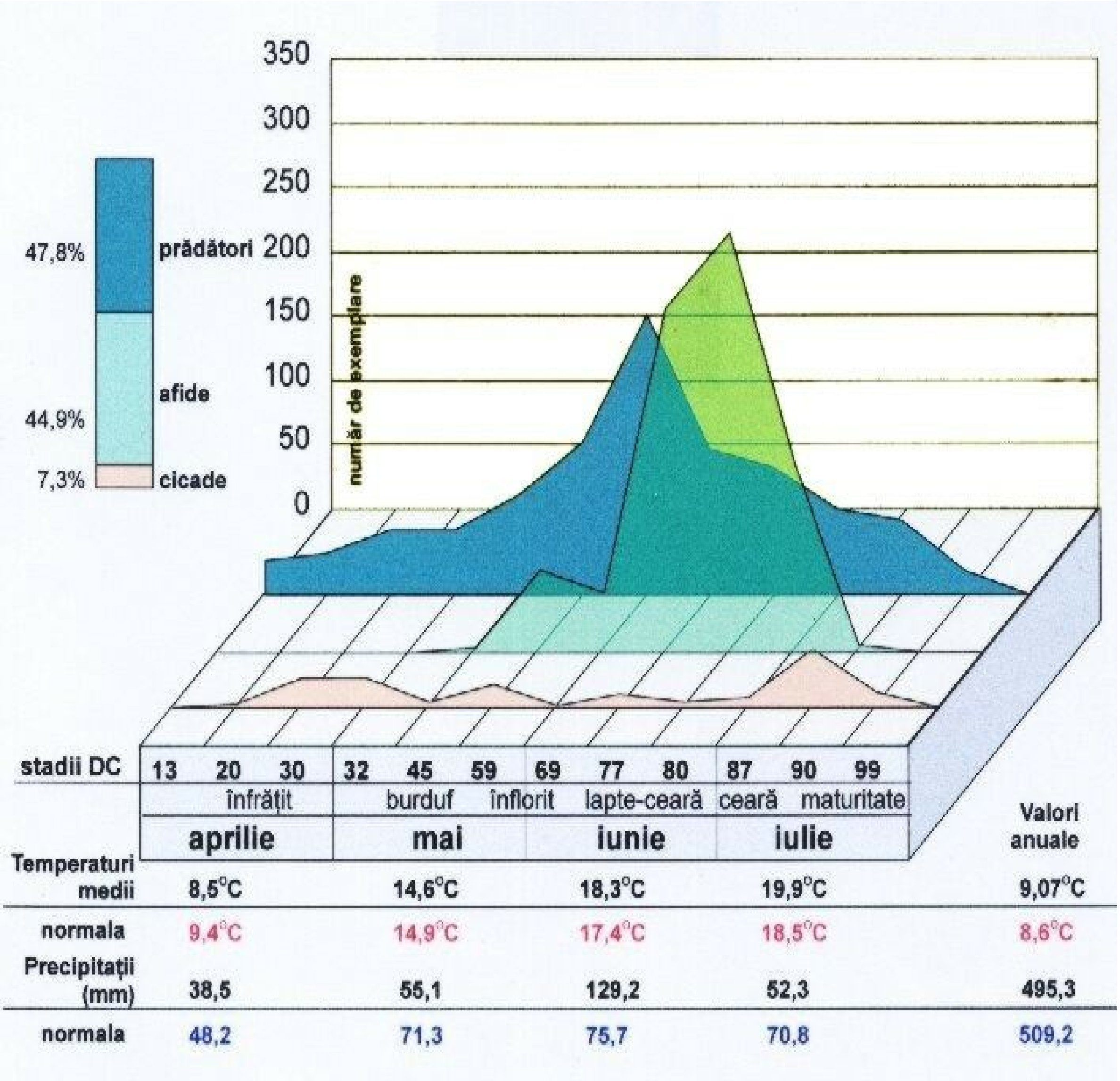
Percentual dyspersion of cicads species on
gramineae, meadows and marginale herbs
(Turda, Cluj).



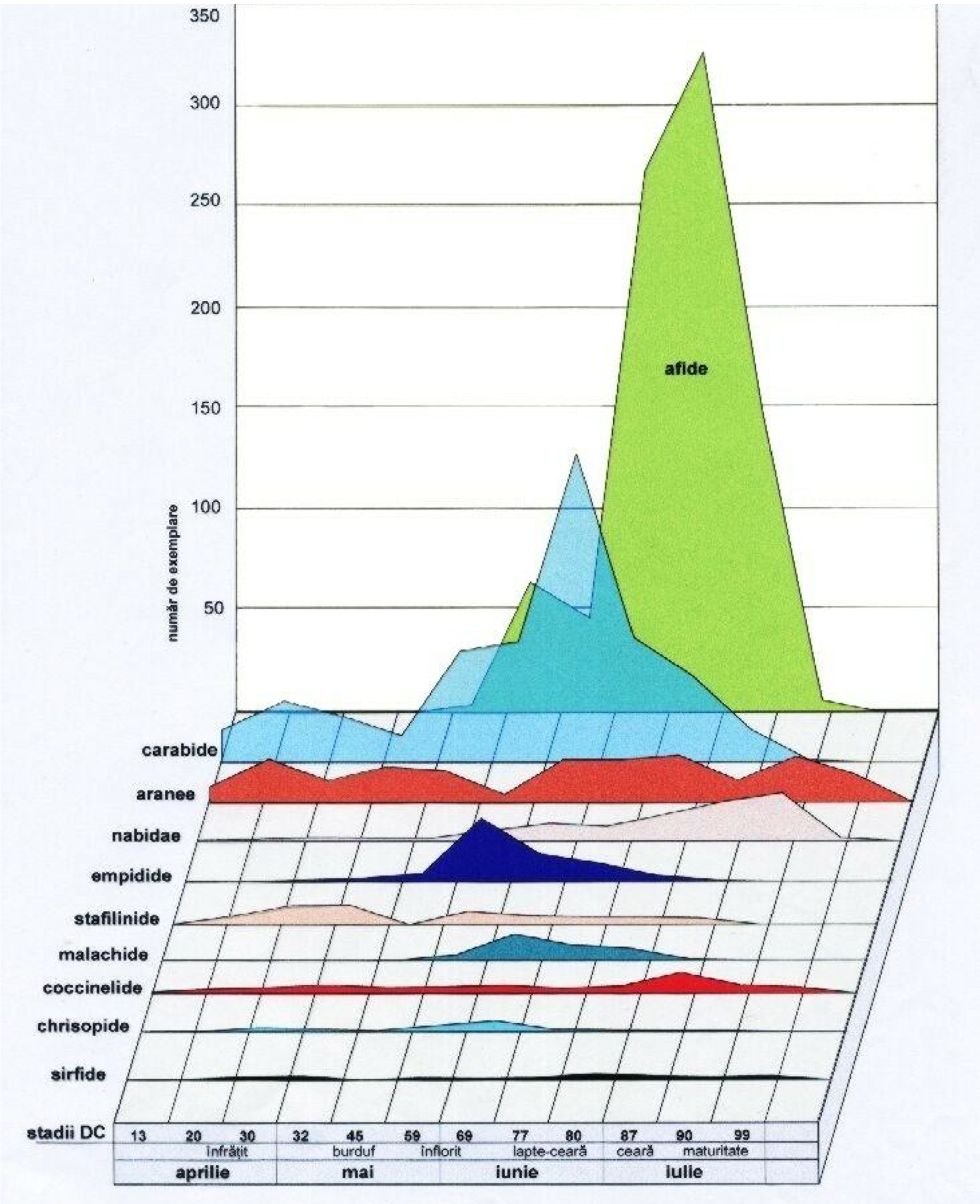
Predators feeding rate on aphids, laboratory trials (consumed aphids number/day/individual predator).



Populations dynamics of aphids and entomophagous predator in wheat crops (1989-1998, A.R.S.Turda).

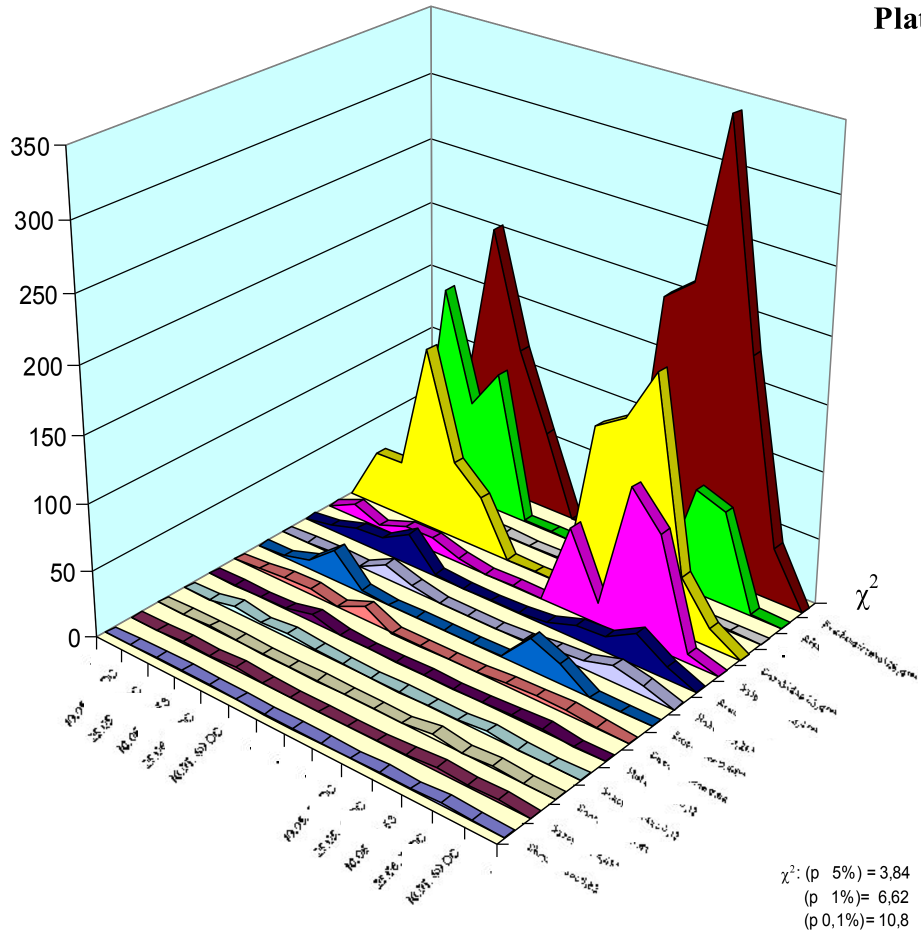


Aphids, cicads and entomophagous predators development in winter wheat crops of Transylvanian vegetation and climate conditions (april-July, 1995-1998, A.R.S.Turda).

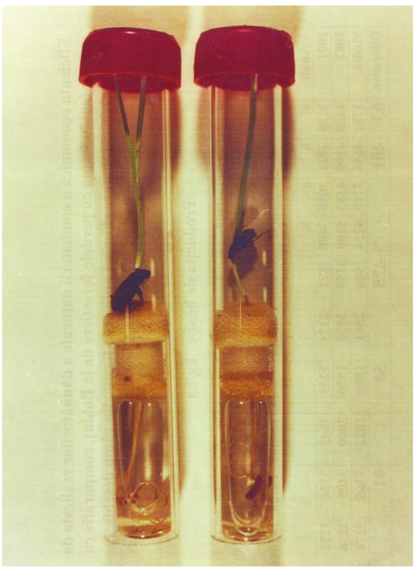


Dynamics of aphids in interrelation with their predators in winter wheat crops of Transylvania, 1995-1998, A.R.S.Turda.

Plate 23



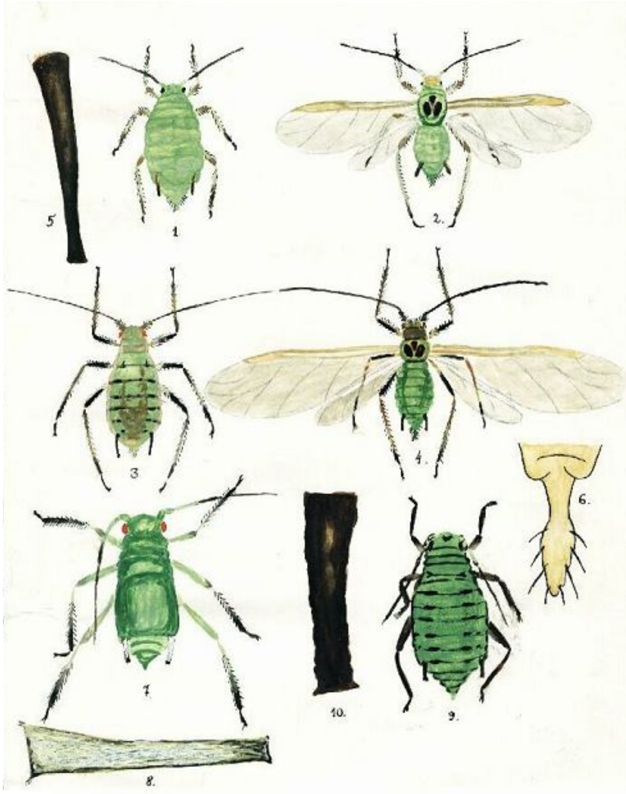
Abundance and dynamics of aphids and their predators in two wheat crop systems, in open field area and with agroforestry belts (1997-1999, A.R.S.Turda).



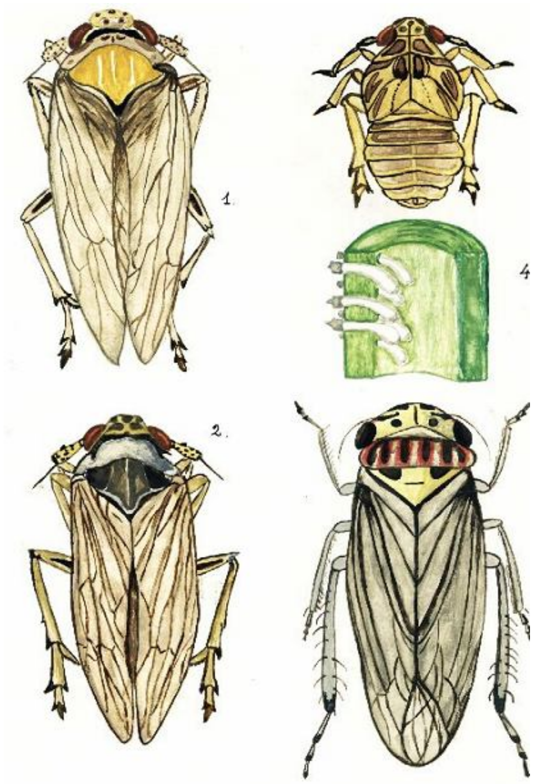
Micro cages for the study of feeding ration of aphidophagous predators, in laboratory trials

Wheat ear with aphids and aphidophagous coccinellidae.

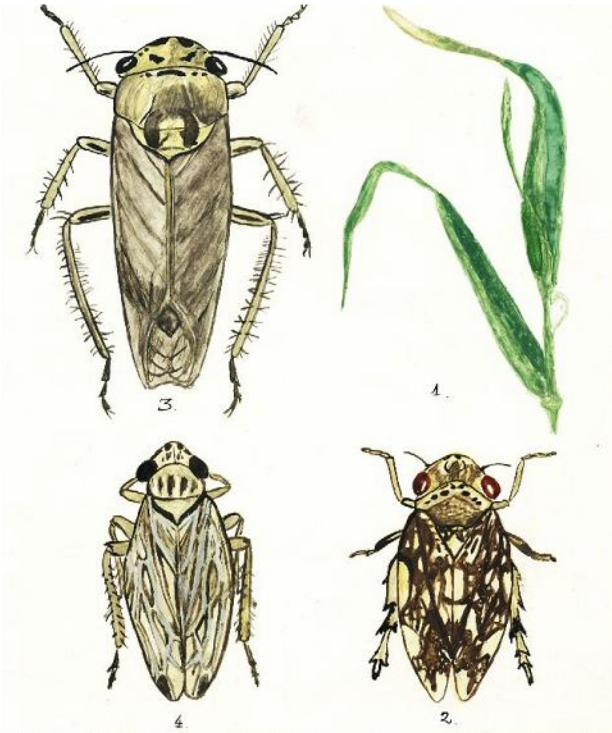
Plate 24



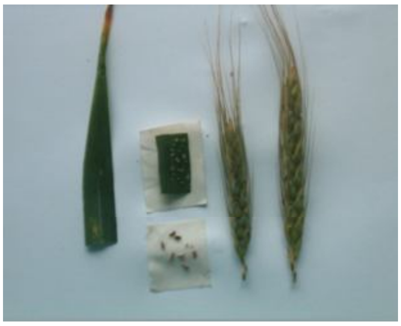
1.-2. *Schizaphis graminum*, femelă nearipată şi aripată;
3.-4. *Sitobion avenae*, nearipată şi aripată, 5. cornicol ,6.- cauda ;
7.- *Metopolophium dirhodum*, femelă nearipată, 8. cornicol;
9.- *Rhopalosiphum padi*, femelă nearipată, 10.-cornicol.



- *Javesella pellucida*, femelă 2.- mascul; 3.- larvă , 4.
- *Psammotettix allienus*, adult, (după Benada, 1967).



1.-2. *Philaenus spumarius*, Plantă de grâu atacată de larvă şi adult;
3. *Macrosteles sexnotatus*, şi 4. *Macrosteles laevis*, (adulţi).
(după Benada, 1967)



Cicade şi afide pe frunze şi spice de grâu.
Cicads and aphids on the wheat leaves and ears

Plants affected by yellowing and dwarfing simptoms

4.1.2. Phytophagous diptera. Identifying and controlling wheat pest species

4.1.2.1. Cereal flies–a pest complex dangerous to small grain cereals

Cereal flies are a varied group of pest species of systematic, faunistic, and especially applicative interest for the agricultural research and practice because only by understanding pest species adequate control measures can be taken. The elaboration of the integrated pest control management system has particularities related to the presence of attack differences, biology and ecology within the variety of the species making up the diptera group in the cereal crops.

The diptera group gathers and attacks cereal crops in different periods permanently due to the sequence and overlap of the attack coming from other species, each having the biological cycle staggered differently during the vegetation stages, from germination-emergence or the emergence of the first leaves and tillers until the ear and grain formation, in contrast with other pests which attack during certain predictable periods and precise vegetation stages.

Attack prognosis has been achieved by establishing the attack potential based on probing repeated in September, October, April, Mai, June. This consists of larvae, pupa and adults analysis obtained from the attacked plants and the flies captured from the crops with the sweepnet catches or on white glued boards.

In accordance with the bioecology of several diptera species which show a permanent biological potential, their damages are major and certain, especially in the first stages of crop vegetation, when the main attack prevention measures such as: avoiding monoculture, avoiding early September sowing have not been followed.

Seedlings and germinating seeds can be destroyed by the grey flies larvae *Delia platura, D. liturata*. The plants emerged in September can be completely destroyed, even before tillering, by the chloropidae complex - *Oscinella*, *Elachiptera, Meromyza, Chlorops, Lasiosina* etc., by the wheat black fly-*Phorbia securis,* by the seedcorn maggot-*Delia platura*, and especially the Hessian fly, *Mayetiola destructor*, which permanently resides in nature on spontaneous and cropped gramineae, being a considerable danger.

Right after the emergence of winter wheat, *Opomyza florum* focussing the crops with a maximum occurrence in mid October and lay the eggs at the plant base where it winters. The eggs of the species *Delia coarctata* – the wheat bulb fly - also winter in the ground, already laid in July-August.

Sometimes in very early spring (February-March) after the first days with stable mean temperatures of 6^{o}C, when the coltsfoot-*Tussilago farfara*-blossoms, the attack of *Opomyza* and *Delia coarctata,* and the presence of the *Phorbia* fly have been recorded.

During this period the main stem and side tillers are usually destroyed, the tillering-stage crops suffering from a severe redustion of plant density and development. The attack of the *Phorbia* flies larvae will be seen later, in April-May. The plants tillered in spring could be damaged, and the crops calamited, especially when the attacks of the above mentioned species overlap.

In April, the spring flying and attack of the chloropidae and Hessian flies also occur, the younger stems and side tillers being damaged. During rainy springs, the spread of wheat yellow midges-*Contarinia tritici* and saddle gall midges-*Haplodiplosis equestris* affecting the wheat ear has also been favored. As successive generation, the Chloropidae attack in June-July affecting the ears, and the biological reserve grow during the following period, occurring on corn, forage gramineae, grasses and lawns, samulastra.

In areas with a significant biological reserve of cereal diptera the following preventive measures have been suggested: a later sowing date that is the first half of October, adequate technological measures to ensure a proper plant growth; sowing wheat varieties with productive tillering compensating capacity after attack; seed insecticide treatment.

The preventive treatments applied on seeds have shown a partial efficiency of 56-77%.

The experimental researches on the use of insecticides in cereal flies special control under the conditions of Transylvania have approached the study of biological efficiency and optimal selective application timing for several insecticides such as organophosphorous, organochloric, carbamate, pyrethroids etc.

The treatments on vegetation have been carried out in April, at the maximum efficiency timing for 1^{st} age larvae of *Opomyza florum* and *Delia coarctata,* and for the adults of *Phorbia securis* and *Ph. penicillifera* simultaneously, when their occurrence have been noticed.

Different insecticides experimentally tested have achieved partial larvae mortality of only 50-66% as a consequence of the presence of many diptera pests species, in different stages of their biological cycle and the parasitary feeding habits of the larvae inside the attacked stems. Spring treatments used for diptera special control have been hard to carry out at the optimal time due to regional climate conditions and other species' staggered attacks in the crops. The insecticide-containing products such as fipronil (Regent 200 SC-90 ml/ha), fenoxycarb (Insegar 25 WG-300g/ha), bensultap (Victenon 50 WP-400g/ha), acetamiprid (Mospilan 20 SP-100g/ha), mixtures of pyrethroids and organophosphorous (Enduro 258 EC-1500ml/ha, Sinoratox Plus–1800 ml/ha, Alpha-Combi 26,25EC, 500-1000 ml/ha), have ensured significant yield increases of 107-112%, protecting the crops against diptera and other pests (aphids, cycads, thrips, Oulema, mites etc.)

As a **conclusion,** the understanding of the systematic, biological and ecological knowledge has proved essential in order to recommend an integrated control system of the main diptera species in small grain crops.

This integrated control system should be a synthesis of the means involved, first of all the biotechnical factors favorable to plant protection against diptera pests such as: optimal regional agrotechnical measures; high after-attack compensatory capacity; preventive plant protection measures (late sowing, in the first half of October and the special chemical control applied on seed and vegetation in the cereal areas with dangerous damaging potential of the main diptera species: wheat bulb fly (*Delia coarctata)*, yellow cereal fly *(Opomyza florum)*, *Phorbia*-black flies, frit fly (*Oscinella frit)*, Hessian fly and others.

4.1.2.2. Structure, spreading and importance of wheat diptera pests

The group Diptera is very important in the structure of the pests occurring the wheat crops in Romania. The researches regarding the structure and spreading of the diptera species causing serious damages in autumn and spring to wheat crops in Romania have revealed a significant growth of the species populations especially in Transylvania, Moldavia and Oltenia during 1978-1985 (Bărbulescu et al.1973, Mustea et al.1982, Malschi, Mustea, 1992, Malschi 1976, 1980, 1982, 1989).

The increasing damages produced by diptera larvae have been recorded in wheat crops severely affected under unfavorable climate conditions and the exploitation system with incomplete or incorrect crop technologies (Malschi, 1993, 1997, 1998, 2003, Malschi, Mustea, 1996, 1997).

For species identification the correlation between the knowledge regarding morphological, ecological, ethological and geographical criteria is very necessary. Because of the several diptera species attack occurrence, species identification represents an important study, required for the determination of the actual importance of diptera pests, for the damages prevention and the elaboration of the adequate control strategy.

The control of the wheat diptera pest species complex has been an important objective of the researches performed at the Agricultural Research and Development Station in Turda, in Central Transylvania, under the special conditions of the period 1980-2005, when the attack of the main damaging species was increasing.

The studies regarding the structure of phytophagous diptera fauna, their biology and the agroecological aspects relevant to the elaboration of the integrated control system of the main damaging diptera species in wheat have been intensified.

The structure of the wheat damaging diptera species, the importance and spreading of the main species in Romania have been the topic the study carried out during 1978-1985, with the cooperation of the Research Institute for Cereals and Technical Plants Fundulea, the Central Laboratory of Phytosanitary Quarantine in Bucharest and the County Centers of Plant Protection for sample taking. The integrated phytophagous diptera control methods have been teste in field experiments conducted under the cereal agroecosystems of Central Transylvania conditions during 1980-2005 at the Agricultural Research and Development Station in Turda, using optimal regional crop technology. The biological samples have been taken by insect and entomophag capturing using the complex traps methods, including ground recipients, glue adhesive traps and captures from 100 double sweepnet catches, in three repetitions, and also the sample analysis of attacked plants, the establishment of attacked plant frequency, the calculation of attack intensity representing the percentage of larvae-destroyed tillers (the deadheart tillers), and the identification of larvae species extracted from the attacked tillers (boards 25, 26).

Complex multiannual researches on the natural and technological agroecological factors influencing the population evolution and the level of damages caused by wheat phytophagous diptera have been the basis of the integrated management system of this significant wheat pests in Transylvania. Their integrated control has included the use of preventive measures, including natural agrotechnical and ecological factors, the use of natural biodiversity resources, regional varieties tolerance to attack, entomophag limitation etc.

4.1.2.3. Attack dynamics and species abundance

In the last years the increase of pest species abundance in some crops and unexpectedly strong attacks have been caused by specific regional factors such as: multiannual continuous increase of pest biological reserve (table 45); the increase of microclimate aridization and attack virulence; the decrease of small grain cereal fields; agricultural exploitation system using incomplete or incorrect technologies (Malschi, Mustea 1992, Malschi 1976, 1980, 1997, 2003, 2007). The increasing damages caused by diptera larvae have been recorded in the regional cereal crops strongly affected by the unfavorable climate conditions and the agricultural exploitation system. Early emerged seedlings in September has caused the dangerous occurrence of the frit flies *(Oscinella frit L),* the Hessian flies *(Mayetiola destructor Say.)* and the wheat black flies *(Phorbia securia Tiensuu).*The biological potential and early spring attack of the yellow cereal flies *(Opomyza florum F)* and wheat bulb flies *(Delia coarctata Fll.*) increase greatly when wheat emerged in October. On the other hand, late emergence of crops in November has drawn the attack of the *Phorbia penicillifera* Jermy şi *Ph. securis* species in spring, and the development of these populations.

The main species of diptera presented occur within their geographical areal and develop significant biological reserves and attack potential in wheat crops (Board 27).

The ecological factors and agrotechnical methods influence species spreading, compositon and the economic importance of the attack in several cereal regions of the country (Alexandri,1945; Bărbulescu et al.1973; Mustea et al.1982; Malschi 1980,1993,1997,2003,2007).

Adult capturing with the sweepnet catches and the examination of larvae stages in the attacked (destroyed) tillers have revealed the presence of several species in pest structure. Taking in to account species dominance and the damages produced, the most relevant species belong to the followinf families: *Opomyzidae, Anthomyiidae, Chloropidae şi Cecidomyidae.* Autumn infestation has been caused especially by *Oscinela frit, Phorbia securis, Delia platura Mg., Mayetiola destructor*. The most significant attack has been performed by *Opomyza florum, Delia coarctata, Phorbia penicillifera şi Ph. securis* at the beginning of spring. (Board 28).

4.1.2.4. Species description

Fam. OPOMYZIDAE: *Opomyza florum* F. has 1 generation / year: the adult (3,5 mm, body dominant color is brown), June-November; the egg (0.6 mm), October -**[ ]**- April in the ground near coleoptile; larva (7 mm), April; pupa (5 mm), May, in the attacked tillers.

Fam. ANTHOMYIIDAE: *Delia coarctata* Fll. has 1 generation / year: the adult (7 mm, body dominant color is grey), June-September; the egg (1 mm), August -**[ ]**- March, in the ground; larva (8 mm), March-April; pupa (7 mm), April-May, in the ground.

Delia platura Mg. has 3-4 generations / year; the adult (6 mm), body dominant color is grey, April-October; the egg (1 mm), in the ground; larva (8 mm); pupa (6 mm), in the attacked tillers or in the ground.

Phorbia securis Tiensuu has 2 generations / year: the adult (5 mm, body dominant color is black), April-May, August-September; the egg (1,14 mm), April-May, September, on coleoptile; larva (7,5 mm), May, September; pupa (5,5 mm), Mai -**[ ]**- August, October -**[ ]**- March, in the ground.

Phorbia penicillifera Jermy has 1 generation / year: the adult (4-5 mm, body dominant color is black), March-April; the egg (1,14 mm), April, on coleoptile; larva (6mm), April-May; pupa (5 mm), Mai -**[ ]**- March, in the ground. (Board 29).

Fam. CHLOROPIDAE*:* *Oscinella frit* L. and *Oscinella pusilla* Mg. have 5-6 generations/ year: the adult (2.5 mm, body dominant color is black-brown), April - October; the egg (1 mm), under the sheath of the first leaf of the seedling and tillers, on the ear; larva (4.5 mm); pupa (3 mm), in the plant at the attack site.

Chlorops pumilionis Bjerk. has 2 generations / year: the adult (3.5 mm, body dominant color is yellow), May-June, July-September; the egg (1 mm), in the upper leaf top; larva (6mm), June, September **-[ ]-** May, in the stalk under the spike, at stem base. (Board 30).

Elachiptera cornuta Fll. has 3-4 generation/year; the adult (3 mm, body dominant color is black-brown), April-May, September; larva (5 mm) at the stem base, in young plants; pupa (4 mm), at the attack site.

Lasiosina cinctipes Fll. has 2 generations / year: the adult (3 mm, body dominant color is yellow), May-June, July -September; larva (5 mm), June, in spiklets, September **-[ ]-** Mai, in seedlings; pupa (5 mm), May, July, at the attack site.

Meromyza nigriventris Macq. has 2 generations / year: the adult (4 mm, body dominant color is yellow), May, July-September; the egg (1 mm), June, September, on the upper leaf; larva (6 mm), April, September, in ear flowers, at the ear and seedling base; pupa (6 mm) May, July, at the attack site. **(Board 31).**

Fam. CECIDOMYIDAE: *Mayetiola destructor* Say. has 3-4 generations / year: the adult (2.5-3.5 mm, body dominant color is brown), April, June, (August), September; the egg (0.6 mm), on the upper side of the main leaf; larva (4 mm), under leaf sheath; pupa (4mm), May, June, (August), September **-[ ]-**April, at the attack site or in the ground.

Contarinia tritici Kyrby has l generation / year: the adult (3 mm, body dominant color is yellow), June; larva (2 mm), June, in the ear flowers or on the grains, July -[ ]- May, in the ground; pupa (1.5 mm), May, in the ground.

Abbreviations: **-[ ]-** = hibernal or aestival diapause (Board 32).

4.1.2.5. The importance of phytophagous diptera attack in small grain cereals in Transylvania. For the useful information of the practitioners interested in the integrated protection of cereal crops and in solving the problems related to pest control, we need to emphasize that presently cereal flies represent an extremely dangerous pest group with high attacking potential, especially in Central Transylvania. The overlapped attack of the diptera species complex on small grain cereals represents an important risk-factor for the crops which leads to significant yield losses especially under unfavorable agroecological conditions marked by critical periods of draught, heat, technological deficiencies with and increased biological pest reserve within their geographical areal and ecological optimal conditions. We need to mention here the scientific literature references regarding the generalized attack situations recorded in the country caused by the Hessian fly (Alexandri A.V., 1945), or the compromised crops and the significant damages caused by the diptera attack on wheat in the last decades

(Perju T, 1961; Perju T, Peterfy Fr., 1968, 1970; Peiu M., Peterfy Fr.,1967, Mustea D., Tătaru V., 1971, 1973, Bărbulescu Al., Mustea D., Emilia Baniţă, Popov C., 1973; Mustea D., Perju T., Bilaus I. Tîmpeanu I, 1982; Dana Malschi, 1980, 1993, 2003, 2004).

The influence of sowing on the attack of diptera species complex

1. Autumn cereal sowing and emergence (wheat, barley, rye etc.) in September may lead to the generalized attack caused by the complex of chloropids species (*Oscinella, Meromyza, Elchiptera etc*), by anthomyiids (*Phorbia securis, Delia platura*), by Hessian fly (*Mayetiola destructor*) etc. which attack in autumn, and also to much more dangerous attack of the species which only attack in early spring, but infest autumn crops, laying the eggs at the stem base in the ground right after the emergence of the seedlings (*Opomyza florum*), and laying eggs in the ground (*Delia coarctata*), sheltered by the previous crops (monoculture of smal grain cereals, beans, peas, soybean, potatoes, corn crops etc.).

2. Consequently, it has been established that the sowing period should be adapted in the first half of October, around 10-15th, in order to avoid this peril of crop infestation with the mentioned species. Moreover, this period of optimal sowing time in Central Transylvania has provided protection against the attack of aphid and cycad species, as vectors of pathogenic agents causing plant yellowing and dwarfing starting in autumn and continuing to spread in spring when causing plant yellowing, dwarfing, withering and sterility during April-May-June

3. It has also been established that sowing delay until November due to several agroecological causes has lead to poor plant growth and resistance, especially to the preferential and damaging attack of the diptera species that fly and infest spring crops (black flies – *Phorbia penicillifera, Ph. securis*; seed corn fly - *Delia platura;* frit fly - *Oscinella frit* and other chloropides, the Hessian fly etc.), flea beetles - *Chaetocnema aridula* (which damages inside the stem as larvae, in a similar way as the fly larvae).

In early spring the larva attack coincides and overlaps on that of the species that have infected the crops in autumn.

Symptoms description of the diptera attack. Many species of diptera represent potential dangers due to their significant regional biological reserves and to the attack mode, in several successive stages of wheat growth in accordance with their biology (table 47). Consequently, at a careful observation of crop plants the symptoms of the diptera attack hav been more than obvious even if in some springs plant vegetative growth and good tillering of wheat hinder the diptera attack, and even if in early spring the agroecological conditions have not been favorable to fly flying and to an easily noticeable virulent attack.

The stems attacked by the diptera larvae have the central leaf withered, yellowed and sheath-loose, while the plants destroyed by the diptera and completely withered remain small, get loose from the ground and disappearent.

After the spring attack of the diptera larvae, the specific reaction of the attacked wheat plants has been a stimulation of compensatory tillering in each plant due to the tiller loss caused by the larva, which lead to late new tillers formation, remaining smaller until harvesting and with a reduced grain yields compared to the normal wheat tillers.

Thus, during the earing stage, three levels of ear height could be recorded in wheat crops: 1-The normal level of the ears from main and secondary tillers in the non-attacked plants, producing normal grain yields; 2-the shorter level of the ears from secondary tillers of the plants attacked by the diptera, saved after the attack, which yield poorer; 3-the very short ear level from the late compensatory tillering simulated after the diptera attack; these ears produce a poor grain yield and a late ripening, staying green at harvest time.

After the attack occurring late in spring caused by the larvae of *Chlorops pumilionis, Meromyza nigriventris* species located at the ear base above the last node, the ear has remained sterile and withered, while the attack of the larvae of *Contarinia tritici, Oscinella frit* species, after heading has destroyed ear flowers and spikelets.

4.1.2.6. The integrated diptera species control

The researches for the elaboration of the integrated cereal flies control strategy performed under the present conditions have taken into account the fact in high temperature springs in the last years, the attack periods of the different diptera species have overlapped. Similar symptoms-showing attacks of wheat flea larvae-*Chaetocnema aridula* and the attacks of cereal sun bug adults, especially *Eurygaster maura* and *Aelia acuminata* have also overlapped. At the same time significant species of the other species occur in the crops: cycads, aphids, leaf beetle, thrips etc.

Consequently, it has been important to perform the attack prognosis and to plan the spring treatment which is normally required for the pest complex, diptera included, at the time of herbicide application at the latest, when the warning criteria have been met. Several insecticides (table 48), especially pyrethroids (table 49 and 50) applied experimentally in control plots have provided good pest control efficiencies and yield increases. Systemic, plant-penetrating insecticides have been used for preventing and diminishing the comlexity of diptera attack. The mixture of these insecticides with pyrethroids has been important to insecticide used for this group of pests control.

In the cereal areas with a significant biological reserve of damaging diptera the integrated control system is recommended as a synthesis of the means used, on the first hand the bio-technological factors favorable to plant protection against the diptera such as: - regional optimal agotechnical measurea for wheat crops; - wheat varieties with high compensatory capacity after attack; - protection preventive measures and special chemical control measures.

Preventive control measures. The experimental results have recommended preventive control measures: late sowing time (the first half of October); area adapted agrotechnical measures for wheat crops, providing good plant growth and the effect of compensatory productive tillering of the attacked plants; sowing wheat varieties with high compensation capacity after the diptera attack (70-80% in the Transylvania, Turda 95, Arieşan, Apullum varieties).

Experimental chemical control measures, insecticide efficiency. Special chemical control should be related to diptera species biology and ecology, the adequate economic thresholds of damaging, insecticide biological efficiency, the side effects of insecticide over the active useful entomophagous fauna, especially the predators (*Carabidae, Staphylinidae, Sylphidae, Coccinellidae, Nabidae, Aranea* etc.) involved in the level of damaging diptera populations, protection and sustainable use of useful activiy of the natural entomophag reserve in the cereal-based agroecosystems

The treatments applied on seeds and insecticide treatments on vegetation have shown partial efficiency of only 50-75% larvae mortality, due to the biological cycle of the diptera species and the feeding habits of larvae inside wheat stems.

The variety of insecticide products used in cereal crops has been the base of the researches on the efficiency of insecticides for the possible control of the main species of diptera under the conditions of Central Transylvania.

During 1980-2005 the biological efficiency and application selective time for several insecticides: organophosphorous, organochloric, carbamates, synthetic pyrethroids, neonicotinoids, fipronil, acetamiprid etc. have been tested in order to achieve a real integrated diptera control, and for the damage prevention, for the protection and use of entomophags natural reserve in the ceral agroecosystems.

The preventive seed treatments have showed partial efficiency in controlling damaging diptera (table 48, 49).

A series of experimental treatments with insecticides applied in autumn have had an important effect on the yield increase by 15-32%, using dimethoate, trichlorfone, or dimethoate with deltametrine.

The effect of insecticide application in early spring, on winter wheat crops emerged early and preferentially attacked by *Opomyza florum* and *Delia coarctata* or, on late emerged crops in November and preferentially attacked by *Phorbia securis* and *Phorbia penicillifera* has been significant for yield increases by 9-15% when dimethoate, trichlorfon or carbaryle, or dymethoate with deltametrine or methylpirimifos (Malschi, 1997) have been used. **Spring treatments** for diptera control have been difficult to carry out at the optimal time due to the regional agroecological conditions, and because wheat crops have been attacked by several diverse diptera species with different bio-ecology. **The optimal application time** of spring treatments has been established at the simultaneous registration of first stage of larvae of the species *O. florum* şi *D. coarctata* and at the flying of the adults belonging to the species *Phorbia penicillifera* and *Ph. securis* (tables 50, 51, 52, 53). The biological effect of the insecticides applied has been significant regarding the increase of wheat yield by 7-21% when the following insecticides have been used: dimethoate, chlorpirifos-ethyl, chlorpirifos-methyl, bensultap, fipronil, acetamiprid, lufenuron, thiacloprid, thiametoxam, complex insecticides such as: fenitrotione with esfenvalerat, oxydemeton methyl with betaciflutrine. The results of the field tests on the side effects of insecticides have revealed that the insecticides applied in early spring have had mild toxicity on the entomophagous auxiliary predators.

Under the special conditions of years 2000-2005 characterized by microclimate aridization, excessive draught and heat, the insecticide control has been required because the attack of the main species of wheat damaging diptera increased and overlapped. Under these agroecological conditions and providing the proper crop technology in the experimental fields, the usual insecticide treatments (organophosphorous, pyrethroids, neonicotinoids, fipronil, acetamiprid, novaluron etc.) have been tested, being carried out at the selective time for diptera larvae control in April, by the end of tillering in 13-33 DC stages. The treatments proved also efficient for the control of the dangerous pest complex occurring simultaneously in wheat crops at this application time. The high efficiency of insecticides in the diptera control and yield increases have been experimental results which recommend the integrated diptera management including the proper technology and modern insecticide application**.**

The fauna of auxiliary arthropods, natural limiters of wheat damaging diptera

Researches regarding the populations of useful arthropods and their importance in cereral crops have been carried out, because the auxiliary entomophags show an intensive and efficient destructive activity of the phytophags in the cereal crops, diptera included. The natural biological control of cereal flies and other regional pests has been higher in the protective forestry belts and marginal grasses system, favorable to entomophagous arthropod fauna development.

Laboratory tests regarding the role of entomophagous predators as limiters of damaging diptera populations in cereal agroecosystems have revealed that many species feed on cereal flies (table 54). The results of the feeding lab tests with diptera larvae and pupa have shown the importance of the predatory species, prey composition and feedig ratio per day and per individual (Malschi, Mustea 1995, 1997, 1998, 1999, Malschi, 2003). *Coccinella septempunctata L. (Coccinellidae*), *Malachius bipustulatus* L.(*Malachiidae*), *Cantharis fusca* L. (*Cantharidae*), *Sylpha obscura (Sylphidae), Tachyporus hypnorum* L., *Staphylinus* spp. (*Staphylinidae*) and *Poecilus cupreus* L., *Harpalus rufipes* De Geer, *Brachinus explodens* Duft., *Amara aenea* De Geer (*Carabidae*) have eaten wheat damaging diptera larvae and pupa.

Insecticide side effects on entomophags. Field and semi-field test results (Malschi, 2003), have shown that some insecticides has an initial light toxicity on the auxiliary entomophagous predators when applied in early spring or when synthetic pyrethroids have been used at different times of wheat pest control, related to damaging diptera population dynamics in the crops.

The researches on the compensatory effect of diptera attacked plants.

The use of proper regional technological measures is important for good development and productive compensatory tillering capacity of wheat plants, after the attack of several diptera species. The researches have revealed wheat high compensatory capacity after diptera attack averaging 60-80% in the varieties Turda 95, Arieşan, Apullum, Transilvania etc.

In winter wheat varieties sown in the area the following mean multi annual data have been recorded (table 55) regarding grain **yield losses** in the spring attacked plants caused by diptera: - for the attack of the *Delia coarctata* species: yield losses 0.92-1.47 g grains / plant, with 62.4-75.1% compensation effect in the attacked plants; - for the attack of the *Opomyza florum* species*:* 0,57 - 1,22 g grains/plant, with 71-84.4% compensatory effect of the plants after attack; - for the attack of *Phorbia securis:* 0,93 - 1,27 g grain/plant have been lost, with 59.3-71.5% compensatory effect in the attacked plants. This means losses in grain yields representing: 414-662 kg/ha for the attack of *D. coarctata;* 297-621 kg/ha for the attack of *O. florum* and 464-549 kg/ha for the attack of de *Ph. securis,* in several wheat varieties and under regional crop conditions, with mean densities of 450 plants/m^2 and 10% plants attacked by diptera.

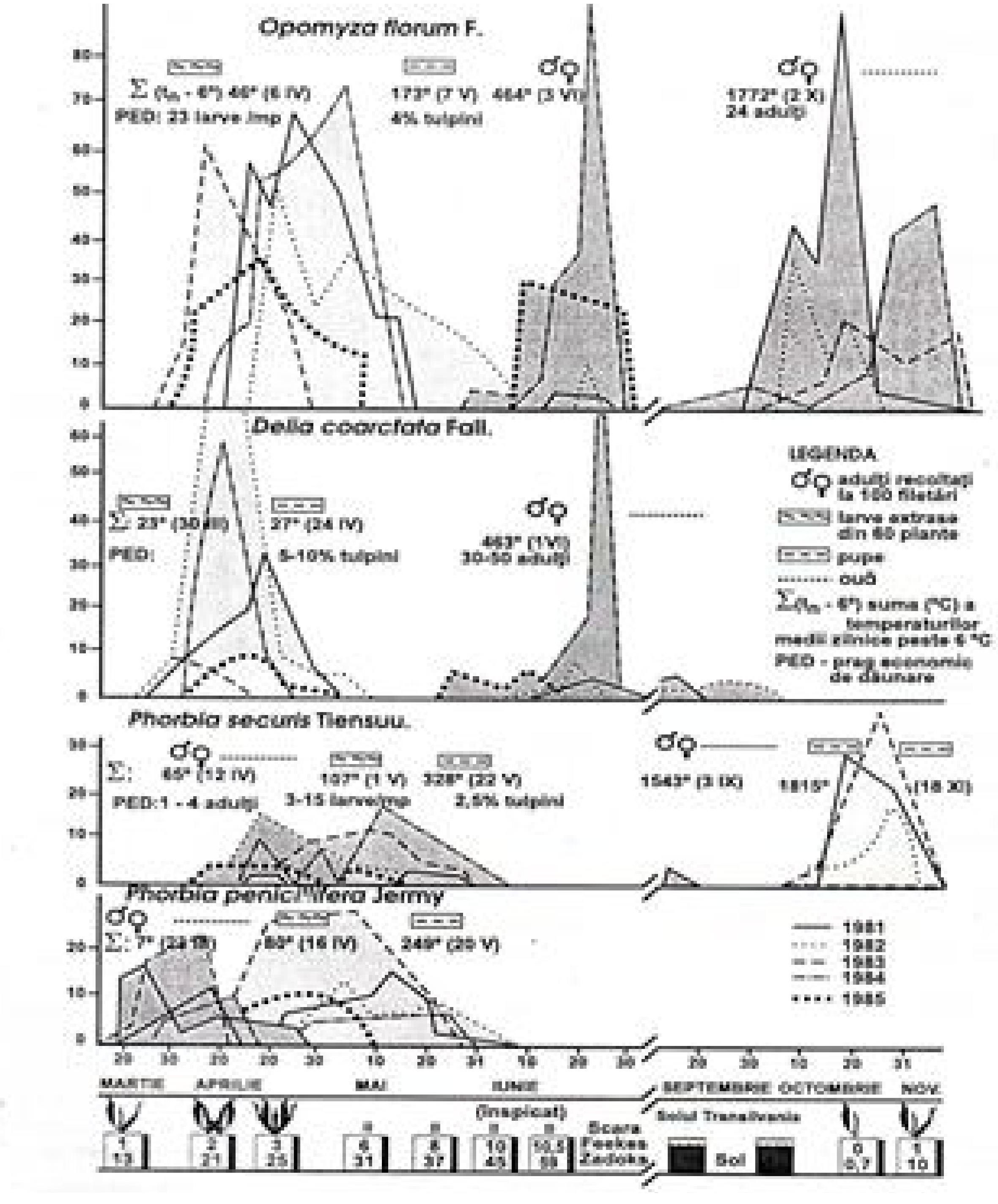


Fig.9. Dinamica, ciclul biologic si structura principalelor apecii de dipte dăunătoare în condiţiile climatice din culturile de grâu, la Staţiunea de Cercet Agricole Turda, în anii 1981- 1985. Dynamics, biological lifecycle and structure of t main diptera species damaging at wheat crops climate conditions, in the years 19 1985 at Agricultural Research Station Turda.

Lunile anului	Sept.	Oct.	Nov.-Mart.	Aprilie	Mai	Iunie	Iulie
Decada	II III	I II III	I II - II III	I II III	I II III	I II III	I
$\Sigma(t_n - 6^{\circ} C)$	1600	1800	12 24	46 70 100	123,250,400	485	
Keller-Baggiolini		A(D)	D(E) D(E)	E F G H	I J K	N O P Q	R
Scara Feekes		0(1)	1(2) 1(2)	2 3	6 8	10 10,5	11,1
Lucrări combatere		TSI TI		TI		TI	
Opomyza florum		A↗0	0 0	L↗	P	A	A
Delia coarctata	A 0	0	0 0L	↗ P		A	
Phorbia penicillifera			A	A↗ OL	P		
Phorbia securis	A0L	P		A↗ 0	P		
Oscinella frit	A0L	P		A 0	L P	A OL	P
Macrosteles sexnotatus		A↗0		L		AL	
Javesella pelucida		A↗0			A L	A	
Sitobian avenae		A↗0			F	↗	
Schizaphiz graminum		A↗0			F	↗	
Haplothrips tritici				A		A↗ L L	
Lema melanopa				A	A	L↗	

LEGENDA

A=răsărire; D=frunza; E F=înfrăţit; H=împăiere; I=primul rod; K=ultima frunză; N O=înspicat; P Q= înflorit; R U=formarea, maturarea seminţelor; TSI=tratarea seminţelor cu insecticide; TI=tratament cu insecticide; A=adulţi; O=ouă; L=larve; P=pupe; Ar=afide aripate; F=afide fundatrigene

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A=emergence; D=leaf; E-F=tillering; H=end of tillering, I= first noose; K= flag leaf; N-O= heading; P-Q=flowering; R-U= grains formation and ripening; TSI= insecticidal seed treatment; TI= insecticidal treatments of field crops; A= adults; O=eggs; L=larvae; P=pupae; Ar=wing aphids; F=fundatrix aphids.

Fig. 10. Principalii dăunători ai grâului, evoluţia lor în funcţie de condiţiile termice, de fenofazele dezvoltării grâului şi de lucrările de combatere, în centrul Transilvaniei (adaptat, după Baicu şi Săvescu, 1974). The main wheat pests, theirs evolution upon termal conditions, development phenofaze of wheat and pests control treatments, in Central Transylvania (adapted after Baicu&Savescu,1974).

Tab. 45.

Dynamics of attack potential of damaging diptera of wheat in 1989-2006 period, A.R.D.S. Turda.

Muştele cerealelor Cereal flies	**Perioada 1989-1999**	**Perioada 2000-2002**	**Perioada 2003-2006**	**Pragul economic de dăunare / *fenofaza.*** **Economic density threshold** ***/ vegetative stage***
Delia coarctata, Opomyza florum, Phorbia penicillifera, Phorbia securis, Oscinella frit, Meromyza nigriventris etc.	**22. 04** **16 % plante**/plants **6 % tulpini**/tillers	**10.03-20.04** **26 % plante**/plants **11 % tulpini**	**10-15.04.** **10% plante**/plants **7 % tulpini**	***Înfrăţit.*** *Tillering* **5-10% plante**/ plants
	10-28.05 **17 % plante**/plants **12 % tulpini**/tillers **65 tulpini**/tillers/**m²**	**4-10.05** **28 % plante**/plants **23 % tulpini**/tillers **186 tulpini**/tillers/**m²**	**20-25.05.** **71%plante**/plants **43 % tulpini**/tillers **275tulpini**/tillers/**m²**	***Sfârşit înfrâţit*** *End of tillering* **10-15 % plante**/ plants

Tab. 46

Potentialul zonal de atac al dipterelor la grau. S.C.A. Turda (1989-1998).
Zone potential of diptera attack in wheat. A.R.S. Turda (1989-1998).

% tulpini atacate . % deadheart tillers.

ANII		1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	Media
Delia coarctata: (2-22.04)	maxim minim	16 8	30 5	7 4,2	9 2	6 4	10 2	14 2	19,5 5	4 2	6,4 4,4	12,2 3,9
Opomyza florum: (10.04 - 10.05)	maxim minim	2 1	5 4,5	12 8,9	32 15,3	6,3 3,8	10 3	15 11	14 11	4,7 3,5	1,0 0,5	10,2 6,3
Phorbia securis şi Ph.penicillifera: (5 - 25.05)	maxim minim	11 2	32,7 15,0	18,3 4,6	20 3,7	4,6 2,1	5 4	2 1	9,7 6,0	5,6 3,8	11,5 8,9	12,0 5,1
Oscinella frit: (10 -25.05)	media	1	4	0,4	-	1	-	-	1	1	0,2	0,9
Mayetiola destructor (10 - 25.05)	medie	-	-	-	-	-	-	1	2	1	-	0,4

Tab. 47

Dinamica atacului de diptere dăunătoare la cereale păioase în perioada 2000-2002.
Attack dynamics of diptera damaging at grain cereals in 2000-2002 period.

Grâu de toamnă. Winter wheat.	2000	2001	2002	Media. Average
Tulpini distruse-larve/m². Deadheart tillers-larvae/m²	97	145	317	186
% tulpini atacate. % deadheart tillers.	13,7%	18%	12,6-62%	14,7- 31%
Grâu de primavară. Spring wheat.	2000	2001	2002	Media. Average
Tulpini distruse-larve/m². Deadheart tillers-larvae/m²	31	71	390	164
% tulpini atacate. % deadheart tillers.	5%	9%	42%	19%
Orz de primăvară. Spring barley.	2000	2001	2002	Media. Average
Tulpini distruse-larve/m². Deadheart tillers-larvae/m²	78	104	275	152
% tulpini atacate. % deadheart tillers.	10%	11%	29%	17%

Tab. 48

Efectul unor noi insecticide testate pentru tratamentul seminţei de grâude toamnă (S.C.D.A. TURDA 2001-2006). The effect of some new insecticides tested for winter wheat seed treatment. (A.R.D.S. Turda, 2001-2006)

Varianta	Doze p.c./t	Efficiency for diptera larvae (%)	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
SIGNAL *(A 1540 ES)*	2,0 l	41	98
SIGNAL	2,5 l	50	108
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
NETRATAT. Check. (number)	-	- (163 larve/m^2)	(3964 kg)

Tab. 49

Effect of insecticides and insecto-fungicides products, comprising gama HCH, tested for winter wheat seed treatment (A.R.D.S. Turda 1999-2004).

Varianta	Doze p.c./t	**Eficacitate pentru larve de diptere (%)** Efficiency for diptera larvae (%)	Kg/ha (%)
DACSEED	3 kg	53	103
MASTERLIN	2 kg	57	102
MICLODAN 50 PTS	2,5 kg	60	115
PROTILIN AL 81 PTS	3 kg	46	111
SUMIDAN SC	2 l	75	117
SUPERCARB T585 SC	3,75 l	70	105
SUPERSEM PTS	3 kg	53	114
TIRAMETOX 625 SC	3,75 l	60	119
LINDAN 400 SC	2,25 l	56	109
LINDAN 750 SC	1,2 l	59	93
LINDAN HC	1,35 l	77	99
NETRATAT Check.		- (138 larve/m^2)	- (4577 kg)

Densitatea larvelor de diptere la atacul din aprilie, in experientele cu tratamente la samanta la grau.
Density of diptera larvae on the April attack in the experiences with wheat seed treatments.

Anul. Year.	1999	2000	2001	2002	2003	2004	2005
Larve diptere/m^2. Diptera larvae/m^2	**117**	**59**	**107**	**159**	**142**	**245**	**605**

Tab. 50

Insecticides efficiency in the experimental control of diptera species spring attack
***(Opomyza florum F., Delia coarctata Fll., Phorbis securis Tiensuu, Ph. penicilifera Jermy)*, in winter wheat crops.**

Diptera species			*Opomyza, Delia*	*Phorbia*	*Opomyza Delia, Phrobia*
Period of treatments (April).			1983 - 85	1986 - 88	1990 - 97
% deadheart tillers.			9,9	9,7	8,3 - 7,8
Insecticide	Produse	Doze / ha	Insecticides efficiency (E %)		
Lindane	LINDATOX 20 EC	2,0 l	39,4	-	-
Endosulfan	THIONEX 35 EC	2,0 l	-	-	49
Lindane+ dimethoate	SINOLINTOX 10 G	20,0 kg	-	72,9	-
Dimethoate	SINORATOX 35 EC	2,0 l	53,5	72,5	52,0
Dimethoate	SINORATOX 35 EC	3,0 l	30,3*	70,4	-
Dimethoate	SINORATOX 5 G	40,0 kg	-	51,7	-
Dimethoate+Deltamethrin	SINORATOX 35 + DECIS 2,5	1,5 l +0,4 l	65,6 *	68,4	-
Dimethoate+ Methylpirimiphos	SINORATOX 35 EC + ACTELIC 50 EC	1,5 l +0,5 l	-	84,0	-
Methylpirimiphos	ACTELIC 50	1,0 l	-	70,7	-
Trichlorphon	ONEFON 80	1,2 kg	41,4*	75,5	63,2
Malathion	CARBETOX 50	1,0 l	-	63,3	-
Quinalphos	ECALUX 25 CE	1,5 l	-	61,5	-
Phonophos	DYFONAT	3,0 kg	-	68,6	-
Fhonophos	DYFONAT 10 G	10,0 kg	-	70,7	-
Phoxim	FOXIM 0,1 %	0,3 l	-	66,3	-
Phoxim	VOLATON 5 G	15,0 kg	-	64,4	-
Diazinon	BASUDINE 10 G	15,0 kg	-	75,0	-
Diazinon	BASUDINE 600 EC	2,0 l	-	-	69
Diazinon	DIAZOL 48 EC	0,9 l	-	-	53
Chlorpiryphos	PYRINEX 50 EW	2,5 l	-	-	29
Fenoxycarb	INSEGAR 25 WP	0,3 kg	-	-	66
Pirimicarb	FERNOS 50 DP	0,6 kg	-	72,7	-
Carbaril	OLTITOX 50	1,0 kg	-	61,2	
Bensultap	VICTENON 50 WP	0,5 kg	-	68,8	51,6
Methamil	LANNATE 80 WS	0,3 kg	-	72,4	-
Oxamyl	VYDATE 24 L	0,6 l	-	74,0	-
Oxamyl	VYDATE 10 G	20,0 kg	-	66,4	-
Cypermathrin	POLYTRIN 200 SC	0,1 l	-	-	50,5
Alphamethrin	FASTAC 10 EC	0,2 l	-	67,6	56,8
Beta-Cyfluthrin	BULLDOCK 25 EC	0,3 l	-	-	31
Thurintox	THURINTOX	0,06 l	-	67,3	-
Acetamipirid	MOSPILAN 20 SP	0,06 kg	-	-	51
Fipronil	REGENT 80 WG	0,025 kg	-	-	45

D.L. p 0,1 % (arcsin $\sqrt{\%}$) 3,81 4,79 5,65.

*) –Special treatments in autumn.

Tab. 51

Efficiency of some insecticides applied in winter wheat for the control of diptera larvae, *Opomyza florum, Delia coarctata, Phorbia penicillifera, Phorbia securis, Oscinella frit.*, **in April the10-20-th, 2000-2002, A.R.D.S. Turda.**

Insecticides.	Product and dose/ha.	Efficiency %	Grains yield.		
			Kg/ha	%	Dif.
Martor . Check.	186 larve/m^2	-	4343	100,0	-
Fipronil	Regent 200 SC 90 ml	45	4778	110,0	434***
Clorpirifos meti	Reldan 40 EC 1250 ml	44	5039	116,0	695***
Bensultap	Victenon 50 WP 400 g	43	4635	106,7	291*
Acetamiprid	Mospilan 20 SP 100 g	56	4778	110,0	434***
Fenitrotion-fenvalerat	Alpha-Combi 500 ml	47	4865	112,0	521***
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***
Clorpirifos-etil	Pyrinex 25EC 3500 ml	50	4952	114,0	608***
Dimetoat	Dimezil 40 EC 2000 ml	47	5256	121,0	912***
	Media tratamentelor	46	4842	111,5	499

DL p 5%-225 kg; DLp 1%-303 kg; DLp 0,1%-404 kg. The notations: 15-25 May.

Tab. 52

Effect of treatment to the control of diptera, Chaetocnema, Oulema adults, applied in winter wheat at the weed control time, in 2003 year conditions.

Variante, doze/ha	Grains yield (Transylvania variety)		
Data of treatment: 12 mai	Kg/ha	Dif	%
Check.	1949	-	100
Decis 25 WG 0,03 kg	2380	431*	122
Alpha-Combi 0,5 l	2218	269	114
Mospilan 20 SP 0,1 kg	2306	357	118
Calypso 480 SC 0,1 l	2201	252	113
Actara 25 WG 0,06 kg	2110	161	108
Regent 200 SC 0,09 l	2210	261	113
Victenon 50WP 0,5 kg	2173	224	112
Pyrinex 26 ME 3,0 l	2039	90	105

DL p 5%=405; DL p 1%=555; DL p 0,1 %=755.

Tab. 53

Pests control in spring barley at the weed contol time in 2003.

Variante, doze/ha	Producţia de boabe (soiul Turdeana). Grains yield (Turdeana variety)		
Data: 12 mai	Kg/ha	Dif	%
Netratat	1602	-	100
Mospilan 20 SP 0,1 kg	2723	1121**	170
Calypso 480 SC 0,1 l	2570	968*	160
Actara 25 WG 0,06 kg	2461	859*	153
Regent 200 SC 0,09 l	2423	821*	151
Decis 25 WG 0,03 kg	2460	858*	153
Alphacipermetrin 0,1 l	2383	781*	149
Fastac 10 CE 0,1 l	2333	731*	145
	DL p5 %=718; DL p1 %=945.		

Tab. 54 **Raţia zilnică individuală de hrană a prădătorilor cu larve de diptere în teste de laborator.** Predators individual feeding rate with diptera pests in laboratory trials.				
Prădători entomofagi. Entomophagous predators.	***Opomyza florum***		***Phorbia securis***	
	larve	***pupe***	***larve***	***pupe***
Chrysopa carnea Stephn.(Chrysopidae) *(larva)*	3	1	2	-
Nabis ferus (Nabidae) *(adult)*	3	4	3	4
Coccinella 7-punctata L. (Coccinellidae) *(adult)*	5	7	5	7
Propylaea 14-punctata L (Coccinellidae) *(adult)*	-	2	-	-
Malachius bipustulatus L. (Malachiidae) *(adult)*	-	-	3	-
Cantharis fusca L. (Chantaridae) *(adult)*	2	-	4	-
Staphylinus caesareus Cederh (Staphylinidae)	1	-	4	4
Tachyporus hypnorum L. (Staphylinidae)	1	-	1	-
Poecilus cupreus L. (Carabidae)	5	10	5	7
Pseudophonus pubescens De Geer (Carabidae)	1	-	2	1
Harpalus distinguendus Duft. (Carabidae)	-	-	2	2
Harpalus aeneus L. (Carabidae)	-	2	4	2
Amara aenea De Geer (Carabidae)	-	-	8	-
Sylpha obscura L. (Sylphidae)	1	4	2	4
Necrophorus vespillo L. (Sylphidae)			4	8

Tab. 55

PIERDEREA DE PRODUCŢIE DUPĂ ATACUL DIPTERELOR LA GRÂU, S.C.A TURDA (g boabe/plantă)

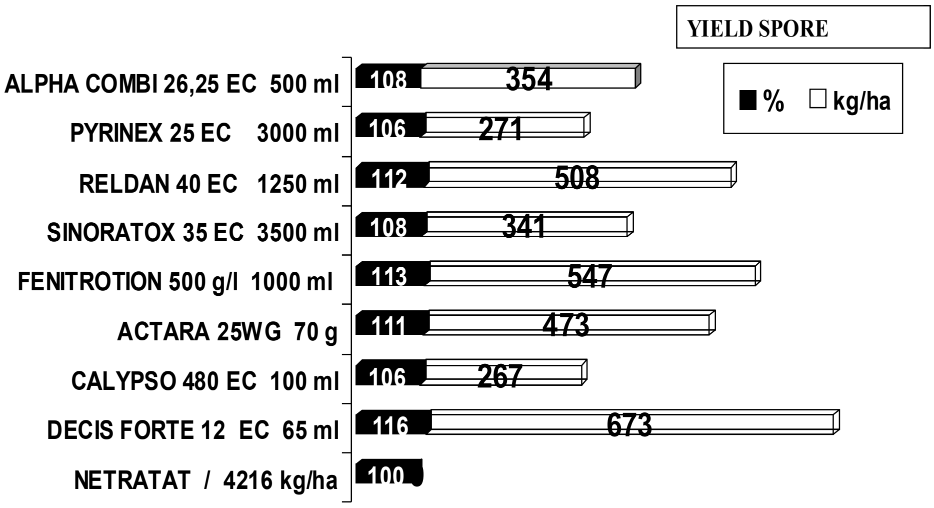
Soiul:	Transilvania	Turda 81	Arieşan	Apullum	Turda 95
1. Specia dăunătoare	**Delia coarctata Fll. (musca cenuşie a grâului)**				
Perioada	1989 - 1996	1989 - 1996	1989 - 1996	1991 - 1996	-
Producţia: $\bar{x}_1 \pm s\bar{x}_1$	3,99 ±0,20	3,91 ± 0,19	3,62 ± 0,23	3,70 ± 0,23	-
$\bar{x}_2 \pm s\bar{x}_2$	2,93 ± 0,19	2,44 ± 0,17	2,49 ± 0,17	2,78 ± 0,16	-
Diferenţa: d ± sd$\bar{x}$	**1,06 ± 0,195**	**1,47 ± 0,18**	**1,13 ± 0,20**	**0,92 ± 0,195**	-
t =	5,436 ⁰⁰⁰	8,17 ⁰⁰⁰	5,65 ⁰⁰⁰	4,717 ⁰⁰⁰	
Pierdere (%)	26,6 %	37,6 %	31,2 %	24,9 %	-
2. Specia dăunătoare:	**Opomyza florum F. (musculiţa galbenă a grâului)**				
Perioada	1990 - 1998	1991 - 1998	1990 - 1998	1991 - 1998	1996 - 1998
Producţia : $\bar{x}_1 \pm s\bar{x}_1$	4,15 ± 0,13	4,08 ± 0,21	3,68 ± 0,20	3,77 ± 0,23	3,09 ± 0,16
$\bar{x}_2 \pm s\bar{x}_2$	2,93 ± 0,23	3,00 ± 0,22	2,88 ± 0,18	3,03 ± 0,19	2,52 ± 0,16
Diferenţa : d ± sd$\bar{x}$	**1,22 ± 0,18**	**1,08 ± 0,215**	**0,80 ± 0,19**	**0,74 ± 0,21**	**0,57 ± 0,16**
t =	6,778 ⁰⁰⁰	5,023 ⁰⁰⁰	4,211 ⁰⁰⁰	3,52 ⁰⁰⁰	3,562 ⁰⁰⁰
Pierdere (%)	29,4 %	26,5 %	21,7 %	19,6 %	18,4 %
3. Specii dăunătoare:	**Phorbia securis Tiensuu şi Ph. penicillifera Jermy (muştele negre ale grâului)**				
Perioada	1987 - 1998	1987 - 1998	1987 - 1998	1991 - 1998	1996 - 1998
Producţia: $\bar{x}_1 \pm s\bar{x}_1$	3,64 ± 0,21	3,61 ± 0,20	3,35 ± 0,22	3,27 ± 0,19	3,61 ± 0,17
$\bar{x}_2 \pm s\bar{x}_2$	2,66 ± 0,195	2,51 ± 0,18	2,42 ± 0,19	2,24 ± 0,17	2,34 ± 0,16
Diferenţa: d ± sd$\bar{x}$	**0,98 ± 0,202**	**1,10 ± 0,19**	**0,93 ± 0,205**	**1,03 ± 0,18**	**1,27 ± 0,165**
t =	4,851 ⁰⁰⁰	5,789 ⁰⁰⁰	4,536 ⁰⁰⁰	5,72 ⁰⁰⁰	7,697 ⁰⁰⁰
Pierdere (%)	26,9 %	30,5 %	27,8 %	31,5 %	35,2 %

t_{58}: p 5%= 2,004; p 1%= 2,669; p 0,1%= 3,476; $\bar{x}_1$=g boabe/plantă, medie la 30 plante neatacate
$\bar{x}_2$=g boabe/plantă, medie la 30 plante atacate

Yield losses after the diptera attack at the wheat varieties

Transilvania, Turda 81, Ariesan, Apullum, Turda 95, (g grains/plant) (A.R.S.Turda).

x_1= g grains/plant, average of 30 unattacked plants;
x_2= g grains/plant, average of 30 attacked plants



DLp5% = 367; DLp1% = 494; DLp0,1% = 658; Ft=2,25 (3.73*)

Fig. 11. The yield effect of insecticides for wheat diptera and other pests, applied at 33 DC phase, 10-20th April.

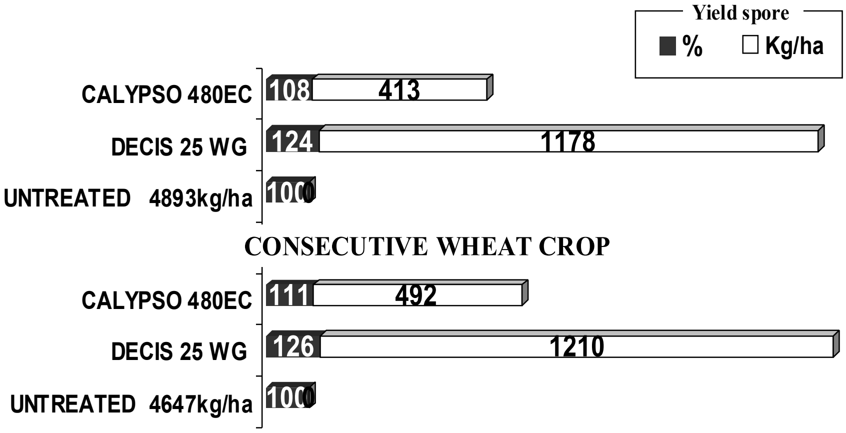
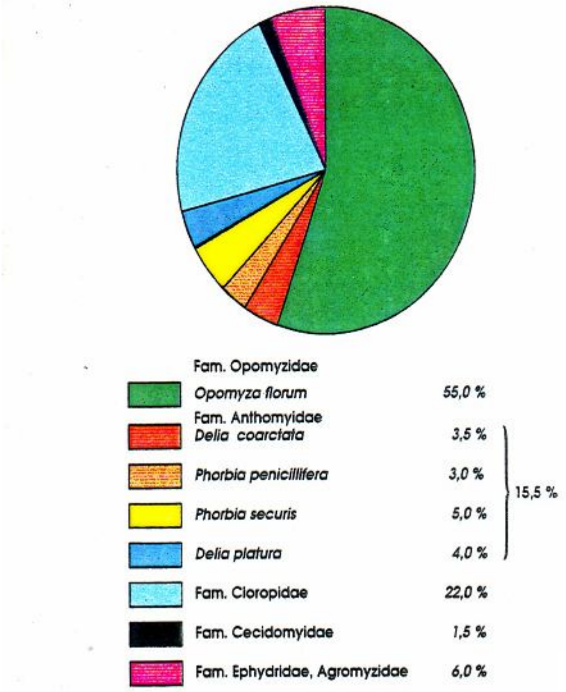
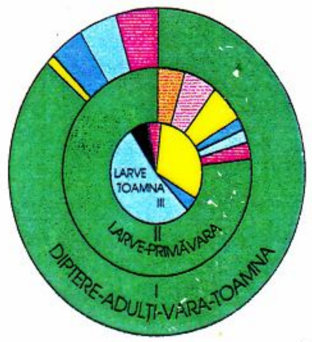


Fig. 12. Wheat pests control by two treatments with Decis 25 WG-30g/ha and Calypso 480EC-100ml/ha, respectively, applied at the end of tillering/33 DC phase and at the spike appearance/45 DC.

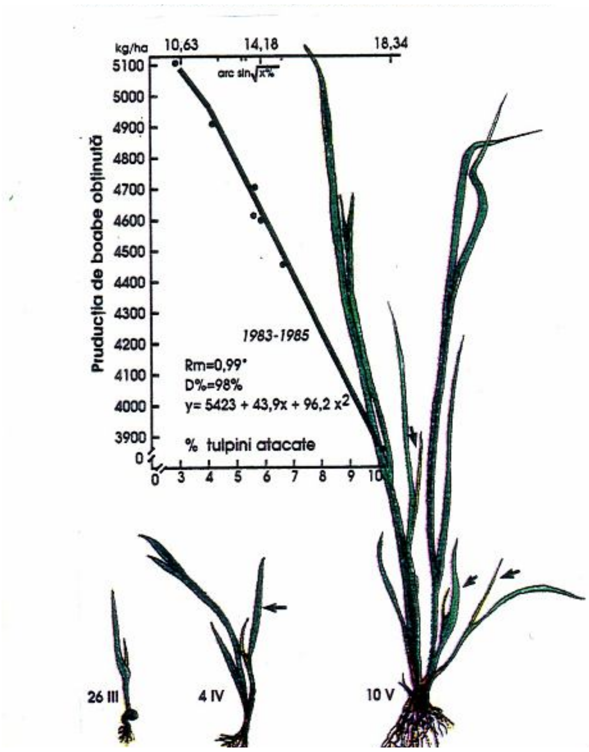


Structure of Diptera species attacking wheat crops in Romania, during 1978-1985.

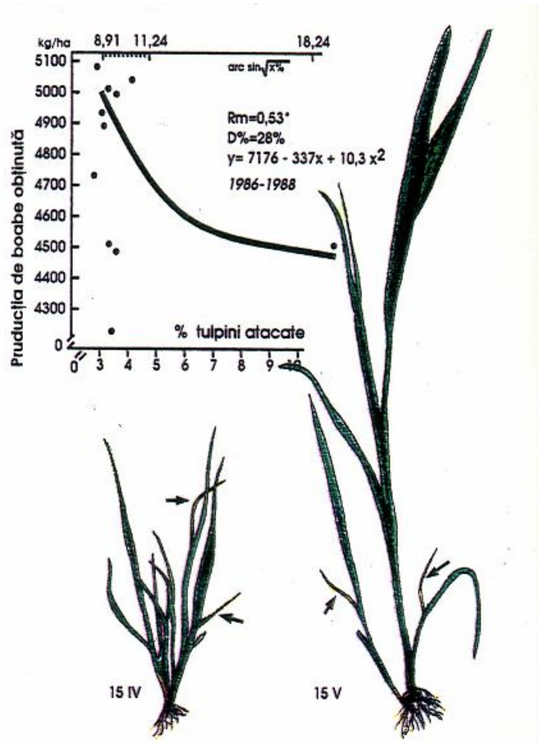


Dominanța speciilor % în perioada:	I V-XI	II IV-V	III X-XI	Nr.
Opomyza florum	87,0	78,0	-	12.723
Delia coarctata	0,3	5,0	-	341
Delia platura	3,3	0,5	2,0	365
Phorbia penicillifera	-	5,0	-	318
Phorbia securis	0,6	7,0	32,0	943
Cloropidae	4,3	2,0	54,0	1419
Cecidomyidae	-	0,5	7,0	135
Ephydridae, Agromyzidae	4,5	2,0	5,0	608
Nr. total exemplare:	9315	5925	1612	16582

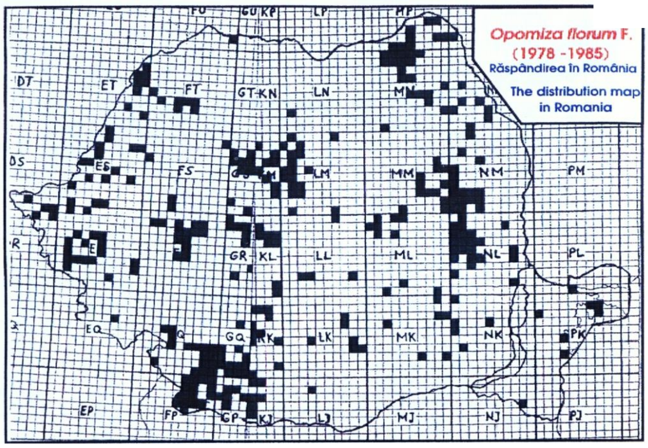
Dominance structure of Diptera pests of wheat during 1978-1985, by the period of gathering: I - May-November (adults); II - April-May (larvae); III – October-November (larvae).

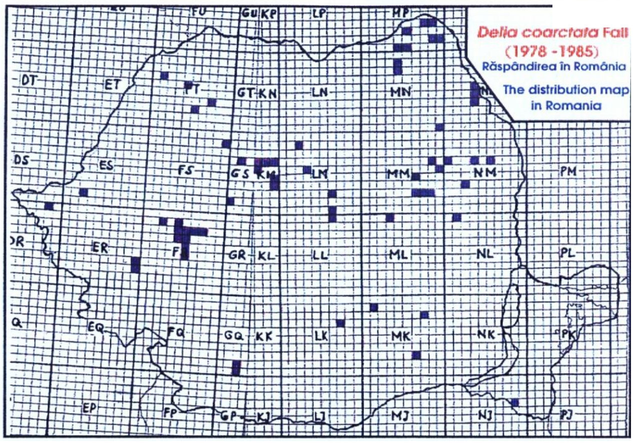


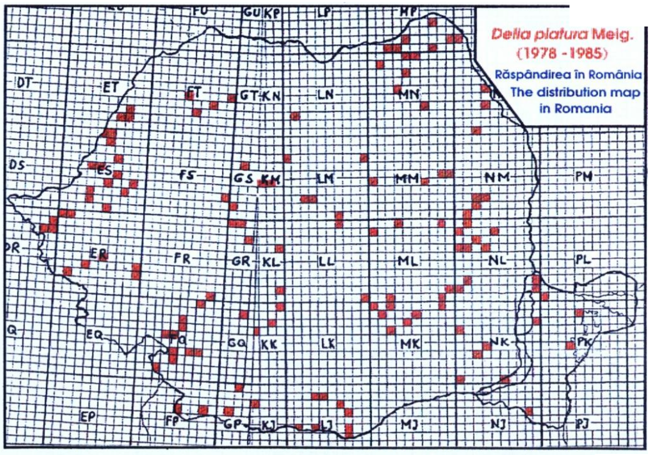
Attack evolution of *Opomyza florum* and *Delia coarctata* (% deadheart tillers) and correlation with wheat yields at A.R.S.Turda

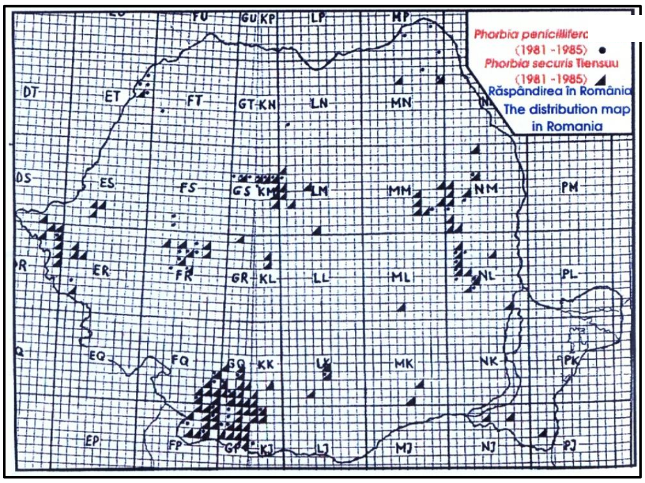


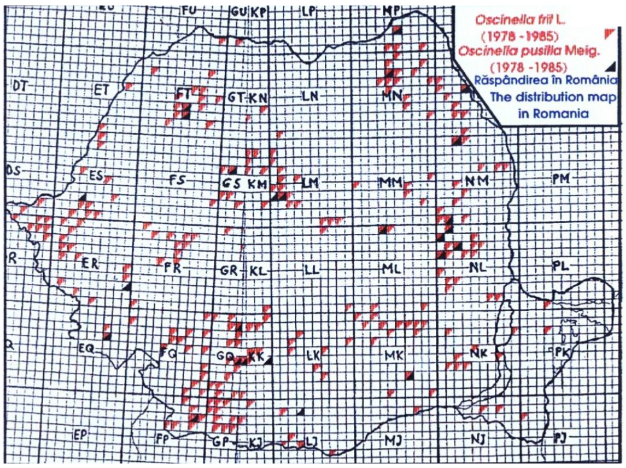
Attack evolution of *Phorbia penicillifera* and *Phorbia securis* (% deadheart tillers) and correlation with wheat yields at A.R.S.Turda.

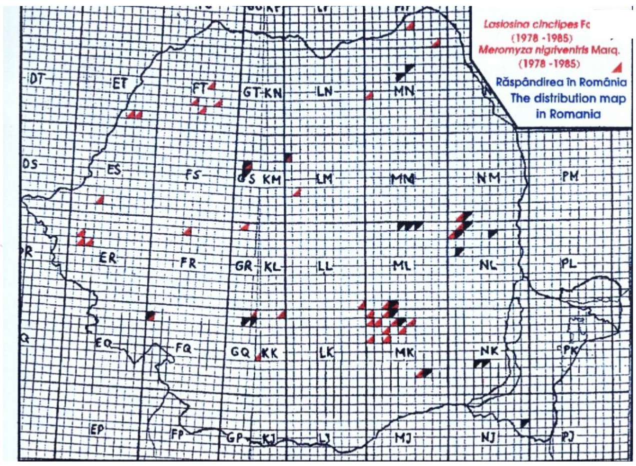












Plants with diptera larvae attack

Plate 27

Populations dynamics of wheat diptera pest species. Percentual repartison (%/year), A.R.D.S.Turda, 1989-1998.

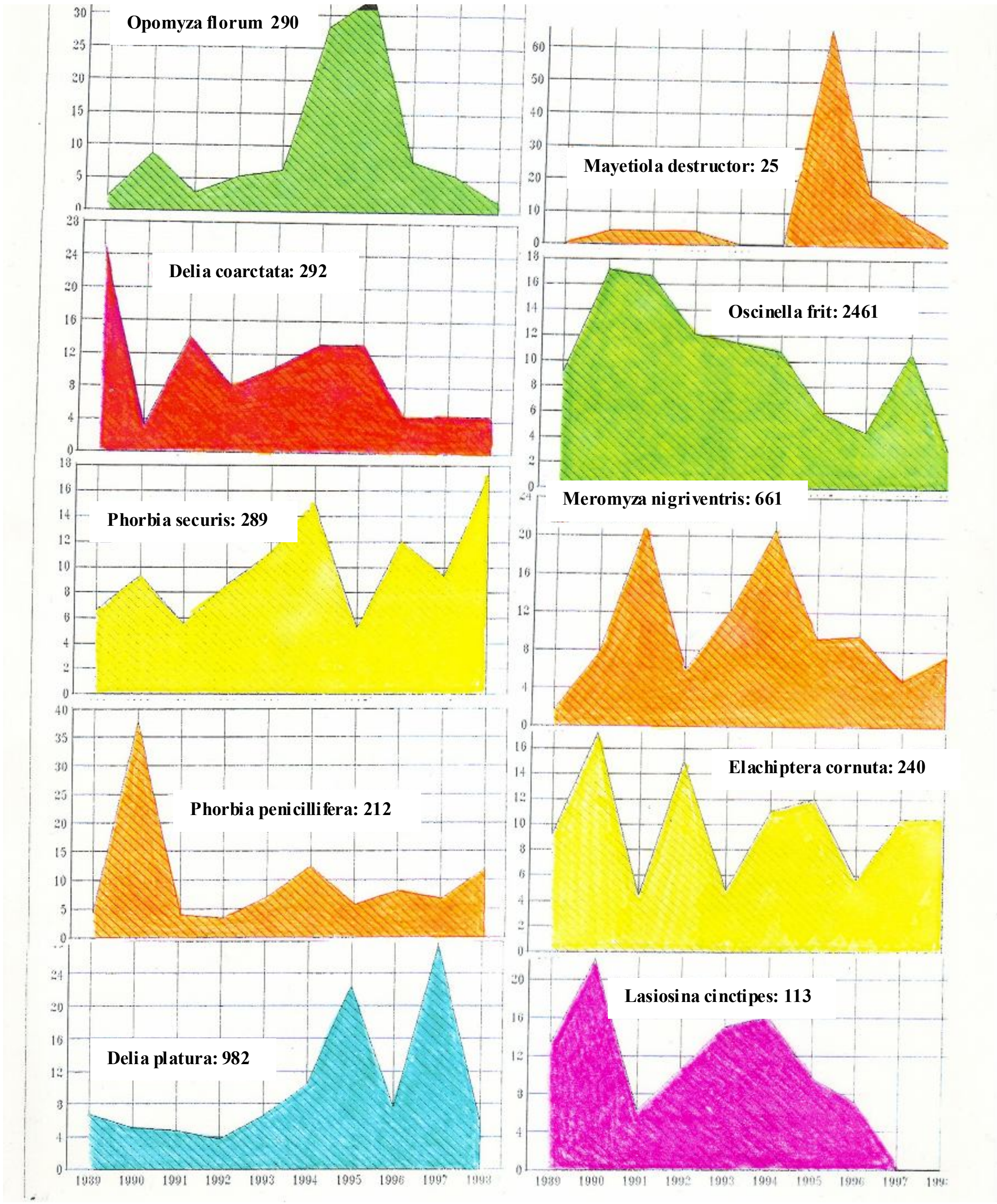
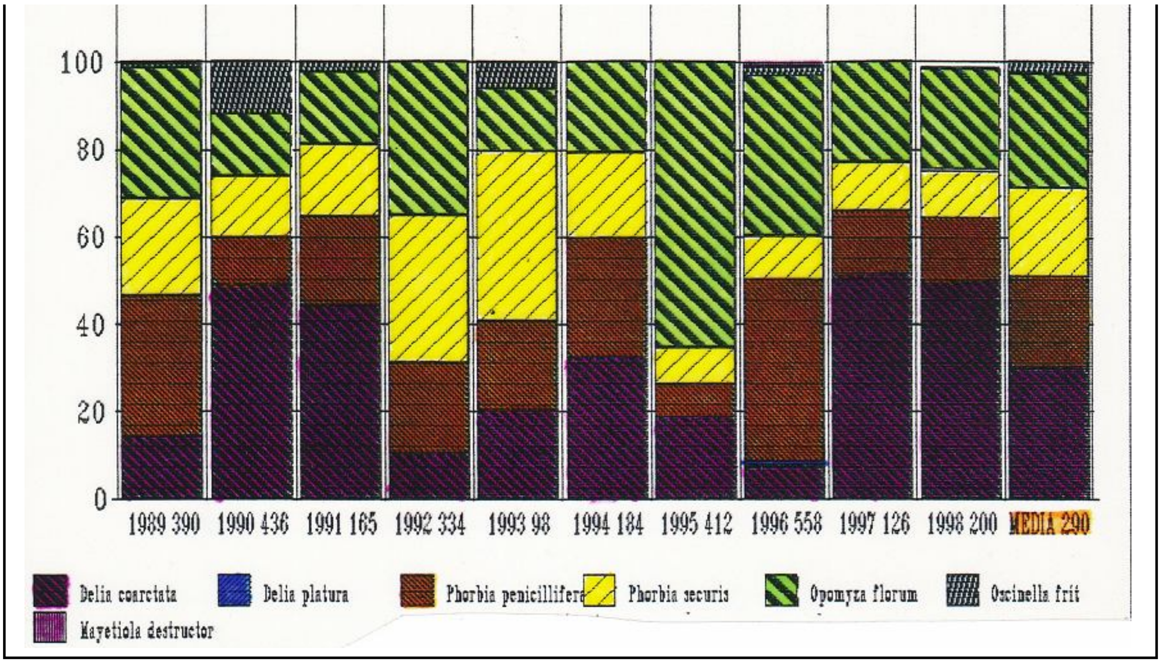
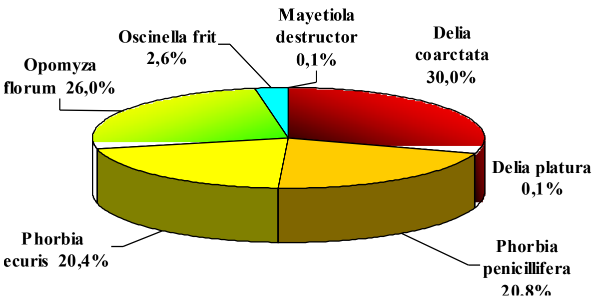


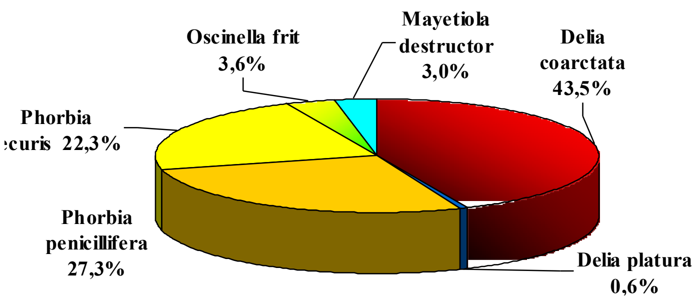
Plate 28

Structure of damaging diptera species (%) colected from wheat attacked plants in April-May, 1989-1998, A.R.D.S.Turda.

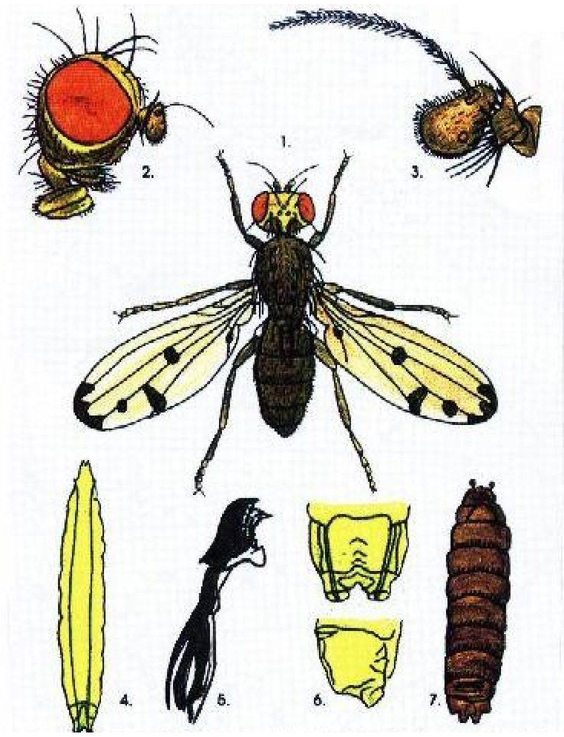




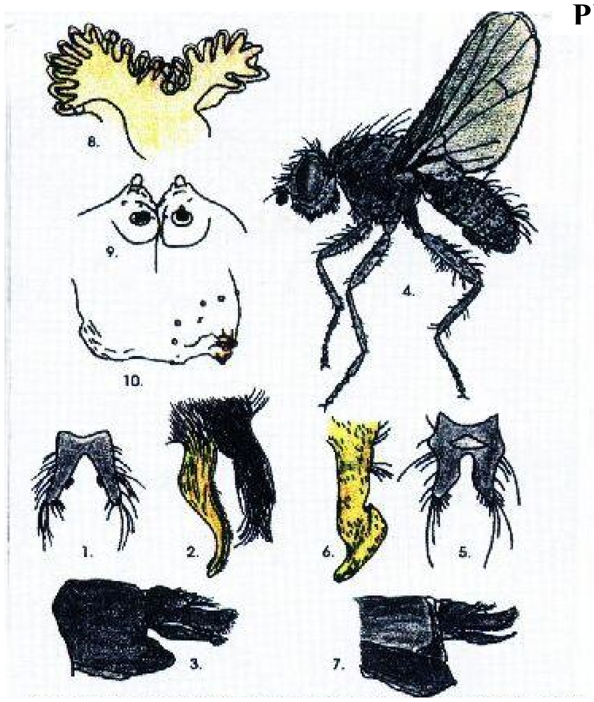
Structure of diptera pests in winter wheat crops sowing in Octomber (larvae from attacked plants in the spring), A.R.D.S.Turda, 1993-1997.



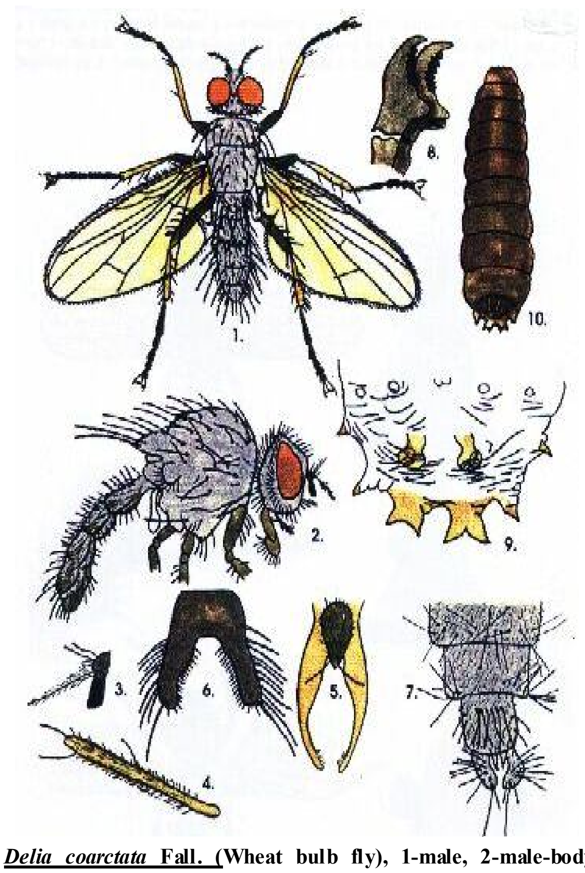
Structure of diptera pests in winter wheat crops sowing in November (larvae from attacked plants in the spring), A.R.D.S.Turda, 1993-1997.



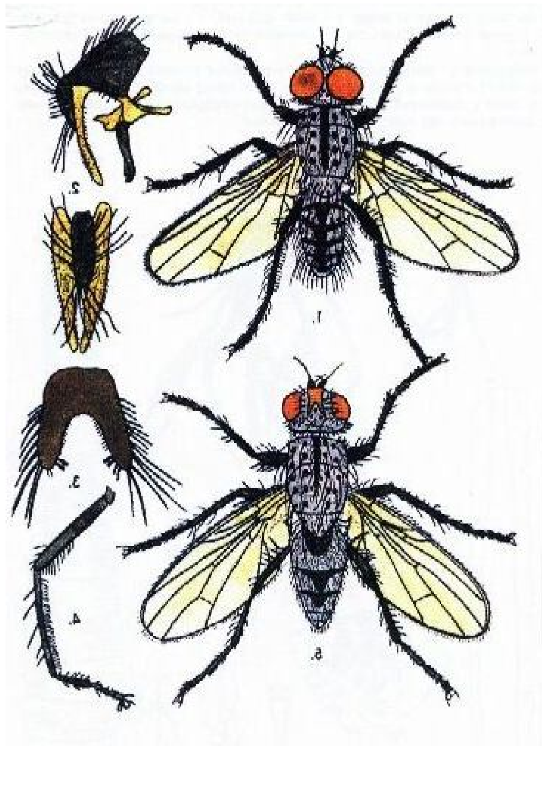
Opomyza florum F. (Yellow small fly) 1-adult, 2-head, in profile, 3-antenna, 4-larva, 5-mandibles crochets, 6-end of larva, rear and lateral view, 7-pupa. (Pétré, Znamenskii, Malschi, 1975, 1997, 2007).



Phorbia penicillifera Jermy (wheat black fly), 1-last sternite of abdomen, 2-hypopygium, lateral view, in male, 3-last abdomen segments of female.
Phorbia securis Tiensuu: 4-male, 5-last sternits of abdomen, 6-cerci, in male, 7-female, last abdomen segments, 8-anterior respiration stigma, 9-antenna, 10-last abdomen segment of larva, (Ringdahl, Jermy, Malschi 1975, 1997, 2007)

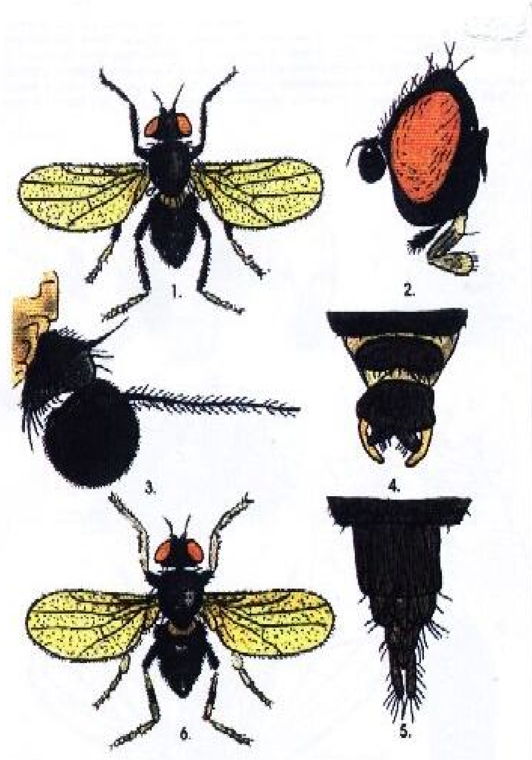


Delia coarctata Fall. (Wheat bulb fly), 1-male, 2-male-body, in profile, 3-antenna, 4-anterior tibia, 5-hypopygium, rear view, 6-abdomen last sternite of male, 7-female, last abdomen segment, 8-mandibles crochets of larva, 9-last abdomen segment of larva, rear view, 10-pupa (Petre, Ringdahl, Malschi 1975, 1997, 2007)

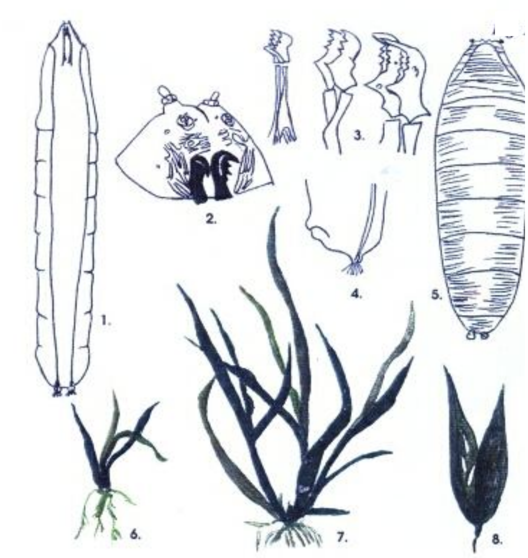


Delia platura Mg. (Seedcorn maggot fly), 1-male, 3-abdomen last sternite of male, 4-posterior leg of female, (Pétré, Ringdahl, Malschi 1975, 1997, 2007).

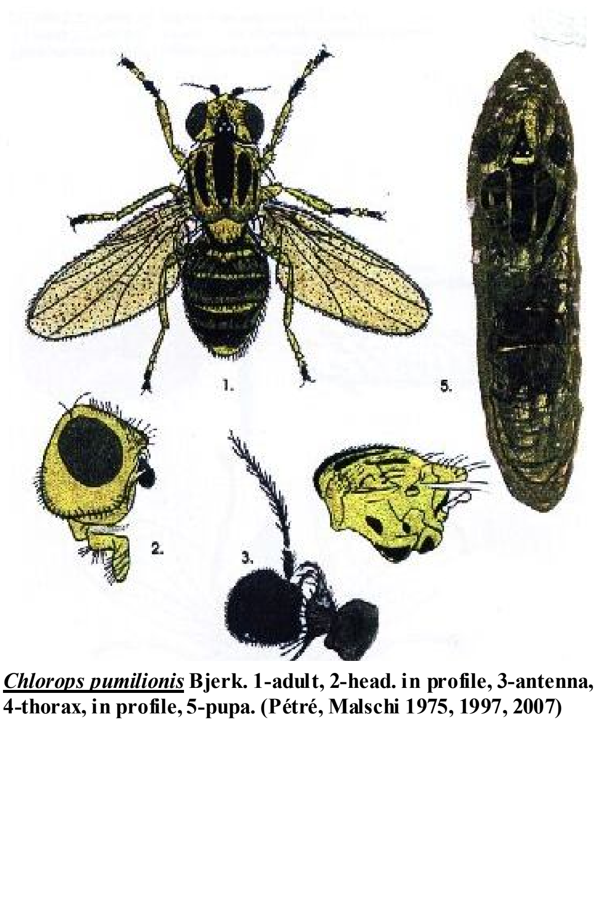
Plate 30



Oscinella frit L. (Frit fly), 1-adult, 2-head, in profile, 3-antenna, 4-copulatory apparatus, 5-ovipositer (Petre, in Balakhovskii & Mesnil, Malschi). Oscinella pusilla Mg. 6-adult. (Pétré, Malschi 1975, 1997, 2007)



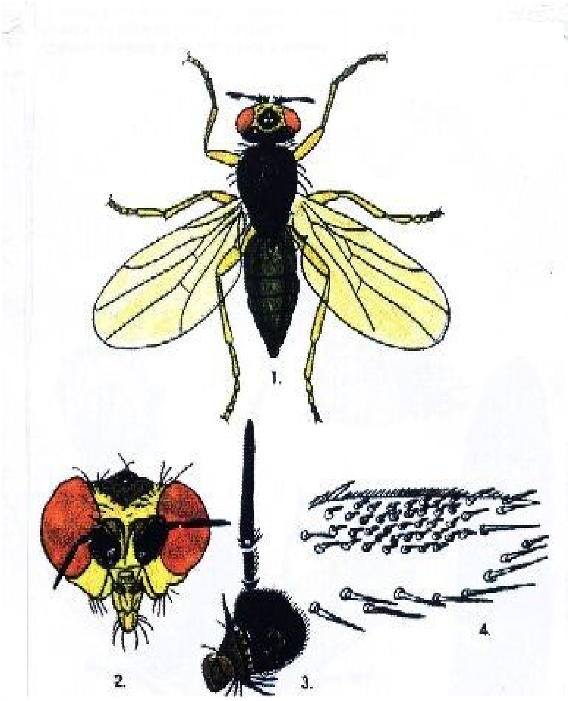
Oscinella frit L. 1-larva, 2-larval facial mask, 3-mandibles crochets on the 3- larval stages, 4-last larval segment, in profile, 5-pupa, hind view, 6-young attaked plant, 7-attacked plant on developped stages, 8-attacked wheat ear. (Znamenskii, Ringdahl).



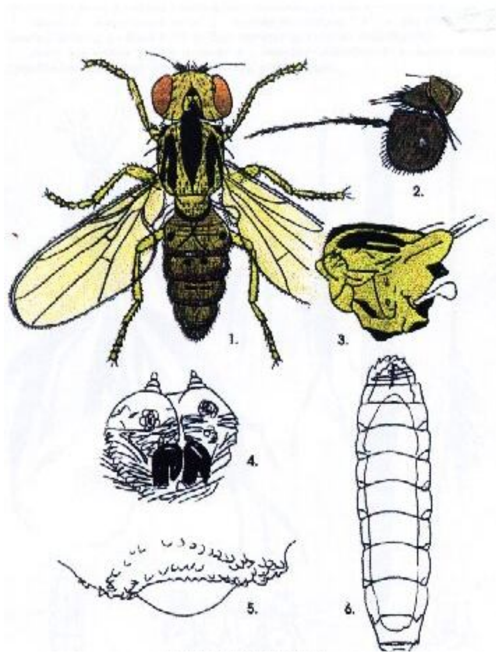
Chlorops pumilionis Bjerk. 1-adult, 2-head. in profile, 3-antenna, 4-thorax, in profile, 5-pupa. (Pétré, Malschi 1975, 1997, 2007)

Chlorops pumilionis Bjerk. 1-larva, 2-facial mask, 3-mandibles crochets, 4-wheat young plant attacked by larva 5-wheat ears and straw damaged by larvae, 6-wheat gout. (Znamenskii, Beliaev, Pétré).

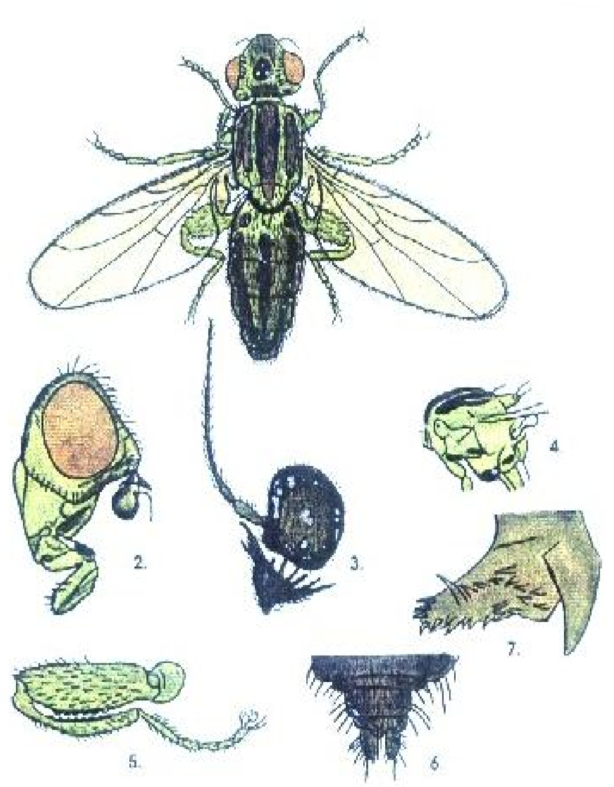
Plate 31



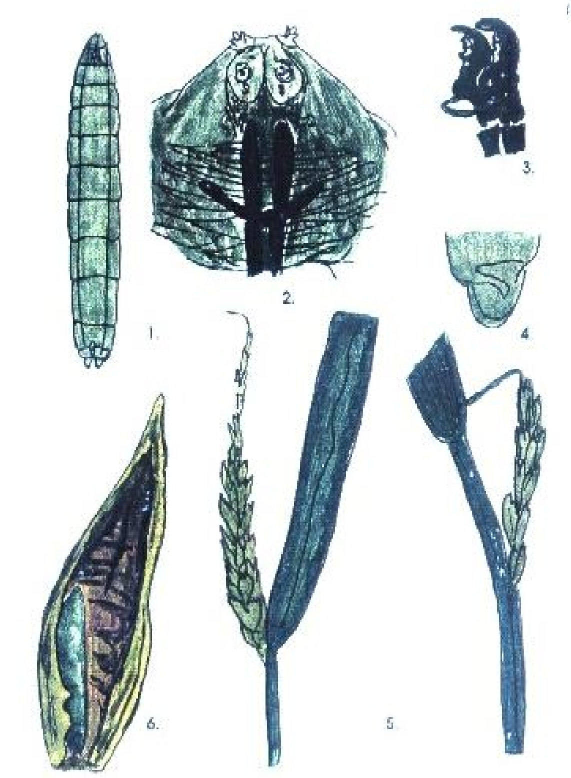
Elachiptera cornuta Fll. 1-adult, 2-head, 3-antenna, thorax dorsal ornaments of male. (Pétré, Malschi 1975, 1997, 2007)



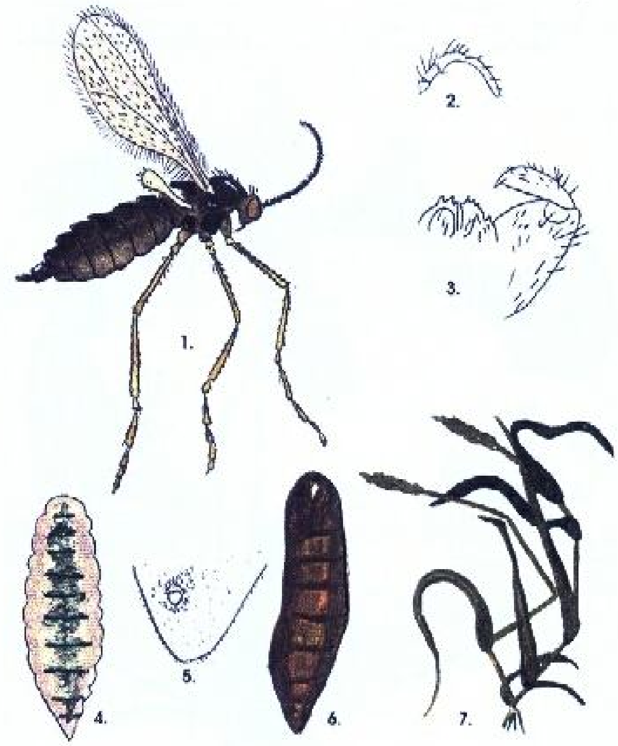
Lasiosina cinctipes Mg. 1-adult, 2-antenna, 3-thorax, in profile, 4-facial mask of larva,5-anal segment of larva, 6-pupa.(Pétré, Malschi 1975, 1997, 2007)



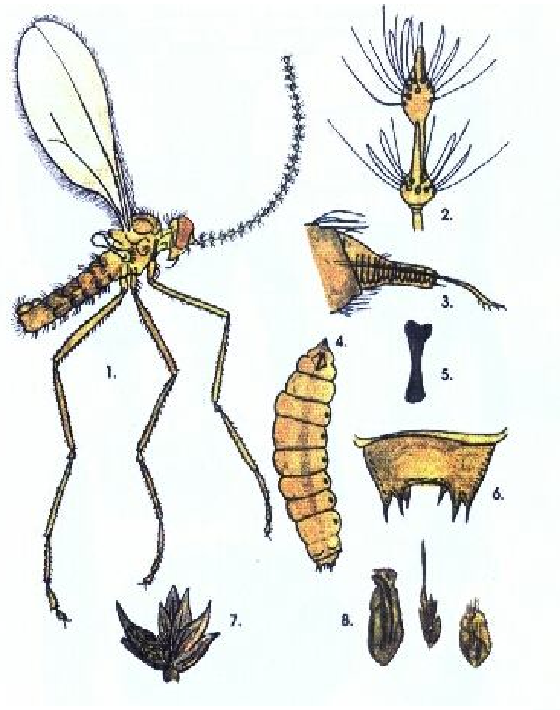
Meromyza nigriventris Macq. 1-adult, 2-head, in profile, 3-antenna, 4-thorax, 5-posterior leg, 6-last abdominal segments of female, 7-parameres of copulatory apparatus. (Pétré, Fedoseeva, Malschi 1975, 1997, 2007).



Meromyza nigriventris Macq. 1-larva, 2-facial mask, 3-mandible crochets, 4-last adbominal segment of larva, 4-lateral view, 5-attacked ears, 6-pupa, in ear.
(Znamenskii, Pétré)



__Mayetiola destructor Say__. (Hessian fly), 1-adult, 2-maxilar palp of female, 3-genital plates and cerci of male, 4-larval II-nd stage, 5-end of larva, 6-pupa, 7-attacked plant. (după Panin, Pétré, Malschi 1975, 1997, 2007)



__Contarinia tritici Kyrby__. 1-adult, last segments of antenna of male, 3-ovipositor, 4-larva, 5-sternal piece of larva, 6-end of larva, 7-attacked ear, 8-attacked grains. (Panin, P., Florica Dan, Dana Malschi, 1975, 1997, 2007)

Soil traps (Barber) and sticky plates for entomofauna, in the experimental field at A.R.D.S.Turda.

Experimental plots for the pest control trials, A.R.D.S.Turda

4.1.3. Cereal leaf beetle (*Oulema melanopus* L.) and the integrated control measures

***Oulema melanopus* L.** is an important pest of wheat, barley, oat, **secara**, rice etc. frequently ocurring in Europe (Bărbulescu, 1996; Dedryver, 1990; Dimitrijevic et al., 2000; Gal, Burces, 1988; Morner, 1988; Rosseberg et al., 1986; Walczak, 1990; Wetzel, 1995). It produces significant losses especially in small grain spring cereal crops, while as a polyphag it attacks several cultivated and spontaneous graminaea as green plants. The biological reserve and the attack potential in the cereal areas in Central Transylvania has caused frequently in the last years the exceed of the economic damaging threshold EDT both in adults (10 adults/m^2) and larvae (250 larvae/m^2). Density increase and pest attack have been recorded in some crops especially because of microclimate aridization in early spring and during May-June, which determined an increase of adult and larvae attack aggressiveness to re-establish the favorable feeding conditions. Larvae damaging potential has been reduced by the activity of predators and some climate conditions such as heavy rains or low temperatures, not favorable for pest's eggs and first generation larvae. The chemical control has been recommended after the activity of the natural limitative factors was completed for the massive emergence of first age larvae, and has been applied in the attack centers of crops depicted in time as being infested by adults and eggs.

The insecticide control of the Oulema larvae has had 85% higher efficiency using several products and doses.

Laboratory trials have established the importance of the auxiliary predatory entomophags in the natural biological pest control, the active predator species with high predatory capacity being shown. They eat 5 to 39 eggs/day/individual, and 3 to 40 *Oulema* larvae/day/individual. Therefore, under the given circumstances integrated pest control measures need to be taken (Bărbulescu et al., 1994, 1995, 1997; Malschi, Mustea, 1992, 1998, 1999; Popov, l991) (board 33).

4.1.3.1. Biology, way of attack and regional damages

Oulema melanopus adults come out from the wintering places and migrate in crops in March-April. They feed and occur in large number in certain crops chosen for eggs during April-May. In the attack center leaf damage – the tissues between the nerves are completely eaten in longitudinal strips – can be observed as yellow spots especially in drier springs when they are more visible. This attack of the adults on leaves may cause an average of 8% loss in grain yield in spring barley.

When the growth cycle has been completed, the new adults emerged in June-July feed on several green gramineae, attacking successive crops, forage gramineae, corn.

The eggs are laid over a long period of time, starting in May until the first decade of June. During all this time the limiting activity of the pest biological reserve occurs, performed by the useful fauna of entomophagous predators: *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. and others.

These auxiliaries are extremely important due to species richness and active population abundance in the cereal crops. The eggs and small larvae are eaten by many predatory species which diminish the Oulema larvae attack potential under the agroecological conditions of Central Transylvania.

The larvae attack occurs in crop spots which appear as yellow-whitish color. Because the larvae eat the leaf tissues along the leaf and above the lower epidermis, the attacked leaves being whithered. Yield losses estimated after the larvae attack, in crop attack **spots** with densities exceeding the EDT (250 larvae/mp) have reached mean values of 14-25-62%, that is: 0,8 grains /ear in wheat, 0,4 g grains / ear in spring barley and 2,58 g grains / panicle in oat (Malschi, Mustea, 1998). In 2000, due to excessive draught, yield losses following larvae attack on winter wheat have been much higher, mean values of 50% being recorded, that is losses of 1,61 g grains/attacked plant, in regional wheat varieties Transilvania, Arieşan, Apullum, Turda 95.

During 1991-2000, researches in field experiments have been conducted at the Agricultural Research and Development Station in Turda regarding the chemical natural biological control of the cereal leaf beetle *Oulema melanopus* L. The efficiency of some insecticides and new doses applied for damaging larvae control have been tested in experimental lots of 10-20 m^2 placed in massive attack centers on small grain cereals (spring barley, winter wheat).

The following aspects have been observed in the variants of the efficiency tests:

1. immediate mortality of larvae (24-48 hours after treatment) and the insecticide remaining effect (5-7 days after treatment);
2. development of larvae stages according to the tested insecticide;
3. insecticide side effects on the useful fauna of active entomophags in the crop.

The observations have been made by establishing larvae densities/ m^2, using the metric frame and by analyzing the samples collected from the experimental lots using the entomological net and Barber traps.

The importance of the predatory species activity involved in the natural limitation of the pests has been studied in lab tests, by repeated tests during 1994-2000, establishing the prey/day/predatory individual ratio in feeding isolators with *Oulema* eggs and larvae.

Under the conditions of the years 1999-2000, an increase of the attack potential of the cereal leaf beetle has been recorded, due not only to a constant, multiannual increase of the biological reserve of the species in the region but also to specific factors such as: 1. decrease of small grain cereal cultivated areas, and late emergence of spring crops which lead to a higher occurrence and increases in pest densities in certain existent crops in April-May; in the spring of 2000 it lead to a massive adult occurrence and larvae attack especially on winter wheat; 2. microclimate aridization in early spring and during May-June, characterized by alternating temperature variations, by draught and heat periods, which caused an increase of adult and larvae attack aggressiveness when the favorable feeding conditions have been re-established. The larvae attack was quick in the first decade of June, being active and with all larvae stages developing massively in a short time.

These factors have caused the occurrence of some unexpected attacks in certain cereal fields which required the sample testing regarding pest occurrence and its attack.

4.1.3.2. Insecticide control

Insecticide treatments have been recommended for larvae destruction, having highest efficiency when the pest is caught in the first age larvae stage (Malschi, Mustea, 1998, 1999). Pyrethroid treatments have shown efficiencies of 90-100%, and so did the new products such as: carbamaţi, acetamiprid, fipronil, etofenprox, novaluron, thiametoxam, used in small quantities per hectar. The organophosphorous products were 70-95% efficient (table 56).

First age Oulema larvae control has had an efficiency of over 95% at the following doses/hectare: BULLDOCK 25 EC (200-300 ml), FURY 10 EC or FASTAC 10 EC (100 ml), SUMI APLHA 5 EC (200 ml), KARATE 2,5 EC or CHINMIX 5 EC (300 ml), SUPERSECT 10 EC (150 ml), DECIS FORTE 12 EC (63 ml), REGENT 200 SC (90 ml), SINORATOX 35 EC (2-3,5 l) SINORATOX PLUS (1,6 l) and others.

In 1999, the product efficiency and the new doses adapted to the larvae attack specificity at different ages have been tested, with eggs and adults also existing in the crop. The diversity of control choices using new insecticides has also been studied, especially for pest control in valuable cereal lots, designed for seed production (table 57). Modern products have been used, such as: REGENT 200 SC (fipronil), which showed very good efficiency for doses of 90 ml/ha (recommended dose) and MOSPILAN 20 SP (100 g/ha) having 96-100 % efficiency in larvae control right after treatment application and 5 days after treatment, respectively.

Pyrethroids have been recommended for the protection of useful fauna where it is active and important for its entomophagous effect. They have had valuable efficiencies: 99,6 - 100 % for SUMI-ALPHA 2,5 EC (400 ml/ha), stressing on the good effect and remanence of the product POLYTRIN 200 SC (100 ml), recorded with 88-97 % immediate efficiency and 5 days after treatment, respectively. For the lots requiring fast and remanant protection, the efficiency of some complex organophsphorous and pyrethroids-based products has been recorded, such as: ALPHA COMBI 26,25 (500 ml/ha), (a mixture of fenitrotion and esfenvalerate) or ENDURO 258 EC (oxidemeton-methyl and beta-ciflutrine) to provide immediate mortality and a lasting remanence of the action for the time of the staggered emergence of eggs and larvae in the attack centers. These products showed efficiencies of 98-100% immediately and after 5 days.

Under the draught and excessive heat conditions of May 2005 a series of insecticides and doses have been tested for the control of age 2 and 3 Oulema larvae, massively developed in attack centers on winter wheat (table 58), obtaining immediate good efficiencies of 80-90% for the products KARATE 2,5 EC and 5 EC, REGENT 200 SC, RELDAN 40 EC, DECIS FORTE EC, CYPERMETRIN 20 EC, and in May in Central Transylvania the level of the damaging potential of the cereal leaf beetle has been greatly diminished due to the activity of entomophagous predators, to which the climate conditions, heavy precipitations and low temperatures, even late soil freezing, may be added. These regional-specific auxiliary factors have been very important in the natural pest limitation, the chemical control being required after their activity at the time when age 1 larvae massively emerged in adults' feeding and reproduction centers which can be observed, very good control efficiencies recorded 7 days after application, reaching values of 95-100%. The optimal time for the overall pest control in the area refers to the massive emergence of age 1 larvae. It is important to observe the crops during adult occurrence and reproduction and the emergence of the first larvae.

During the growing period of the *Oulema mepanopus* population in April-May, many predatory entomophags are active in amall grain cereals (spring barley) to reduce the abundance of pest eggs and larvae. The tests performed in the laboratory regarding the regional importance of useful predatory fauna have revealed the capacity of destroying Oulema eggs and larvae by the predatory species isolated from the field. In May-June many predatory insects have proved to eat 5-39 eggs/day/individual and 3-40 larvae/day/individual (Malschi, Mustea, 1999) (tabelul 59). In this period, the following species of entomophagous predators can easily be seen as actively occurring in the crops: **buburuzele**-Coccinella, Carabidae (Poecilus, Pterostichus, Pseudophonus, Brachinus, Amara, Harpalus etc.), Malachius, Cantharis, Aleochara, Tachyporus, Sylpha, Nabis, Chrysopa adults and others.

Under field conditions the active predators complex made of 16 species with densities of 16 individuals/m^2 could destroy 250 eggs and larvae/m^2 in 24 hours, representing the EDT value. By selecting the type of insecticide, the use of useful fauna-selective products has been studied together and the achievement of maximum biological control efficiency by application at the regional optimal time (Malschi, Mustea, 1997, 1998, 1999). Most of the insecticides tested during 1999-2000 have had moderate toxic impact on the pest's predators in the treated crops, diminishing the auxiliary populations by 50-75 %. Strong toxic effects have been recorded with the products ENDURO 258 EC, ALPHA-COMBI 26,25 EC şi SUMI-ALPHA 2,5 EC in which the diminisging of the entomophags in the treated variants exceeded 85% 5-7 days after treatment. Consequently, in the last years the biological reserve and the attack potential of the cereal leaf beetle *Oulema melanopus* L in the cereal areas of Central Transylvania have exceeded the economic damaging threshold (EDT) in the attack centers both in the case of adults (over 10 adults/m^2) and larvae (over 250 larvae/m^2). The regional specific factors which determine the massive occurrence and increase of pest density in certain lots and the occurrence of surprising attacks have been as follows: 1. permanent, multiannual increase of the biological reserve; 2. decrease of small grain cereal cultivated areas; 3. microclimate aridization in early spring and during May-June, which causes the increase of adult and larvae attack aggressiveness under favorable feeding conditions. The optimal time for an overall pest control in the region is the massive emergence of age 1 larvae. To establish this moment the observation of the crops during the period of adult occurrence, reproduction and the emergence of the first larvae has been important. The level of pest larvae damaging potential during this period has been diminished due to the activirty of entomphagous predators, to which the climate conditions unfavorable to the pest have been added (heavy precipitations and low temperatures). The chemical control has been recommended when the age 1 larvae massively emerged, after the action of the natural, region specific limiting factors has occurred in the feeding and reproduction centers of the adults established by sampling. The importance of the auxiliary entomophagous predators in the natural biological pest control has been established in laboratory tests, the active predatory species in the crops being noticed as having high preying capacity of 5-39 eggs/day/individual and between 3-40 Oulema larvae /day/individual. The chemical control of the Oulema larvae has shown efficiencies of over 85% when using the following products and doses /ha: BULLDOCK 25 EC (200-300 ml), FURY 10 EC or FASTAC 10 EC (100 ml), SUMI APLHA 5 EC (200 ml), KARATE 2,5 EC or CHINMIX 5 EC (300 ml), SUPERSECT 10 EC (150 ml), DECIS FORTE 12 EC(63 ml), REGENT 200 SC(90 ml), VICTENON 50 WP(400 ml), SINORATOX 35 EC (2-3,5 l), RELDAN 40 EC (1,25 l }, SINORATOX PLUS (1,6 l), ALPHA COMBI 26,25 (500 ml).

Tab. 56

Efficiency of insecticides on *Oulema melanopus* larvae control (ARDS Turda)

Period of treatments (May - June)			Efficiency (%)	
Insecticide	Product	Doze (ml/ha)	1991 – 1999	2000-2003
Pyretroizi de sinteza.				
Alpha-cipermetrin	FASTAC 10 EC	100 ml	100	100
Alfa-cipermetrin	ALPHAGUARD 10 EC	150 ml	99	-
Alfa-cipermetrin	ALPPHACIPERMETRIN	100 ml	-	95,8
Beta-cipermetrin	CHINMIX 5 EC	300 ml	100	-
Deltametrin	DECIS 2,5 EC	300 ml	94	93
Deltametrin	DECIS FORTE 12 EC	63 ml	91	95,0
Deltametrin	DECIS 25 WG	30 g	-	96,6
Beta-Cyflutrin	BULLDOCK 25 EC	200 ml	98	-
Esfenvalerat	SUMI-ALPHA 2,5 EC	400 ml	97	-
Esfenvalerat	SUMI-ALPHA 5 EC	200 ml	98	100
Labdacihalotrin	KARATE 2,5 EC	300 ml	99	98,3
Labdacihalotrin	KARATE 5 EC	150 ml	-	99,2
Labdacihalotrin	KARATE ZEON	150 ml	-	96,0
Zetametrin	FURY 10 EC	100 ml	97	-
Cipermetrin	POLYTRIN 200 SC	100 ml	98	-
Cipermetrin	SUPERSECT 10 EC	150 ml	97	-
Cipermetrin	CIPERTRIN 10 EC	100 ml	-	96,0
Cipermetrin	CIPERMETRIN 20 EC	75 ml	-	100
Cipermetrin	FASTER	100 ml	-	93,0
Tau-fluvalinat	MAVRIC 25 EW	200 ml	-	99,1
Carbamati				
Fenoxicarb	INSEGAR 50 WP	300 g	66	-
Bensultap	VICTENON 50 WP	400 ml	88	-
Organofosforice si complexe				
Dimetoat	SINORATOX 35 EC	2000-3500 ml	95	-
Clorpirifos metil	RELDAN 40 EC	1250 ml	100	99,6
Clorpirifos 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 + Cipermetrin	SINORATOX PLUS	1600 ml	100	-
Quinalfos+Tiometon	ECALUX S	1000 ml	75	-
Fenitrotion+Esfenvalerat	ALPHA-COMBI 26,25	500 ml	100	97,9
Oxidemetonmetil+betaciflutrin	ENDURO 258 EC	1000 ml	-	98,3
Alte insecticide				
Etofenprox	TREBON 30 EC	250 ml	100	-
Novaluron	RIMON 10 EC	250 ml	91	-
Thiaccloprid	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
Densitatea daunatorului. Pest density : 250-350 larve / m^2				

Tab. 57

Efficiency of some insecticides on *Oulema melanopus* larvae control in spring barley (1999-A.R.S. Turda)

Insecticide.	Products.	Doze/ha	At 24 h after treatment.		At 5 days after treatment.	
			Larve/ m^2	Efficiency %	Larvae/ m^2	Efficiency %
1.Fipronil	REGENT 200 SC	75 ml	122,0	63,0	18,0	93,0
2.Fipronil	REGENT 200 SC	90 ml	0,0	100,0	1,7	99,3
3.Fipronil	REGENT 200 SC	100 ml	4,0	98,8	0,0	100,0
4.Acetamiprid	MOSPILAN 20 SP	100 g	12,7	96,1	0,7	99,7
5.Bensulptap	VICTENON 50 WP	400 g	34,7	89,5	34,7	86,7
6.Fenoxicarb	INSEGAR 25 WP	300 g	112,7	65,8	105,3	59,5
7.Cipermetrin	POLYTRIN 200	100 ml	39,3	88,1	7,3	97,2
8.Esfenvalerat	SUMI-ALPHA 2,5EC	400 ml	1,3	99,6	0,0	100,0
9.Fenitrotion+ esfenvalerat	ALPHA-COMBI 26,25	500 ml	5,3	98,4	0,0	100,0
10.Oxidemeton metil+betaciflutrin	ENDURO 258 EC	1000 ml	2,7	99,2	0,0	100,0
11.Martor. Check.	Netratat		330,0	-	258,7	-
	DL(p5%): 37,4; DL(p1%): 49,8; DL(p0,1%): 64,9. Proba F: (F. teoretic=2,02): 7,45*				DL(p5%): 13,4; DL(p1%): 18,1; DL(p0,1%); 23,6. F: 276,16*	

Tab. 58

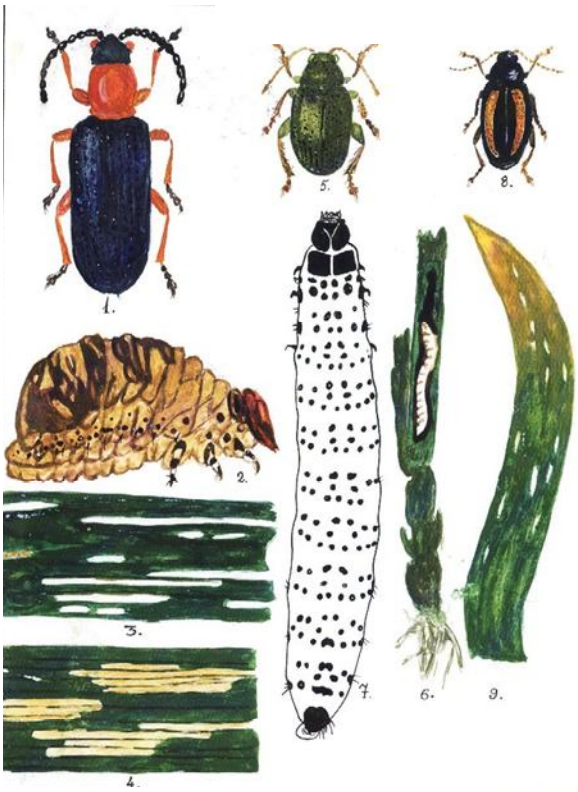
Efficiency of some insecticides on *Oulema melanopus* larvae control in winter wheat (2000-ARS Turda)

Insecticides.	Products.	Doze/ha	At 24 h after treatment.		At 7 days after treatment.	
			Larve/ m^2	Efficiency %	Larve/ m^2	Efficiency %
1.Fipronil	REGENT 200 SC	75 ml	19	85,8	2,0	98,3
2.Fipronil	REGENT 200 SC	90 ml	74	44,8	3,0	97,5
3.Fenitrotion+esfenvalerat	ALPHA-COMBI 26,25	500 ml	71	47,1	2,5	97,9
4.Oxidemeton metil + betaciflutrin	ENDURO 258 EC	1000 ml	63	53,0	2,0	98,3
5.Clorpirifos metil	RELDAN 40 EC	1000 ml	23	82,8	0,0	100,0
6.Clorpirifos metil	RELDAN 40 EC	1250 ml	39	70,9	0,5	99,6
7.Clorpirifos metil	RELDAN 40 EC	1500 ml	105	21,7	1,0	99,2
8.Pirimifos metil	ACTELLIC 50 EC	1000 ml	61	54,5	1,0	99,2
9.Thiametoxam	ACTARA 25 WG	60 g	51	62,0	1,0	99,2
10.Thiametoxam	ACTARA 25 WG	90 g	66	50,8	1,0	99,2
11.Deltametrin	DECIS FORTE 12 EC	65 ml	17	87,3	6,0	95,0
12.Cipermetrin	CYPERMETRIN 20EC	75 ml	28	79,1	0,0	100,0
13.Lambda cihalotrin	KARATE 2,5 EC	300 ml	14	89,6	2,0	98,3
14.Lambda cihalotrin	KARATE 5 EC	150 ml	12	91,1	1,0	99,2
15.Martor. Check.	Netratat	-	134	-	119,2	-
	DL(p5%): 19,4; DL(p1%): 26,0; DL(p0,1%): 34,1. Proba F: (F t=2,00): 27,18*				DLp5%:5,6; DLp1%:7,5; DLp0,1%Ş 9,9. F: 234,8*	

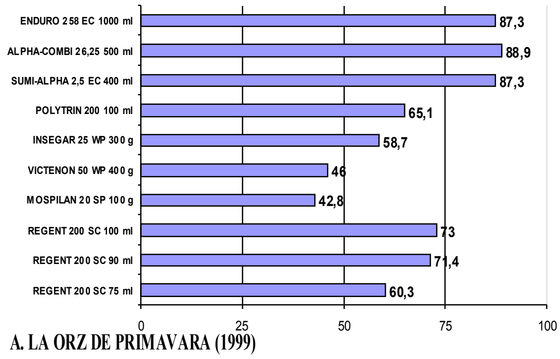
Tab. 59

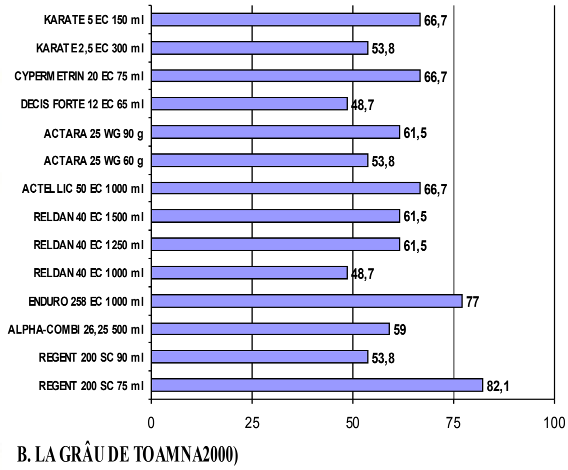
Minimum prey ratio by day and individual for the main entomophagous predators in feeding trials with *Oulema melanopus* L. in laboratory conditions(1994-2000, Agricultural Research Station Turda).

Entomophagous predators	*O. melanopus* (consumed individuals / day / predator)		
	eggs	larvae I stage	larvae II stage
1.Chrysopa carnea (larva II stage)	10	17	-
2.Nabis ferus (adult)	15	17,8	14,6
3.Coccinella septempunctata (adult)	10	23	15
4.Propylaea 14-punctata (adult)	7	3	-
5.Malachius bipustulatus	-	19	20
6.Cantharis fusca	6	-	-
7.Aleochara bilineata	10	-	-
8.Tachyporus hypnorum	8	-	-
9.Poecilus cupreus	38,8	40	38,5
10.Pterostichus melanarius	37,5	20	-
11.Pseudophonus pubescens	8	9	-
12.Harpalus distinguendus	8	3	-
13.Harpalus aeneus	5	4	-
14.Amara aenea	9	5	-
15.Brachinus explodens	28	23,5	-
16.Sylpha obscura	14	26	-
Active predators (total)	214,3	210,3	88,1

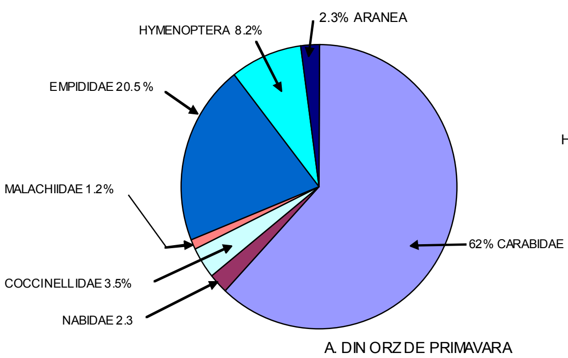


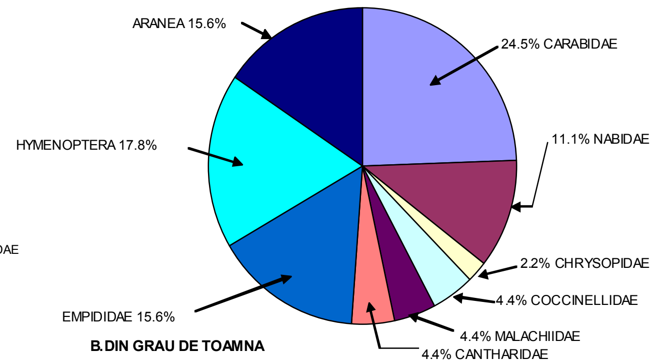
***Oulema melanopus* L. :**
1-adult, 2-larva, 3-leaf attacked by adult, and eggs, 4-leaf attacked by larva.
***Chaetocnema aridula* Gyll.: 5-adult, 6-larva on wheat straw.**
***Phyllotreta vitulla* Redt.: 8-adult, 9-attacked leaf.**





Entomophagous populations percentual reduction at 5-7 days after insecticides control of *Oulema melanopus*. Insecticides toxicity on the useful fauna, A. Spring barley. 1999, B. Winter wheat. 2000. A.R.D.S.Turda. Scale (percent mortality): 1=harmless(<25%); 2=slightly harmful(25-50%); 3=moderately harmful (51-75%); 4=harmful (>75 %), (Hassan & colab.1985).





Structure of active entomophagous arthropods at insecticides application time on the control of cereal leaf beetle *Oulema melanopus*, 1999-2000,S.C.D.S.Turda.

4.1.4. Wheat thrips (*Haplothrips tritici* Kurdj.) and the integrated control system

Wheat thrips (*Haplothrips tritici* Kurdj.) is a significant pest, the adults and larvae causing damaging by feeding in wheat ears. The population level and the wheat thrips attack have been higher in late grown crops. The larvae cause the greatest damages at the end of June and the beginning of July especially if the growing stage of the wheat plants is late. In the last years the increase of *H. tritici* populations at mean values of 12,5-22 larvae/ear has been favored by the agroecological conditions, mainly microclimate warming and the constant cultivation of wheat in the area.

One of the most important factors limiting pest development has been the activity of entomophagous predators. They destroy the thrips adults, eggs and larvae occurring on wheat ears in June and diminishing thrips populations at values below the damaging economic threshold EDT. If the EDT value of 5 adults/m^2 or /10 sweepnet catches has been exceeded every year, starting at wheat ears heading, the EDT values of 8 adults/ear and 40 larvae/ear have not been reached during grain ripening.

The study of wheat thrips natural limiters effect reflected in yield increases of regional varieties has been conducted in ecological field experiments, and the results showed multiannul mean increases of 15.5-24% in grain yield and 15.5% MMB values, respectively, in spikes visited by predators belonging to Chrysopidae, Nabidae, Aranea, Aeolothripidae, Carabidae, Staphylinidae, Coccinellidae, Malachiidae, Cantharidae, Syrphidae, Empididae and others. The most intense activity occurs in mid June especially by the thrips predator larvae.

4.1.4.1. Chemical control

Under the conditions of periods with normal climate, the chemical thrips larvae control has been carried out with new products REGENT 200 SC, MOSPILAN 20 SP, INSEGAR 25 WP, POLYTRIN 200 SC, SINORATOX PLUS, ALPHA-COMBI 26,25, ENDURO 258 EC) during June 20-25 (a month before wheat ripening) and protecting the activities of the auxiliary predators. Grain yield increases of 10-20 percentages and very good control efficiencies have been recorded in the experiments conducted in 1997, 1999 (table 60).

The chemical control has been performed in experimental lots of 10-20 m^2 in 3 repetitions against thrips larvae, and the efficiency of modern, common insecticides has been tested. The treatment time has been chosen in the second decade of June (20-25th), in accordance with the predatory activity in order to protect and use them.

The efficiency of some insecticides in larvae control and the influence on grain yield has been tested by treatments applied in flag leaf and ear emergence stage (stage 45-59 DC) during May 15-25, 2001-2002, and in 2003 (table 61, 62), and during June 20-25, 2000-2001, in the milky-wax stage (stage 77-87 DC), (table 63), in order to protect and use the peak activity of the auxiliary predators. The new treatments with adequate insecticides such as: chlorpirifos-methyl, dimethoate, deltametrine, thiachloprid, thiametoxam, acetamiprid, fipronil, bensultap, fenitrotion-fenvalerate, oxidemetonmethyl-betaciflutrine, chlorpirifos-cipermetrine etc. have shown yield increases, statistically ensured, reaching 10-23% and high thrip control efficiencies of 70-90% (table 63).

4.1.4.2. Agroecological factors involved in population dynamics and the degree of damages caused bywheat thrips in Central Transylvania

During the last years, winter wheat crops have recorded increases in thrips populations (*Haplothrips tritici Kurdj*.), their larvae sometimes exceeding the damaging economic threshold densities in grain formation and milky-wax ripening phenophase (10-40 larvae/spike). The years 1997-1999 characterized by heavy precipitations and excessive heat in May, June and July favored thrips development on ears, which revealed the regional importance of the study.

One of the most important pest development limiting factors has been the activity of natural entomophagous predators. Thrips adults, eggs and larvae have been destroyed by these predators. In June, predator occurrence on wheat ears have diminished thrips population under the economic damaging threshold EDT. Every year, at the beginning of ear emergence, EDT of 5 adults/m^2 (or 5 adults/10 sweepnet catches) has been exceeded, while in the next vegetation stages, at grain filling and ripening the EDT of 8 adults/ear or 10-40 larvae/ear has no longer being achieved due to predators activity. At flowering and milky-ripe stage, in mid June, maximum activity of the following predators (*Chrysopidae, Nabidae, Aranea, Aeolothripidae, Carabidae, Staphylinidae, Coccinellidae, Malachiidae, Cantharidae, Syrphidae, Empidiidae*) in the natural limitation of wheat thrips has been reached. The ecological researches on the effect of the predators involved in thrips destruction in wheat ears, have shown significant yield differences(g.grains/ear) 17,5-25,9% and MMB of 15% in the case of the ears visited by predators. The studies on the pest destructive capacity against wheat thrips in the lab feeding tests, have shown that 10-15 thrips adults/day/individual of *Chrysopa, Episyrphus, Malachius sau Cantharis* have been destroyed, and also 10-42 trips larvae/day/individual of *Chrysopa* and *Episyrphus*, adults and larvae of *Nabis* and *Coccinella*, *Propylaea, Malachius, Pseudophonus pubescens*.

The comparative researches on the abundance and dynamics of the thrips and its predators have been conducted in two wheat crop systems, in open field at Turda and agroforestry belt system at Cean-Bolduţ. The results have shown significant results of thrips populations level in open field averaging 12.5-22 larvae/ear and 1.9-3.8 larvae/ear, in agroforestry belt system; the determination index of 23%-32% and significant correlations with R=0.48 in open field and R=0.59, forestry belts system, respectively, has shown a stronger impact of the entomophagous fauna on thrips populations in the forestry belts-based agroecosystem. The study of the evolution and dynamics of wheat thrips has been achieved by entomofauna analyses captured every ten days in 300 double sweep net catches/sample in wheat crops, in 2 comparative studies: in open field and agroforestry belts, while the attack has been established by periodical analysis of 30 ears of the studied variants. Under the conditions of experimental field, observations on wheat thrips and its predators have been carried out in an winter wheat poly-factorial experiment, the ecological factors being as follows: **- wheat phenological stage** differentiated by two distinct sowing periods (1-in technological optimal time /10.11.1998, and 2- at late time/10.21.1998, factors that caused significant differences among variants through their different phenological phases of grain formation and ripening); **-four varieties:**Transilvania, Arieşan, Apullum, Turda 95; **- two differentiated ecological variants**: 1-by placing a glue ring at the ear base which stopped predatory larvae occurrence on thrips-populated ears, and 2-the variant commonly visited by predators, without the glue ring, respectively, both having 30 ears. In the same 3 factor experimental system two other variants have also been differentiated comprising: different sampling dates: 06.10.1999 and 07.05.1999. **The controlled biological control** has been experimented in two variants represented by lots treated with 2 *Chrysopa carnea* or *Coccinella 7-punctata* larvae/m^2 in the wheat milky-wax ripening phenophase, and untreated controls, respectively (in wheat variants sown later with late ripening). Yields measured as grams of grains/ear, kg/ha and the MMB values have been recorded on the lots or analyzed samples in 3 repetitions. It has been noticed that in June-July thrips larvae populations developed in accordance with the climate conditions and wheat vegetation stage (tables 63, 64), being more abundant on the ears of phenologically late wheat lots due to late sowing. Better thrips-populated varieties were Transilvania and Apullum. At the beginning of June high densities values have been recorded in technological optimal time, larvae attack continuing until July. In the first decade of June a significant density of thrips larvae in phenologically late variety Transilvania reaching 5.9 larvae/ear. In the other varieties, the higher number of larvae has been recorded in phenologically late variants reaching values of 7.4, 8.8 and 10 larvae/spike/07.05.1999.

4.1.4.3. Limitation of *Haplothrips tritici* population with entomophagous predators. Biological control. The effect of predators activity involved in thrips natural limitation on ears has been observed in the ecological field experiments, recording and analyzing grain yields in normal ears visited by predators (during June 10-30), most of them as larvae, compared to the yield of the isolated ears (predators free).The isolation has been performed by a glue ring at the ear base. The study has been carried out on 30 marked ears/variant, in accordance with the phenological development of the crop in two variants sown at the right time and late, respectively in 5 zone wheat varieties: Transilvania,Turda 81,Arieşan, Apullum,Turda 95. Twenty *Chrysopa carnea* age 1 larvae/lot have been launched in lots of 10 m^2 and 3 repetitions/variant in wheat milky-ripe phenophase. *Chrysopa* larvae have supplemented the natural entomophagous activity and have lead to yield increases in the breeds Transilvania, Arieşan and Turda 95 (96, 189, 532 kg grains/ha or 102, 104, 113 % yield increase). The importance of the natural biological control has been revealed by the analysis of individual variation performed by the predatory larvae complex on the wheat ears over the thrips larvae under the conditions of year 1999. It has been noticed that in phenologically late wheat (sown late in 10.21.1998), in the ears visited by predators significant yield positive differences have been obtained compared to those isolated by glue ring at the ear base (0.35g grains/ear in Transilvania; 0.18g/spike in Arieşan; 0.40g/spike in Apullum; average of 0,25g grains/spike, that is 16% increase. Significant yield increases in the non-isolated ears visited by auxiliary entomophagous predators have been recorded in wheat varieties sown within technological optimal time (10.11.1998), increases of 0.16, 0.26g grains/ear, that is 11% and 17.8% increase in later varieties,Transilvania and Turda 95. The MMB values could be analyzed from the data in table 65. The factors studied in their different scales have provided significant differences among the variants. The non-isolated ears visited by the natural predators reserve have yielded grains with significantly higher MMB values compared to the isolated spikes both in the technologically optimal time sown wheat and the late one. Supplementing the number of natural predators by launching 2 *Chrysopa* age 1 larvae/m^2 has given obvious results, which shows that yield increases resulted from the biological control has been reflected in significant MMB value.

The study of thrips dynamics in open field wheat crops and forestry belt-protected wheat crops has shown the presence of some strong structural interactions with the predatory entomophags. Especialy in the forestry belted crops they have diminished the abundance of thrips populations (mostly larvae) to values below EDT during the critical attack period. During 1997-1999**(fig.13)** thrips limitation was 36% higher in agroforestry belted wheat crops than the open field wheat crops.

Tab. 60

Insecticides efficiency (%) in wheat trips (*Haplothrips tritici*) control (ARDS Turda)

Treatment period (20-25 June)			Efficiency %	
Insecticide	**Produsul. 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 50WP	500 g	80	-
Fenoxicarb	INSEGAR 25 WP	300 g	77	-
Fenitrotion	FENITROTION 500g/l	500 ml	-	86
Dimetoat	SINORATOX35EC	3500 ml	84	-
Dimetoat	EFDACON 40 EC	3500 ml	91	-
Diazinon	DIAZOL 48 EC	1500 ml	59	-
Clorpirifos	PYRINEX 50 EW	1500 ml	76	-
Clorpirifos etil	PYRINEX 25 MF	3000 ml	-	97
Clorpirifos metil	RELDAN 40 EC	1250 ml	90	-
Oxidemetonmetil+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
Cipermetrin	POLYTRIN 200SC	100 ml	69	-
Cipermetrin	CIPERTRIN 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
DENSITATEA (larve/spic). Pest density (larvae/ear)			12,5	16,5

Tab. 61

Effect of the treatment for wheat trips control, applied at flag-leaf phaze, in 45-59 DC stage, at 15-25 May 2000-2002, ARDS Turda.

Product and dose/ha.	**Eficacitate (%)**	Grains yield		
		kg/ha	dif.	%
Netratat. Check. 9,2 larve/spic	-	5.081	-	100
Mospilan 20 SP 100 g	44	5.887	806	116
Alpha-Combi 25,26EC 500ml	78	5.657	576	111
Victenon 50 WP 500 g	66	5.657	576	111
Actara 25 WP 60 g	57	5.696	615	112
Calypso 450 SC 100 ml	62	5.555	474	109
Nurelle D 400 ml	68	5.788	707	114
Reldan 40 EC 1250 ml	70	5.946	865	117
Regent 200 SC 90 ml	72	6.330	1.249	124
DL p 5%-641, DL p1%-883, DL p 0,1 %-1216				

Tab. 62

Effect of the treatment for ear pests control, applied at flag-leaf phaze, at 24 May 2003, A.R.D.S. Turda.

Variante, doze/ha	Ears/m^2	Grains yield		
		kg/ha	dif.	%
Netratat . Check.	339	3.195	-	100
Decis 25 WG 0,03 kg	485	3.791	596	118
Alphametrin 0,1 l	416	4.045	850	127
Fastac 10 CE 0,1 l	397	3.705	510	115
Sumi-Alpha 5% 0,2 l	441	3.390	195	106
Calypso 480 SC 0,1 l	307	3.310	115	104
Mospilan 20 SP 0,1 kg	411	3.460	265	108
Regent 200 SC 0,09 l	393	3.220	25	101
Victenon 50WP 0,5 kg	403	2.816	-379	88

Tab. 63

Effect of the treatment for wheat trips larvae control, applied at milky-ripenig phaze, in 77-87 DC stage, at 20-25 June 2000-2002, ARDS Turda.

Product and dose/ha.	Larvae/ear	Efficiency	Grain yield			TGM	
			Kg/ha	%	Diferenţa	TGM	%
Martor netratat	21,2	-	3970	100	-	46,8	100
REGENT 200 SC 90 ml	6,0 ooo	72 %	4565	115	595 ***	46,6	100
ALPHA-COMBI 25,26 500 ml	5,6 ooo	74 %	4666	118	696 ***	48,1***	103
ENDURO 258 EC 1000 ml	4,5 ooo	79 %	4531	114	561 ***	47,7**	102
RELDAN 40 EC 1250 ml	6,4 ooo	70 %	4369	110	399 **	48,9***	104
DECIS FORTE 12 EC 65 ml	7,1 ooo	67 %	4794	121	824 ***	47,7**	102
ACTARA 25 WG 60 g	6,3 ooo	70 %	4874	123	904 ***	49,8***	106
VICTENON 50 WP 400 g	8,2 ooo	61 %	4813	121	843 ***	49,2***	105
MOSPILAN 20 SP 100 g	5,4 ooo	74 %	4868	123	898 ***	48,7***	104
DLp5%; DLp1%; DLp0,1%; Testul (Ft.=3,12)	1,5; 2,0; 2,7; 95,7**		290; 390; 517; 4,2**			0,63; 0,84; 1,11 12,1**	

Tab. 64

The effect of entomophagous predators activity expresed in grain yielded after biological natural control against the ear pests of wheat, 1994-1998, A.R.S.Turda.

Grain yield / ear (g), in Ariesan variety.

Marked ears. (10-30 iunie)	**1994**	**1995**	**1996**	**1997**	**1998**	**Average**
	x±sx	**x±sx**	**x±sx**	**x±sx**	**x±sx**	**x±sx**
With predators.	2,13±0,05	2,46±0,04	2,59±0,06	2,12±0,06	2,01±0,03	2,26±0,05
Without predators	2,04±0,08	1,81± 0,04	2,34±0,13	1,63±0,04	1,43±0,06	1,85± 0,05
d ±sdx	0,09±0,06	0,62±0,04	0,25±0,095	0,49±0,05	0,58±0,045	0,41±0,05
Testul t	1,38	15,5***	2,63*	9,8***	12,8***	8,2***
% grain yield increasing.	4,2%	25,5%	9,6%	23,1%	28,8%	18,2%

n1=n2=30 spice(ears); t 58 : p 5%=2,004; p 1% =2,669; p 0,1%=3,476

Pests density / ear (nr.).

Year.	1994	1995	1996	1997	1998	Average
Halothrips tritici	20	5	26	9	8,9	13,8
Sitobion avenae	10	25	20	2	1	11,6

Tabelul 64, continuare

Effect of the activity of natural predators of wheat ear pests, expressed by grain yield in the conditions of 1998, A.R.S. Turda

1. On the wheat zone varieties, with optimal sowing date (at 10 october 1997). Average grain yield - g /ear.						
g/ear	Transilvania x+sx	Turda 81 x+sx	Arieşan x+sx	Apullum x+sx	Turda 95 x+sx	Average x+sx
With predators.	2,17 + 0,07	2,24 + 0,06	1,98 + 0,06	1,77 + 0,06	2,13 + 0,07	2,06 + 0,06
Without predators	1,96 + 0,06	1,68 + 0,07	1,60 + 0,05	1,23 + 0,03	1,40 + 0,06	1,57 + 0,05
d +sdx	0,21 + 0,065	0,56 + 0,065	0,38 + 0,055	0,54 + 0,045	0,73 + 0,065	0,49 + 0,055
Testul t	3,231**	8,615***	6,91***	12,0***	11,23***	8,91***
Spor de producţie. % increasing yield.	9,7%	25,0%	19,2%	30,5%	34,3%	23,8%
2. On wheat zone varieties, with later sowing date (at 25 october 1997). Average grain yield - g /ear						
g/boabe/spic. g/ear	Transilvania x+sx	Turda 81 x+sx	Arieşian x+sx	Apullum x+sx	Turda 95 x+sx	Average x+sx
With predators.	2,04 + 0,06	1,68 + 0,05	2,01 + 0,03	2,14 + 0,03	2,57 + 0,08	2,09 + 0,05
Without predators	1,56 + 0,07	1,13 + 0,03	1,43 + 0,06	1,30 + 0,05	1,69 + 0,08	1,42 + 0,05
d +sdx	0,48 + 0,065	0,55 + 0,04	0,58 + 0,045	0,84 + 0,04	0,88 + 0,08	0,67 + 0,05
Testul t	7,385***	13,750***	12,889***	21,0***	11,0***	13,4***
% increasing yield	23,5%	32,7 %	28,8%	39,2%	34,2%	32,1%
t 58 DL 5%= 2,004; DL 1 % = 2,669; DL 0,1%= 3,476; sdx= sx1+ sx2: 2; t + d : sdx; n1=n2=30 spice						

Tabelul 65

The effect of natural biological control of wheat ear pests realized by predators, in relation with the sowing time and wheat variety (Transilvania, Turda 81, Arieşian, Apullum, Turda 95), (the grain development in g TGM),

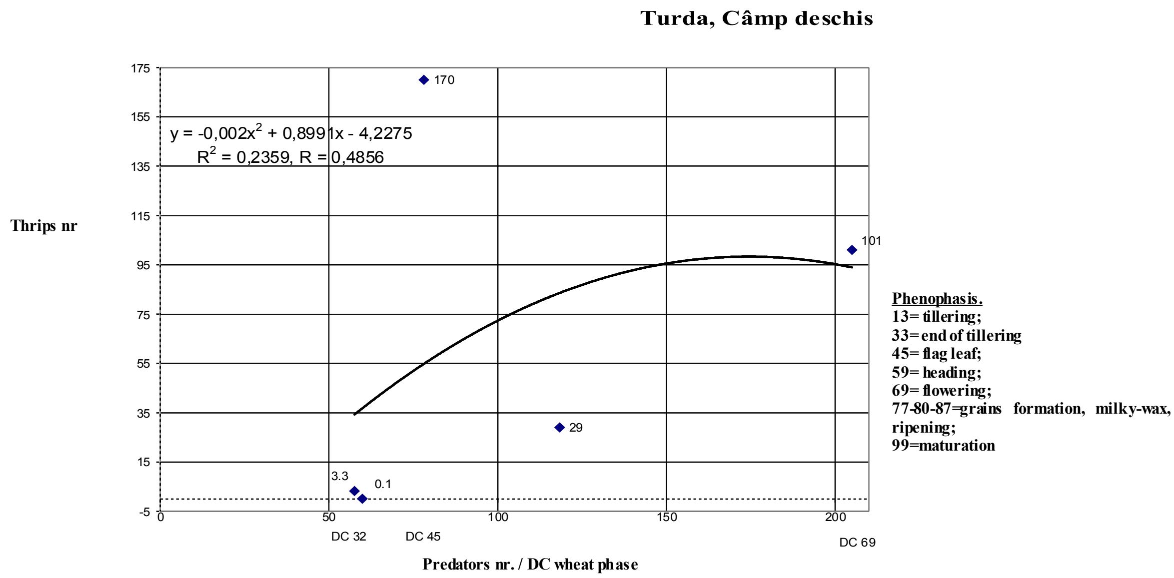
1. Factors influence and interaction.	TGM	%	Dferenţa
Sowing time at 11 oct.1997.	41,35	100	0,00
Sowing time at 24 oct.1997.	38,92	94,1	-2,44[00]
DL (p 1%) 0.97 ; DL (p 0,1%) 3,09			
2. Ears. * Without predators * With predators.	37,23 43,04	100,0 115,6	0,00 +5,82***
DL (p 0,1%) 0,46			
Cultură semănată la 11.X.1997. Sowing time at 11 oct.1997			
Ears. * Without predators * With predators.	38,81 43,89	100,0 113,1	0,00 +5,08**
Sowing time at 24 oct.1997.			
Ears. * Without predators * With predators.	35,64 42,19	100,0 118,4	0,00 +6,55***
DL (p 0,1%) 0,66			
Sowing time at 11 oct.1997			
Transilvania * Without predators * With predators.	44,03 46,73	100,0 106,1	0,00 2,70***
Turda 81 * Without predators * With predators.	32,13 39,07	100,0 121,6	0,00 6,93***
Arieşian * Without predators * With predators.	46,27 47,27	100,0 102,2	0,00 1,00*
Apullum * Without predators * With predators.	33,63 42,20	100,0 125,5	0,00 8,57***
Turda 95 * Without predators * With predators.	38,00 44,20	100,0 116,3	0,00 6,20***
Sowing time at 24 oct.1997.			
Transilvania * Without predators * With predators.	38,7 46,13	100,0 121,2	0,00 8,07***
Turda 81 * Without predators * With predators.	29,87 35,20	100,0 117,9	0,00 5,33***
Arieşian * Without predators * With predators.	44,20 47,30	100,0 107,0	0,00 3,10***
Apullum * Without predators * With predators.	31,53 40,13	100,0 127,3	0,00 8,60***
Turda 95 * Without predators * With predators.	34,53 42,20	100,0 122,2	0,00 7,67

DL p 5% 0,80; DL p 1% 1,08; DL p 0,1% 1,47.

Tab. 66

Wheat grain yield realized by biological control of aphids and trips larvae, applied at milky-ripening 78-90 DC phase by the supplementary launching larvae second stage of *Coccinella 7-punctata* or *Chrysopa carnea* (2 larvae/m^2), A.R.S. Turda, 1997.

Launching predators.		*Coccinella septempunctata* L.					*Chrysopa carnea S*tephn				
		Grain yield			TGM		Grain yield			TGM	
Variety	Variante	Kg/ha	Diff.	%	g	%	Kg/ha	Diff.	%	g	%
Transilvania	Untreated Check.	6406	Mt.	100	54,8	100	6406	Mt.	100	54,8	100
	Untreated Treaty.	6650	+244	104	56,5**	103	6222	-184	97	56,5**	103
Turda 95	Untreated Check.	5703	Mt.	100	51,2	100	5703	Mt.	100	51,2	100
	Untreated Treaty.	5789	+86	102	56,8***	111	6188	+485	109	56,8***	111
	DL 5 %		682					571		-	
	DL 1 %		-							1,65	
	DL 0,1%		-							2,43	



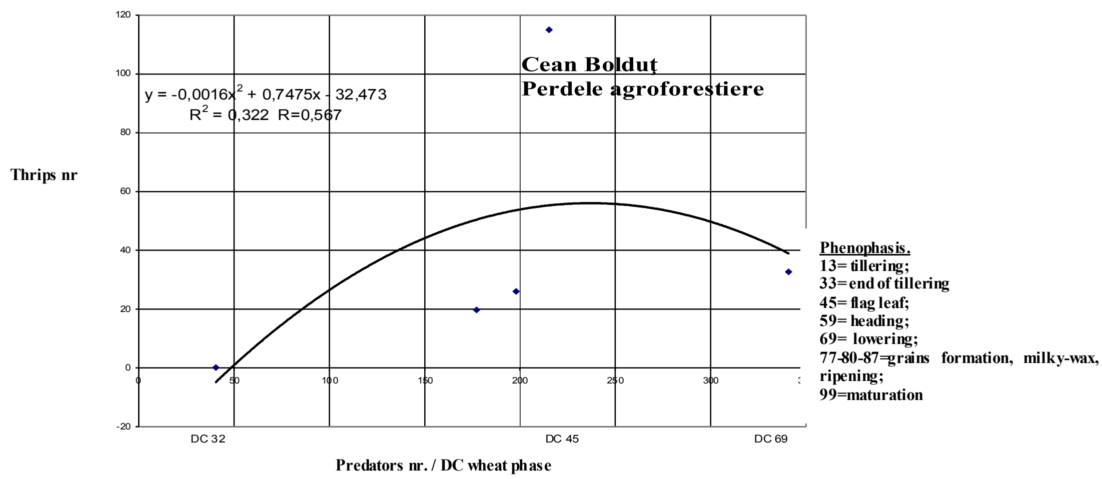
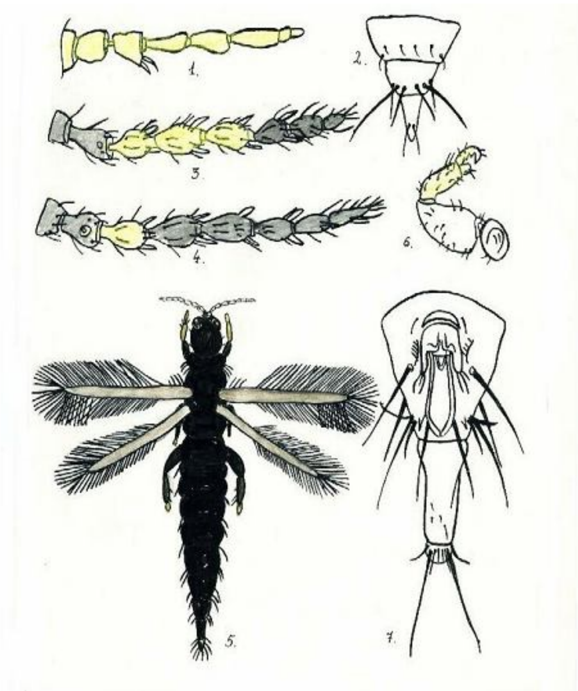
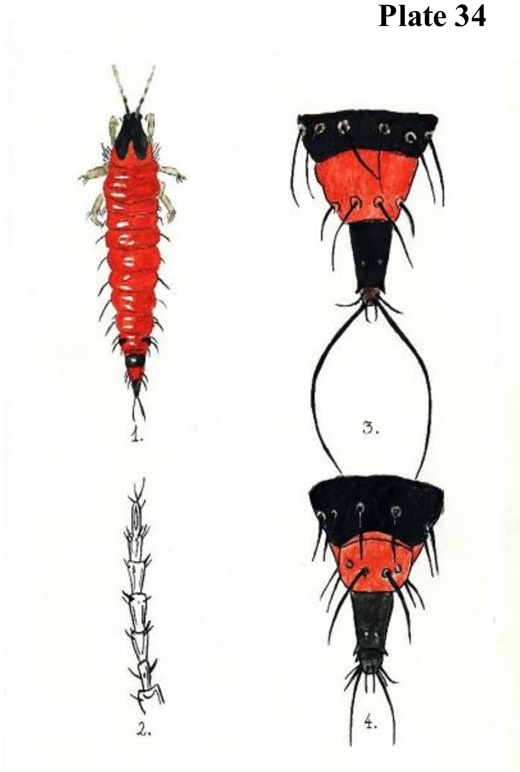


Fig. 13. Dynamics of wheat thrips (*Haplothrips tritici*) depending on aphidophagous predators abundance and on wheat phenophasis in open field area agroecosystem in Turda and in Cean-Boldut agroecosistem with agroforestry belts (ARDS Turda).

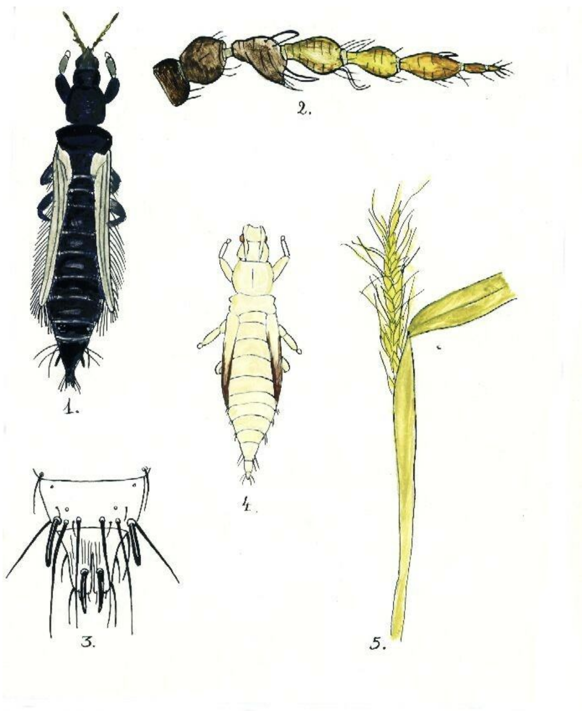
Plate 34



***Stenothrips graminum* Uzel.: 1-antena; 2- abdominal last segments. *Haplothrips aculeatus* F.: 3-antena; *Haplothrips tritici* Kurdj.: 4-antena; 5-adult; 6- anterior leg, 7- abdominal last segments of male (Malschi, 1975).**



***Haplothrips tritici* Kurdj.: 1-larva, 2-antena of the first stage larva, 3- abdominal last segments of the first stage larva, 4- abdominal last segments of the second stage larva. (Baniţă, 1974, Malschi, 1975).**



***Limothrips denticornis* Hal.: 1-adult, 2-antena, last segments of abdomen, 4-nymph, 5-attacked ear of wheat. (Malschi, 1975).**

Wheat ears attacked by *Haplothrips tritici* larvae.

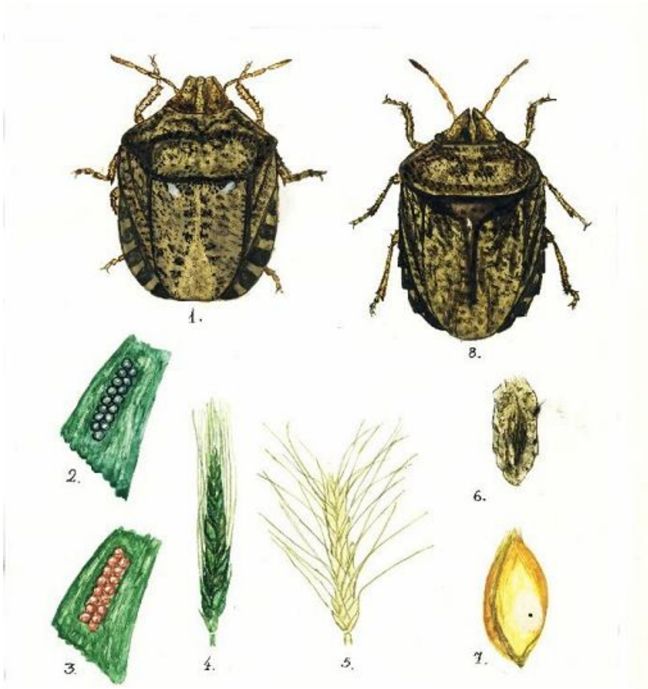
4.2. Monitoring the appearance and attack of small grain cereal pests

Applicative researches regarding the modernization of wheat pest control system have been carried out in the last years and their objective was to experiment new integrated regional control techniques. The integrated management of cereal pest control for the specific agriculture in the Transylvanian Plain is a modern and new principle. The use of the integrated pest control technological complex in field production has an immediate impact on profitable yields and replicability by reducing pest biological and attacking potential from one year to another.

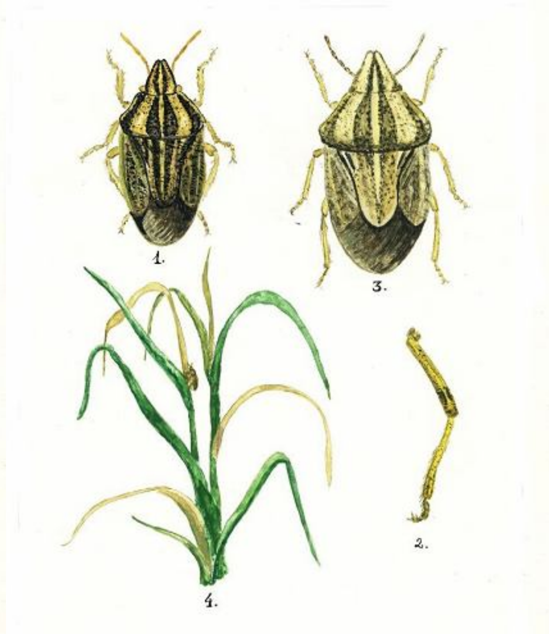
The present period has been characterized by the attack of some small grain cereal pests, typical for Central Transylvania, among which we should mention the complex of cereal flies species complex, wheat flea beetle (*Chaetocnema aridula*), wheat thrips (*Haplothrips tritici),* wheat and barley yellowing and dwarfing vectors (aphids and cycads), and also by the attack of some species which have become damaging such as wheat sun bugs (*Eurygaster, Aelia*), corn ground beetle (*Zabrus tenebrioides)*, cereal beetle (*Anisoplia*) etc. which have been often recorded as a real threat (boards 34-37).

The planning and application of the integrated fighting strategy against pests include special prevention and control measures such as: agrotechnical measures (especially the optimal sowing period, avoidance of monoculture), insecticide treatment application on seed and vegetation in the risk areas where the economic damaging threshold have been exceeded (EDT). The establishment of pest biological and attack potential values in relation with EDT has been achieved by activities of monitorization and prognosis of pest attack based on the applied entomology and ecology knowledge in the field of plant protection.

The recommendation regarding the use of integrated technology, including insecticide treatments and other special pest attack limiting measures has been made under the conditions when the economic damaging threshold (EDT) has been exceeded. The following EDT values have been recommended: for *diptera*: 10-15% attacked plants; for *Lema* - 10 adults or 250 larvae/m^2; for *Haplothrips tritici* - 5 adults/m^2 at the beginning of ear emergence, 8 adults/ear, 10-40 larvae/ear at grain formation and ripening, respectively; for *aphids* and *cycads*: 25 aphids/ear, 10 aphids/plant or 5 cycads/m^2 in autumn after crop emergence. In the crops following cereals, in lots with over 5% attacked plants (or 5 larvae/m^2) by pests in the soil (*Zabrus*, *Agriotes* etc.), insecticide treatments on vegetation have also been recommended (Baicu, 1989, Malschi, Mustea, 1998, Popov et al.,1983, Tanskii, 1981).



1-*Eurygaster maura* L., adult; 2-eggs at lying; 3-eggs at eclozion; 4-unattacked ear; 5-attacked ear; 6-attacked wheat grain 7-punctured grain (Săvescu, 1962, Malschi,1975, 2007)



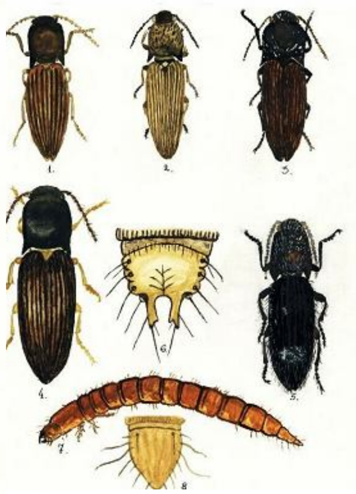
1-*Aelia acuminata* L., adult; 2-leg (two black spot on femur); 3-*Aelia rostrata L.*, adult; 4-wheat young attacked plant (Săvescu,1962, Malschi, 1975,2007)

Zabrus tenebrioides Goeze, 1-adult; 2-larva; 3-life cycle in soil (egg, larva, pupa), 4-5-attack manner (Săvescu,1962, Malschi,1975, 2007)

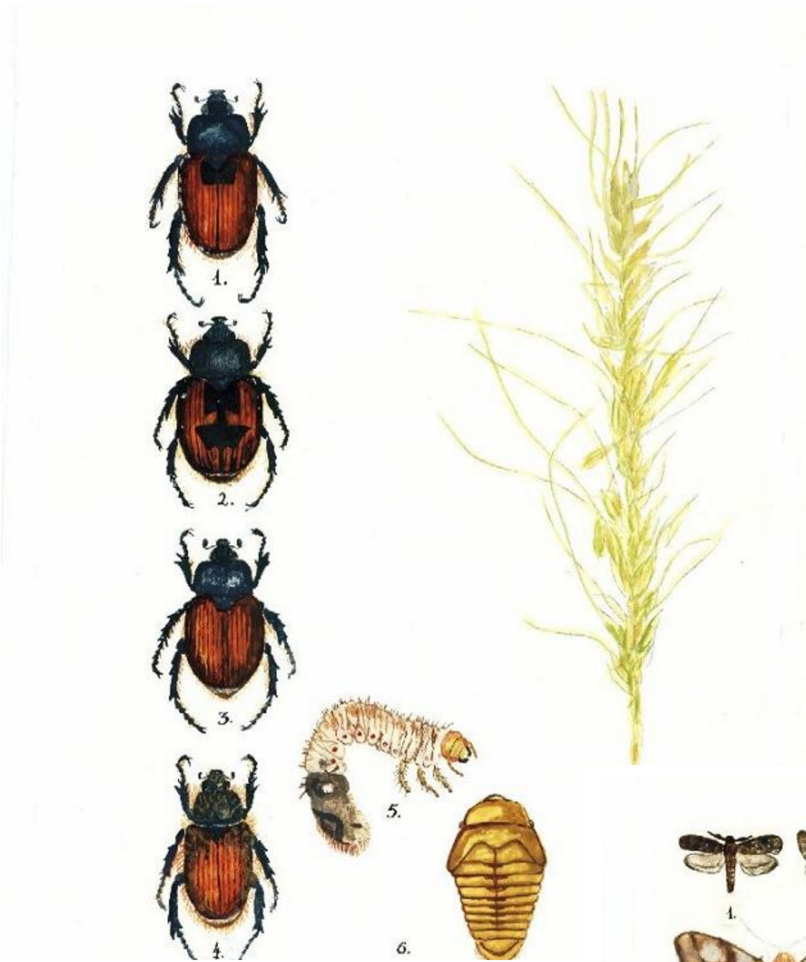
Wheat attacked plants by *Zabrus tenebrioides* (A.R.D.S.Turda, the 10th Mai 2004).

Field aspects of plants after *Zabrus tenebrioides* larvae damages.

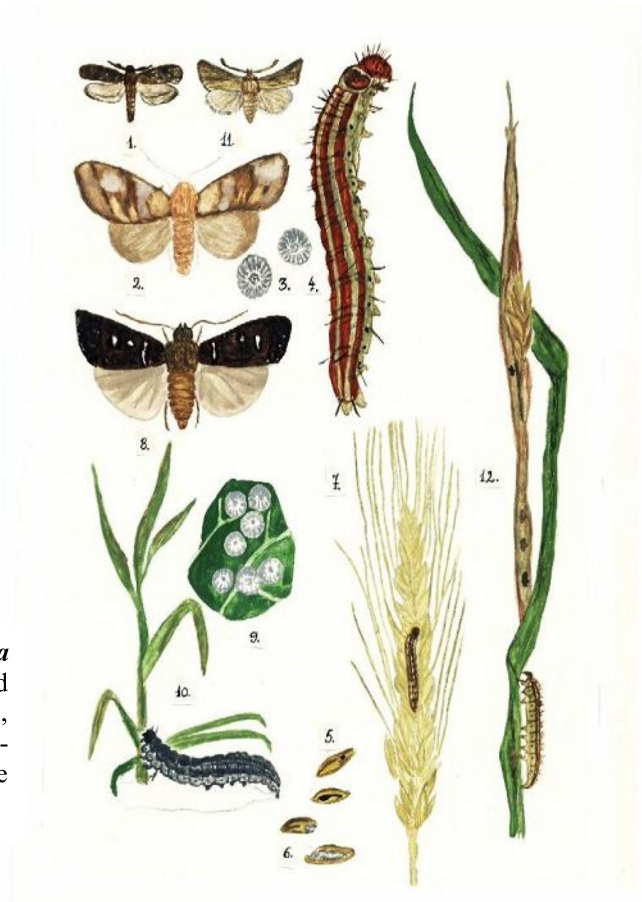
Plate 36



1-***Agriotes lineatus***; 2-***Agriotes ustulatus*** ; 3- ***Agriotes obscurus***; 4- ***Agriotes sputator***; 5-***Athous niger***; 6-last segment of *A. niger* larva; 7-*Agriotes* larva; 8-last segment of *A. lineatus larva*.(Malschi, 1975, 2007)



1- *Anisoplia austriaca* Hb.; *2- Anisoplia agricola* Poda, *3- Anisoplia lata* Er. *4- Anisoplia segetum* Hb.; 5-larva, 6-pupa, 7-attacked ear. (Săvescu,1962, Malschi, 1975, 2007)



1- ***Ochsenheimeria taurella*** Schiff.; 2- ***Hadena basilinea*** F., adult; 3-eggs; 4-larva; 5 şi 6-attacked grains; 7-ear with larvae; 8-***Agrotis segetum*** Schiff., adult; 9-eggs; 10-larva and attacked wheat plant; 11-***Oria musculosa*** Hb., adult; 12-ear attacked by larvae (Malschi, 1975, 2007)

Plate 37

Laboratory isolated wheat with *Psammottetix aliaenus* and *Javesella pellucida adults*, the 29th August 2008)

Laboratory isolated wheat (Arieşan variety) with *Psammottetix aliaenus adults vectors* (2 September 2008)

Isolated wheat (Apullum, Turda 2000, Ariesan, Dumbrava varieties) with *Psammottetix aliaenus* vectors, in 2 September 2008.

Wheat yellowing symptoms after the attack of *Psammottetix aliaenus* sau *Javesella pellucida*, 2008.

Wheat yellowing symptoms after the attack of *Rhopalosiphum padi*, in laboratory trials (5.09.2008).

Yellowing and dwarfing symptoms in wheat voluntiers and wheat crop (A.R.D.S. Turda, the 7th November 2008)

4.2.1. The impact of agroecological, technological and natural factors on the attack potential of wheat pests in Transylvania

At present, critical situations of pest attack have been frequently encountered in small grain cereal crops due to: the incidence of excessive and sudden warming periods in April-May-June; the presence of low density crops and plant late development; the diminish of areas cultivated with small grain cereals. Under crop special conditions of incorrect or incomplete technology, in cereal monocultures, the ground pests *(Zabrus*, *Agriotes*, *Opatrum*, *Gryllus* etc.) play an important role, while some pests, diptera and especially the cycads may cause calamities to the late sown small grain crops.

In the years when, due to climate and technical-economic causes, the small grain cereal cultivated areas have been mighty diminished, a more careful observation of the level of damaging insects populations with significant biological reserves in the region should be carried out. Sampling should be performed at the ground level before sowing after crop emergence (especially in long summers), in early spring and the second half of May when the attack of most pests occurs affecting plants, ears and grain yield (soil pest, diptera, cycads, cereal leaf beetle, aphids, thrips, bugs etc.).

In the structure of the damaging insects recorded in the small grain crops in Transylvania at the Agricultural Research and Development Station in Turda over 50 species have been recorded every year, but only a small number of species-diptera, cycads, coleoptera, aphids and thrips-have caused damages which exceeded the economic damaging threshold (EDT). The protection and conservation of useful arthropod fauna (Coccinellidae, Chrysopidae, Nabidae, Carabidae, Syrphidae, Aranea etc.) diminishing the phytophagous insect populations has been an important aspect of the integrated control concept. The entomophagous predators of the mentioned area-specific pests have developed in crops, reaching a maximum in June. In this period they destroy ear pests ensuring mean yield increases of 15.6%, the regional researches showing the role of the important auxiliaries of the entomophags in pest control.

The impact of the insecticides applied on the wheat crop in Transylvania. Under optimal technological conditions, the experimental data recommend seed treatment with insecto-fungicides which determine a yield increase of 4 - 10 % (300 - 700 kg/ha) and ensure diptera control - as key pests - of 53 - 75 %. Diptera control in vegetation has had partial efficiency of 50 - 75%, being difficult to achieve at the optimal time due to regional agroecological conditions and different pest species in April-May. The treatment applied in early spring when the attack of *Delia* and *Opomyza* and the presence of black fly *Phorbia* has been recorded may provide yield increases of 7-14% (400 - 800 kg/ha) exercising an impact on the pest complex in the crop.

Measuring the damages caused by the diptera attack in winter wheat. Yield losses in the diptera attacked plants have been studied in accordance with the varieties and after attack compensatory reaction under the optimal experimental technological conditions for the wheat crop in the area. At the average frequency of 10% attacked plants and mean density of 450 plante/m^2 in the varieties Transilvania, Turda 81, Arieşan, Apullum, Turda 95 the following values have been recorded: the March-April attack caused by *Delia coarctata* Fall.(wheat bulb fly) approximately 0.92–1.47g grains/attacked plant have been lost; damages have been produced in the egg infested soils over August-September from the previous vegetation year; when the attack of *Opomyza florum* F.(yellow cereal fly) occurred in March-April, an average loss of 0.57-1.22g grains/attacked plant has been recorded; damages of crops emerged in October and infested by eggs have been recorded; when the attack of the black fly *Phorbia securis* Tiensuu and *Phorbia penicillifera* Jermy occurred in May 0.93-1.27g grains/attacked plant have been lost; damages have been produced especially in plants with poor and late phenologial development in spring wheat which are preferred for egg laying in April-May. The study allows the calculation of the regional damaging potential and the economy of the prevention and control measures in accordance with the damaging species, emphasizing the partial efficiency of 50-70% of insecticides (table 67). For the ground pest control (Zabrus, Agriotes) treatments with the following products can be applied:Pyrinex48EC(2,5 l/ha),Dursban 480EC,Basudin600EW(2l/ha).

The *Oulema melanopus* L. larvae control has had an efficiency of over 95% at the following doses/ha: Bulldock 25 EC (200-300 ml), Fury 10 EC or Fastac 10 EC (100 ml), Sumi-Alpha 5 EC (200 ml), Karate 2,5 EC or Chinmix 5 EC (300 ml), Supersect 10 EC (150 ml), Decis Forte 12 EC (63 ml), Regent 200 SC (90 ml), Sinoratox 35 EC (2-3,5 l), Sinoratox Plus (1,6 l) etc. Yield losses have been of 14%, 25%, 62% in wheat, barley and oat, attacked by larvae.

For the control of ear pests the following values have been noticed: for aphids – 90-100% efficiency–in the case of organophosphorous products; 80-90% in pyrethroids, 70-80% in carbamats; for thrips larvae–efficiencies of 60-80% in organophosphorous products and 90-95% in mixtures of organophosphorous and pyrethroids. Very good efficiencies (76-95%) and significant yield increases have been displayed by some new insecticides in experimental doses/ha such as:Sinoratox-Plus(1,6l),Enduro258EC(1-1,5l),Polytrin200SC(100ml),Regent 200SC(90ml), the insecticides affecting wheat pest complex. Harvest delaying in some wheat lots may cause the occurrence and attack of the cereal bugs (*Eurygaster, Aelia*), exceeding the EDT. Bug control is performed by applying Sinoratox35CE(3,5 l/ha),Onefon80PS(1,2kg/ha), Fury10EC(0,1l/ha),Decis2,5CE(0,3l/ha),Fastac10CE(0,15 l/ha), Karate2,5 CE (0,3 l/ha),Sumi-Alpha2,5CE(0,4l/ha).In the invasions caused by locusts Fastac10CE (0,3 l/ha) may be applied.

The aridization of the temperate continental climate in the cereal regions of Transylvania has been manifested in the last years by critical periods of excessive draught, emphasized by heat and gusty winds, and the interposition of short periods of unusual low temperatures. The critical situations caused by the prolonged draught in autumn months causing cereal late emergence and lack of crop emergence are already known in relation with microclimate aridization. Low temperatures and frost starting at the beginning of November or even earlier have caused plant development and tillering stagnation, so that in early spring crop has been feeble developed from the phenological point of view and at diminished densities of emerged plants.

In these cases, the large biological reserve of the pests represents real dangers especially in the case of the species with attacking potential encountered and increasing every year: cereal flies (*Phorbia, Delia, Opomyza, Oscinella*), cycads (*Psammotettix, Macrosteles, Javesella*), cereal leaf beetle (*Oulema)*, wheat fleas (*Chaetocnema, Phyllotreta*) etc. A series of pests from the natural species reserve may become important and damaging again, especially in the small field crops where precursory small grain cereals or monoculture crops have been cultivated in the vicinity. Agricultural land division in small lots on which incomplete or incorrect technologies was used has favored the development of the following pests: corn ground beetles (*Zabrus*), cereal beetle (*Anisoplia*), wireworms (*Agriotes*), aphids, cycads, thrips, many species of cereal flies (*Mayetiola, Oscinella, Chlorops, Meromyza, Phorbia, Opomyza, Delia* etc.). The biological reserve of diptera and cycad species complex has increased to levels which may cause crop calamity in the area, where the attack prevention measures cannot be applied. In the last years the biological reserve of the cereal leaf beetle and wheat fleas have reached dangerous levels and surprising attacks.

Under the conditions of the years with climate dezequilibrium, with draught and excessive heat and aridization, the pest dynamics occurring in autumn and especially spring should be observed by testing samples, invasion tracking and prognosis taking into consideration the vicinity of previously infested lots, dominant wind direction, phenological development and crop density. The record and mapping of the fields with significant densities of pests and the lots preferred for attack should be achieved in every farm by specialists.

In order to prevent the damages caused by these autumn cereal pests, the use of the following agrophytotechnical instructions has been beneficial, contributing to adequate crop development: soil tillages and the soil preparation of the germination at the highest quality level, crop rotation and an adequate precursory crop, fertilization, herbicide treatment and disease control.

Performing sowing with good seed varieties, treated with insecto-fungicides if needed, and most of all the optimum sowing time, that is the first half of October, which ensures the prevention of diptera and cycad attacks, has been especially important. Sowing delay in November may cause the occurrence of more aggressive attacks of the black flies(*Phorbia*), wheat fleas, cycads in early spring.

The diminishing of small grain cereal areas or the delay in spring cereal crops emergence has caused another aspect of regional pest attack, that is the more abundant and preferential occurrence in the existing winter and emerged spring small grain cereal fields which may provide optimal conditions for the development of the pest biological cycle. Thus, in 2000, the *Lema* adults have abundantly occurred first on winter wheat, and then on spring cereals, the larvae attack developing on wheat as well, and control treatments were required.

Insecticide treatments applied in April for diptera and *Oulema* adults control have taken the thrips by surprise and reduced attack potential of the cycads which transmitted via their stings the pathogenic agents of wheat and barley dwarfing and sterility. Cereal leaf beetle (*Oulema)* control is recommended against larvae in the center of attack. Thus, the biological reserve of the pest in the region is diminished and the useful predatory fauna which feeds on eggs and small larvae is protected, achieving an important natural auxiliary control.

After earing, during the milky-wax ripening phenophase, abundant colonies of aphids, cereal bug larvae– mainly thrips – may appear. Insecticide treatments have been recommended in the wheat seed crops yield, in order to avoid yield losses especially in the case of late wheat maturation. In this period the populations of cereal sun bugs have been kept under control because their stings in wheat grains and embryons may be dangerous.

The importance of insect-caused damages has been studied in accordance with the understanding of the level of pest populations, the critical attack time and attack incidence in different plant phenological stages, as well as the productive compensatory capacity of the plants after attack. Under the regional conditions and different wheat varieties, the diptera species causing spring damages (*Delia coarctata*, *Opomyza florum*, *Phorbia securis* etc.), may cause a 300-660 kg/ha yield loss at a frequency of 10% attacked plants, while for 24% attacked plants the loss reached 700-1500 kg/ha, with the attack of several species overlapping in April-May. The attack of the *Oulema melanopus* larvae may cause losees of 14-62% in wheat, barley and oat in the fileds where the economic damaging threshold has been exceeded.

In order to prevent the attack of these pests the following measures are recommended: optimal time sowing (the first half of October and avoiding sowing in September), as a regional measure of preventing diptera and cycad attacks; the use of adequate agrotechnical measures to ensure plant growth; cultivation of varieties with good compensatory tillering capacity, after diptera attack, the compensation being 60-80% in grain yield; insecto-fungicide treatment on seeds (homologated) especially in cereal monocultures; some special insecticide treatments (homologated) applied at the warning time, mainly in seed production fields, for diptera attack control, cereal leaf beetle, ear pests (aphids, thrips, bugs etc.), in the infested crops over the economic damaging threshold.

Establishing the optimal insecticide application time required good understanding and awareness of the natural entomophagous auxiliary reserve activity, which play a significant role in the diminishing of the pest populations, sometimes reaching levels below the economic damaging threshold under the cereal agroecosystem conditions of Transylvania.

As a conclusion, the damages caused by pests to winter cereals have been more severe in dry years, yield losses explaining the need of special crop protection measures. The periodical check of the fields regarding pest infestations, tracking the pest attacks and the recommendation for the required economically efficient treatments were important to foresee and prevent the attacks.

4.2.2. Characteristics of the regional pest structure and attack on cereals

The agricultural entomological researches in the last years conducted at the Agricultural Research and Development Station in Turda have revealed new information regarding the prognosis and prevention of the pest attack on the stalky cereals in Transylvania, under the special regional agroecological conditions (table 58).

During 2000-2007, the increase of the attack potential of the pest complex on the stalky cereals based on the effect accumulation of the unfavorable agroecological and technological factors in the agricultural exploitations has required the planning and use of the integrated control strategy for three structural groups of key pests: **1. insects that attack young plants, right after emergence or in early spring: - diptera larvae-***Oscinella frit, Elachiptera cornuta, Meromyza nigriventris, Mayetiola destructor* (the Hessian fly)*, Opomyza florum, Delia coarctata* (wheat bulb fly), *Phorbia securis, Ph. penicillifera* (black flies); **wheat flea larvae**-*Chaetocnema arridula;* **-aphids-***Sitobion avenae, Schizaphis graminum, Rhopalosiphum padi, Metopolophium dirhodum*; **-cycads**–*Psammottetix alliaenus, Macrosteles laevis, Javesella pellucida*, **-ground pests**– *Zabrus tenebrioides (cereal beetle)larvae, Agriotes* (wireworms), *Opatrum*, *Anisoplia* etc.; **2. leaf damaging insects:** *Oulema (cereal leaf beetle)* and lice (*Chaetocnema, Phyllotreta);*

3. leaf and spike affecting pests: aphids (*Sitobion, Schizaphis, Rhopalosiphum, Metopolophium*), **thrips** (*Haplothrips tritici*), **cereal bugs** (*Eurygaster* şi *Aelia*) etc.

The diminishing of species range and increase of population abundance of the dangerous pests has been recorded in pest structure. Due to aridization and climate warming the critical attack timing of the different species have been recorded 3-4 weeks earlier than normal and they overlapped.

4.2.3. The attack of winter cereal pests and the prognosis of actual damages

Under the regional agroecological conditions over the vegetation period, particular aspects related to pest attack have been recorded. Their understanding is important to the diagram of diagnosis activities and damage prognosis. In early spring a series of possible situations of pest occurrence and attack have been recorded such as:

1. The snow cover is hosting a condition inherited since autumn, especially in single crops and crops emerged in September comprising: ground pest reserve: -*Zabrus, Anisoplia, Agriotes, Opatrum* etc.; -cycads, vegetal remains and aphid-contaminated plants; diptera eggs: *Delia coarctata, Opomyza florum;* -diptera pupae:*Delia platura,Phorbia secures,Ph. penicillifera,O.frit etc; -Haplothrips* etc.; -chloropide attacked stems *(Oscinella frit etc.)*, *Phorbia securis* etc. (with frequencies of 5%); plants displaying yellowing and dwarfing.

2. **In early spring**, we may notice:

● rare plants showing yellowing and dwarfing symptoms

● small plants in the 3-4 leaves phase or the beginning of tillering, with larvae attacked stems attacking in the first stage (*Delia coarctata şi Opomyza florum*), during the attack the plants can be destroyed;

● black fly flying and occurrence towards crops (*Phorbia), Chaetocnema*, cycads etc.

3. At the end of tillering, during herbicide treatment:

● If there is enough humidity and the crop is gapless, with large leaves: the pest attack is diminished, and only some plants display dwarfing, on crop borders; diptera attacked stems, with yellow central leaf, or the whole stem dry.

● If there is draught: pest attack may be more severe, the danger of producing large gaps caused by plant drying and damage as a result of dipteralarvae attack, ground pest larvae, the dwarfing attack spread by cycads and aphids is more probable

● If there is excessive heat: all species attacking in May occur in crops since April causing stem yellowing and drying overlapped attacks in the case of of the diptera species(*Phorbia securis, Delia platura, Oscinella, Meromyza, Elachiptera* etc.), larvae of

Chaetocnema aridula, bug adults (*Eurygaster, Aelia*); causing partial leaf yellowing in the case of bug, cycad, aphid, thrips adults attacks, *Lema melanopus* adults, leaf-miner flies (*Agromyzide*) etc. This condition requires the first insecticide treatment applied with herbicide treatment at the latest.

4. 3-leaf (burduf) – spike emergence stage: - the attack of some species of flies, lice, bugs continue to develop; - plants display dry stems at the base following the attack of flies, lice, bugs, smaller stems emerging after the compensatory tillering following the diptera larvae attack or other pest attack as pathogenic agents of dwarfing. Plants are dry and show symptoms of dwarfing and sterility.

In this stage, plants may further be damaged by: thrips and bugs, some diptera species (*Chlorops, Meromyza*), which destroy the spike partially or entirely while still in the **Burduf** stage; aphids, cycads, Lema melanopus larvae, bugs, leaf-miner flies etc, attacking the leaves.

5. After tillering wheat thrips, cereal bugs, aphids, some diptera species(*Meromyza, Oscinella, Contarinia)*, ear miner moth (*Hadena basilinea*) will develop its larvae populations or colonies, in the case of aphids on soikes, further damaging the spikes and forming grins, diminishing yield quality. The insecticide treatment applied in the 3-leaf **burduf** – spike emergence stage proved to protect against the pest complex yield damaging (tables 57, 58 şi 59).

6. In the milk-wax grain filling stage the fields affected by severe attack of bugs, thrips, aphids and lately *Zabrus* adults, cereal beetles *Anisoplia* etc. have been noticed. (boards 35, 36).

4.2.4. The attacking potential and the biological reserve of dangerous insects on small grain cereals under the conditions of microclimate drying and warming

Continuing the dry and warm-specific years, the **period 2000-2002** has been characterized by exceptional events regarding the dynamics and abundance of pest insects whose unusually rich populations were favored by higher temperature winters and springs than normal.

The aggressivness of some pests has been increased due to the draught in early spring and thermal stress especially of heat and wide temperature variations between day and night in spring. The period of occurrence and attack in the crops has been advanced by 2-3 weeks, and a significant development of diptera, thrips, aphids, cycads and bugs populations have been reported during the spring months in the already affected by draught and heat crops.

Although the crops have emerged in good conditions both in autumn and spring, the excessive dry period during the winter months and in April-May have caused particular symptoms regarding pest attack intensity and attacked plant reaction. The diptera, through the species complex, have launched three successive attack stages. There were the species that infected the winter wheat (*Opomyza florum şi Delia coarctata* causing the first attack stage), and the flying species that attack in spring, in April (*Phorbia penicillifera şi Ph. securis*). Extra densities of Chloropidae (*Oscinella frit, Elachipterea cornuta*) and Anthomyiidae (*Phorbia securis and Delia platura*), as well as wheat fleas (*Chaetocnema*) launching the third attack overlapped on the usual spring attack have been recorded. Thus, 150-320 diptera destroyed tillers/m^2, a stimulation of plant tillering following diptera attack (5-6 tillers/plant), have been recorded in May, the attack frequency reaching 95-100%. The *Oulema* larvae attack has been recorded especially on spring cereals with 250-350 larvae/mp during May 17-28. During the dry springs a strong attack has occurred in the first stage especially on the winter wheat, the spring cereals being poorly developed at the time of attack. The thrips attack potential (adults and larvae) has been recorded at unusual, extremely high values. Draught and heat have caused faster ear heading, so that the ears were attacked by thrips (5-6 spice/m^2) starting May 15-20. Thrips larvae have reached mean densities of 22 larvae/ear, with limits of 13-34 larvae/ear in the milky-wax ripening stage. The development of aphid colonies on the ears averaged 8-55 aphids/ear, being more aggressive after My 25, when averaging 24-32 aphids/ear.

In 2003, during April-May-June, the damages caused by the main regional wheat pests have been extremely high. Pest abundance in the crops, based on the biological reserve which increased every year and the aggressiveness of attack in successive stages on vegetation under conditions of draught and higher than normal temperatures, have caused an unprecedented damage intensity. **By the end of April, in the tillering stage, and in May until flag leaf stage,** the abundant populations of the most dangerous pests(cereal flies-*Delia coarctata, Opomyza florum, Phorbia penicillifera, Ph.securis, Oscinella frit, Elachiptera cornuta, Meromyza nigriventris;* fleas-*Chaetocnema arridula;* bugs-*Eurygaster, Aelia*) have caused massive damages to wheat tillers. In the beginning the affected tillers have displayed the yellowing of the central leaf, then all the tiller dried out completely. Both diptera and fleas *Chaetocnema* larvae eat the heart of the tiller. Bug adults which occur in spring crops sting the leaves and stems, through the leaf sheath, causing stem drying. Consequently, the ear heading has been dramatically diminished although the plants have shown normal tillering, while the densities of 320 destroyed stems/m^2 have been recorded. We mention that under the conditions of excessive draught of 2003 in May 10-20, the attack affected 80-100% of the plants with 60-70% tillers successively destroyed by:
I. diptera larvae in early spring - *Delia, Opomyza, Phorbia* – representing 65% which stimulated the compensatory but unyielding tillering; **II.** chloropides-*Oscinella, Elachiptera* larvae*,* respresenting 11% and affecting secondary tillers; **III**. wheat flea larvae-Chaetocnema, representing 24%; **IV.** sun bug adults' stings. Under the draught and heat conditions of May,

diminished densities of 250-300 plante/m^2 yielding only 160-300 ear/m^2 have been recorded. The result was that each plant had a yielding ear and 3-5 dry tillers attacked by the mentioned pest complex. During May the significant attack of *Oulema melanopus* affecting plant and the ear growth in the flag leaf has also occurred on wheat leaves.

The ear damages caused by thrips adults (*Haplothrips tritici)* and cereal bugs in the flag leaf stage affecting 5-10% of the ears in the third decade of May, and after flowering, at grain forming and ripening especially in the second decade of June have been added as a result of thrips and cereal bugs larvae attack.

In 2003, cereal sun bugs populations have added to the regionally significant pest complex reaching the economic damaging threshold of 3-5/m^2 adults in spring and larvae on the ears in low density crops perishing ears density, grain yield and its quality. A series of pests from the regional natural reserve have been considered dangerous especially for the crops in small lots in the vicinity of small grain cereals or monocultures. Thus, the soil ground pests such as *Zabrus, Anisoplia, Agriotes, Opatrum* and others; aphids, cycads, leaf wasps-*Dolerus*, diptera species – the Hessian fly - *Mayetiola,* saddle gall midge- Haplodiplosis ş.a.) have been recorded. The rich biological reserve of some pest groups, accumulated due to temperature increases, single crop practice, disregard of phytosanitary technological sequences, division of cultivated fields in small lots close to each other etc. represent a potential danger.

During **2004-2007** extremely favorable conditions for the pest attack and population isolated bursts with increasing frequencies were recorded. Thus the *Zabrus tenebrioides* larvae have been recorded as attackin in isolated attack centres but spreading out and more frequent (intensities of 90-100% destroyed plants /05.15.2004) especially on the crop borders which in the past year had precursor crops favorable to egg laying in the ground: single crops, sunflower, soybean etc., while the adults have been recorded on ears in unusual large number (2-6 adults/m^2/20.06.2004, especially on the crop margins). This pest has become significant again under the conditions of weather warming, in the previous years being only sporadic. High densities of *Anisoplia lata* have been recorded in the same period on spikes in isolated lots.

The first diptera attack stage caused by *Delia coarctata, Opomyza florum, Phorbia penicillifera* during **2004** April 10-20 have produced damages of 6-15% attacked plant and up to 10% larvae destroyed tillers. The overlapped attack caused by the species *Phorbia securis*, *Oscinella frit*, other chloropids and flea larvae *Chaetocnema aridula* has been recorded in May 15-25 or even earlier with frequencies of 65-85% attacked plants, while, as a consequence of successful crop tillering, the intensity was 22-28% tillers destroyed by the larvae, representing an average of 268 tillers destroyed by the diptera/m^2. The attack evoled in accordance with annual conditions reaching densities of 110-150 tillers attacked/m^2 in **2007**, with intensities of 15-21% destroyed tillers (05.14.2007).

In **2004 thrips adult** (*Haplothrips tritici)* attack was generalized (80% attacked ears with 8.8 thrips/ear/06.10-20.2004, and larvae attack (90% attacked ears, with mean density of 5 larvae/ear/07.1-15. 2004), the population densities on the wheat ears increasing. In **2007,** the thrips adult attack was recorded at mean values of 12 attacked ears/m^2. The thrips larvae attack was generalized in the first decade of June, the symptoms showing the main spikelet completely withered, yellow attacked by thrips larvae as compared to the green spikelets in the milky stage. Mean attack intensity was 30% spikeltes attacked by the thrips larvae and destroyed, while de pest density was 21.5 larvae/ear.

Bug adults (*Eurygaster, Aelia*) had a significant ear damaging potential, recording densities of 4.5 attacked spikes/ m^2/06.17.**2004**. Cereal bug attack potential have evolved, showing densities of 10 adults/10 double sweepnet catches/10 m^2, 1-3.0 adults,eggs, larvae/m^2 /4-06.11.**2007** and an attack of 3 destroyed ears /m^2.

The **aphids** developed abundant colonies on leaves (30-50 aphids/leaf) with frequencies of 25% attacked leaves/06.01.**2004**, while on the ears, densities of 4-10 aphids/ear, with frequencies of 60 % attacked ears/06.10.2004 have been recorded. Pest dynamics and the attack in **2007** showed lower values explained by the impact of high temperatures of 30^{o}C, unfavorable for colony development on ears. Densities of 11 aphids/leaf and 0.5-20 aphids/ear was recorded.

In autumn, the dangerous attack potentials of **dipter**a - *Phorbia securis, Oscinella frit, Elachiptera cornuta, Meromyza nigriventris, Mayetiola destructor*, aphids and especially cycads, soil ground pests (*Zabrus tenebrioides*) have caused in the sowing and emerged crops in September massive infestations and damages. There are infested lots and possibly attacked by *Zabrus, Agriotes, Anisoplia*; cycads, aphids, flies (*Opomyza, Phorbia, Oscinella*). The attack occurring in autumn and having as a result the destruction of the stems attacked by diptera larvae, the destruction of plants attacked by *Zabrus* or leaf yellowing as a consequence of aphid and cycad stings have continued until after early spring. Aphids and Cycads causing as vectors plant infestation by the pathogenic agents of cereal dwarfing and yellowing have proven dangerous due to the attack in autumn and continuing to spread after early spring, simultaneously with the development of the mentioned species known as vectors.

The problems created in the agricultural practice by the small grain cereal pests is continuously getting more serious as a result of: - the increase of diptera, cycad, aphid, thrips and cereal bug biological reserve, *Zabrus and Chrysomelids Oulema, Chaetocnema, Phyllotreta* etc.; - farmers' insufficient understanding and knowledge regarding the occurrence and dynamics of the pests; - one sided direction for plant protection focusing on weeds and phytopathogenic agents; - poor knowledge and application of pest control strategy which recommends insecticide treatments together with herbicide treatments or disease control, providing yield salvation as shown in the years with excessive draught and heat (year 2003).

A series of practical measures have been required such as: - providing in time attack prognoses and regional weather forecasts in early spring, as well as the prognosis of other attack times; delimitation of risk areas which need treatments, crop fields under attack peril, monoculture single crops, crop marginal areas (especially for pests with increasing attack potential and soil related bio-ecology such as *Zabrus, Delia, Opomyza* etc., which lay eggs in the ground under the protection of the previous crop in the lot, mostly on the marginal belts); - preparation and supply of treatment application choices at the optimal time; - update of the homologated insecticide list for key main pests (diptera, aphids, cycads, thrips etc.); - knowledge dissemination regarding the potential dangers of the attack and the new adequate measures of integrated pest control. Thus, the role of the agricultural entomological research is not over: there are new challenges coming up in the agricultural practice, new attack situations due to the changes in the agroecological conditions. The synthesis of the long term research results on the small grain cereal pests has produced firm attitudes regarding the attack potential of dangerous species and the need to use their integrated control as an important, real and present problem of crop protection.

The importance of wheat pests within the conservative tillage technological system, characterized by an intensively pest control strategy. In the conservative ploughless tillage technology the attack of the diptera species complex has been recorded in May **2008** having average intensities of 60-64 % destroyed stems. Even in the seed treated variants with the Yunta 246 FS insectofungicide a 42-57% destroyed tillers attack has occurred. The species occurring in April-May are: the cereal flies: *Delia coarctata, Opomyza florum, Phorbia securis, puricele grâului Chaetocnema aridula, dăunători din sol (Agriotes, Opatrum etc.).* After earing in June significant densities of the spike pests have been recorded (10-15 thrips adults/ear at spike emergence, 18 thrips larvae/ear; 4-7 aphids/leaf, 4 aphids/ear; 2-3 sun bugs/m^2). Researches regarding the effect of the integrated pest control technology within the conservative crop system have shown significant results. Thus, the treatment using Calypso 100 ml/ha insecticide (containing tiacloprid, cloronicotinilic insecticide with contact, shock-inducing action, and a long term systemic action), applied at the time of treatment with herbicide, fungicide and foliar fertilizers, by the end of tillering, gave significant results regarding the decrease of the attack coming from various pests, diminishing the attack potential of main pests: *chloropidae diptera*, *Chaetocnema, Oulema, cycads*. It also reduced instantly the *Chloropidae* diptera invasion, had a significant effect on the occurrence of *Oulema* adults, instantly reduced the *Javesella* cycad populations and *Chaetocnema* flea-beetles.

The impact on the natural reserve of auxiliary entomophags in the crops has been recorded as moderate to medium as the entomophags continued to occur on wheat. The application of Proteus OD 110 0,4 l /ha insecticide, fungicide and foliar fertilizer treatments in the flag leaf stage and the beginning of earing has been highly significant in pest control especially of spike pests: thrips, aphids, sun bugs etc., and is considered the most important treatment applied in the integrated system. The application of Proteus OD 110 0,4 l /ha insecticide, fungicide and foliar fertilizer treatments in the flowering phenophase has given significant results similar to the previous treatment.

The importance of preservation and use of natural auxiliaries and biodiversity. Entomological researches have been shown the increasing role of entomophagous predators and their efficiency in the cereal pest limitation, in the protective forestry belts-based agroecosystem. During 2000-2008, pest attack in the open field cereal biocenoses has been real risk situations requiring a complexity of repeated insecticide treatments. By comparison, the protective and qualitative importance of the agroforestry belts agricultural system has been proven, being extremely favorable to the conservation of the natural reserve of auxiliary entomophags in the Cean-Bolduţ farm founded in 1952.

Tab. 67

The yield losses produced in winter wheat crops of Transylvania by diptera attack and the saving grain yield after the insecticides application (A.R.S.Turda)

Variety	*Delia coarctata*		*Opomyza florum*		*Phorbia sp.*	
	kg/ha	%	kg/ha	%	kg/ha	%
Transilvania	477	26,6	549	29,4	441	26,9
Turda 81	662	37,6	486	26,5	495	30,5
Arieşan	509	31,2	360	21,7	419	27,8
Apullum	414	24,9	333	19,6	464	31,5
Turda 95	-	-	257	18,4	572	35,2
Average	516	30,1	397	23,1	478	30,4
Insecticides efficiency (E%) and average of saving yield						
E = 50 %	258 kg/ha		199 kg/ha		239 kg/ha	
E = 70 %	361 kg/ha		278 kg/ha		335 kg/ha	

Table 68

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 :	22 April	10 March-20 April	15-30 April	***Tillering***
Delia coarctata, Opomyza florum,	16 % plants 6 % tillers	26 % plants 11 % tillers	30 % plants 11 % tillers	5-10% plants
Phorbia penicillifera,	10-28 May	4-10 May	12-22 May	***End of tillering***
Phorbia securis, Oscinella frit, Meromyza nigriventris	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	8-15 June	28 May-17 May	6-24 May	***Flag leaf-heading***
Oulema melanopus	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 trips- adults :	25 May	15-17 May	12-22 May	***Heading***
Haplothrips tritici	6 adults/ear	12 adults/ear	12 adults/ear 20 adults/m^2	8 adults/ear 5 adults/m^2
Wheat trips - larvae	10-25 June	10-25 June	12 June	***Milky- ripening***
Haplothrips tritici	13 larvae/ear	22 larvae/ear	11 larvae/ear	10-40 larvae /ear
Cereal bugs	10-25 June	15-25 May	22 May-10 June	***Heading-ripening***
Eurygaster maura, Aelia acuminata	1-2 adults/m^2 2-3 larvae/m^2	1-3 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
Aphids:	25 June	10-24 June	10 June	***Milky- ripening***
Sitobion avenae,	12 aphides/ear	32 aphides/ear	1,3 aphides/ear	25 aphides/ear
Schizaphis graminum			14.11. 2002	***2-3 leave/plant***
Rhopalosiphum padi, Metopolophium dirhodum			4-6 aphides/pl. 80% plants	5 afide/plant
Cicades:leafhoppers	5-14 July	20 June-5 July	10 May-10 June	***Emergence***
Psammotettix aliaenus Javesella pellucida Macrosteles laevis ş.a.	9,9 /m^2/10/ sweep net catches	2,5-5 cicadae /m^2/10 sweep net catches	7-10 cicadae/m^2 14 November. 6 cicadae/m^2	5 cicads/m^2/10 sweep net catches/

Tab. 69

The long term evolution of wheat pests structure by comparison with the structure in new minimum tillege conservative technology, in A.R.D.S. Turda

	Evolution of structure in 1980-1999 and 2000-2005 years, in classic technology			Pests structure in May 2006-8 at conservative technology		
	1980-1989	**1990-1999**	**2000-2005**	**2006**	**2007**	**2008**
Wheat leafhoppers.	**10.5**	**9.4**	**9.0**	**8.0**	**1.1**	**1.0**
Cereal aphids.	**32.5**	**40.4**	**6.0**	**13.0**	**4.0**	**11.0**
Wheat thrips.	**30.0**	**23.3**	**27.0**	**36.0**	**88.0**	**79.2**
Cereal bugs.	**0.2**	**2.3**	**6.0**	**1.0**	**1.0**	**4.0**
Cereal leaf beetle.	**1.0**	**4.0**	**14.0**	**5.5**	**0.3**	**0.5**
Chaetocnema aridula	**5.0**	**3.0**	**19.6**	**5.0**	**0.5**	**3.0**
Phillotreta vitula	**4.0**	**1.1**	**6.5**	**0.5**	**0.2**	**0.5**
Cephus pygmaeus	**0.3**	**0.7**	**1.2**	**1.0**	**1.0**	**0.4**
Cereal flies.	**16.5**	**16.0**	**10.7**	**30.0**	**4.0**	**1.4**

Tab. 70

Attack frequency and pests density in 2000-2005 at wheat in classical technology by comparison with 2006-2008 in minimum tillege technology.

Technological system.		Classic technology	Non tillage technology		
Pests.	The attack.	**2000-2005**	**2006**	**2007**	**2008**
Flies.	% deadheart tillers.	**46**	**41**	**21**	**64**
Thrips.	Adults/ear.	**11**	**8**	**8**	**15**
Thrips.	Larvae/ear.	**14**	**12**	**22**	**21**
Bugs.	Sun bugs/m^2.	**5**	**1**	**2**	**3**
Aphids.	Aphids/ear.	**21**	**2,5**	**0.5**	**5**

Tab. 71

Effect of insecticide treatments in the wheat flag-leaf stage application (Ariesan variety),ARDTurda, 2008

	Ears / m^2			**Kg / ha**			**TGM**		
Tratamente. Treatments.	**Average**	**%**	**Difer.**	**Average**	**%**	**Difer.**	**Average**	**%**	**Difer.**
Netratat. Untreated.	**463**	**100.0**	**martor**	**5456**	**100.0**	**martor**	**45.100**	**100.0**	**martor**
Yunta 246 FS, 2 l/t TS	**389**	**84.2**	**- 74.0 °°**	**5650**	**103.5**	**194**	**45.800**	**101.5**	**0.700**
Cylothrin 60 CS 80 ml/ha	**575**	**124.2**	**112.0 *****	**6850**	**125.5**	**1394 *****	**50.167**	**111.2**	**5.067 *****
Alphamethrin 10 CE 100 ml/ha	**504**	**109.0**	**41.0**	**7170**	**131.4**	**1714 *****	**48.567**	**107.7**	**3.467 *****
Decis 25 WG 0,030 Kg/ha	**580**	**125.4**	**117.0 *****	**6793**	**124.5**	**1337 *****	**48.000**	**106.4**	**2.900 *****
Proteus OD 110 400 ml/ha	**488**	**105.5**	**25.0**	**5990**	**109.8**	**534 ***	**50.377**	**111.7**	**5.277 *****
Calypso 480 SC 100 ml/ha	**567**	**122.5**	**104.0 *****	**6150**	**112.7**	**694 ***	**45.067**	**99.9**	**-0.033**
Grenade SYN 75 ml/ha	**556**	**120.2**	**93.0*****	**5540**	**101.5**	**84**	**49.267**	**109.2**	**4.167*****
DL p 5%		**9.4**	**43.7**		**9.2**	**503.5**		**2.7**	**1.237**
DL p 1%		**13.1**	**60.6**		**12.8**	**687.9**		**3.8**	**1.715**
DL p 0.5%		**18.2**	**84.2**		**17.7**	**969.5**		**5.3**	**2.383**
270 l solutie/ha	**F=21.74 (2.76)**			**F= 15.9 (2.76)**			**F=29.13 (2.76)**		

Tab. 72

Efficiency of insecticides applied in the wheat flag-leaf stage application (Ariesan variety), ARDTurda, 2008

	Aphids/ear / 11.06.2008			/Thrips larvae/ear / 11.06.2008		
Treatments.	**Average**	**%**	**Difer.**	**Average**	**%**	**Difer.**
Untreated.	**2.50**	**100.0**	**-**	**3.70**	**100.00**	**-**
Yunta 246 FS, 2 l/t TS	**2.50**	**100.0**	**0.00**	**3.70**	**100.00**	
Cylothrin 60 CS 80 ml/ha	**0.20**	**8.0**	**- 2.30**	**0.10**	**2.70**	**°°°**
Alphamethrin 10 CE 100 ml/ha	**0.60**	**24.0**	**- 1.90**	**0.05**	**1.35**	**°°°**
Decis 25 WG 0,030 Kg/ha	**0.40**	**18.0**	**- 2.05**	**0.10**	**2.70**	**°°°**
Proteus OD 110 400 ml/ha	**0.50**	**20.0**	**- 2.00**	**0.05**	**1.35**	**°°°**
Calypso 480 SC 100 ml/ha	**5.35**	**214.0**	**2.85**	**4.00**	**108.11**	
Grenade SYN 75 ml/ha	**0.05**	**2.0**	**- 2.45**	**0.10**	**2.70**	**°°°**
DL p 5%			**3.171**		**28.00**	**1.037**
DL p 1%			**4.396**		**38.80**	**1.438**
DL p 0.5%			**6.107**		**53.90**	**1.998**
	F= 3.09(2.76)			**F= 31.91 (2.76)**		

Tab. 73

Attack dynamics of wheat pests in 2007 at agricultural system in open field area (Turda) and at protective agroforestry belts system (Cean-Bolduţ).

Aphids attack.		Thrips larvae attack. 5-10.06.2007		Attack of bugs adult and larvae in milky-ripening phase. 5-10.06.2007		Attack of diptera larvae	
Turda	**Bolduţ**	**Turda**	**Bolduţ**	**Turda**	**Bolduţ**	**Turda**	**Bolduţ**
11 aphids/leaf. 25 aphids/ear	5 aphids/leaf. 0.5 aphids/ear	21.5 larvae/ear. 80% destroy ears and 29.6% spikles	4.5 larvae/ear	1-3 adults/m^2 3 attacked ears/m^2	0.5 adults/m^2 <0.5 attacked ears/m^2	15.3% dead heart tillers	13,2% dead heart tillers

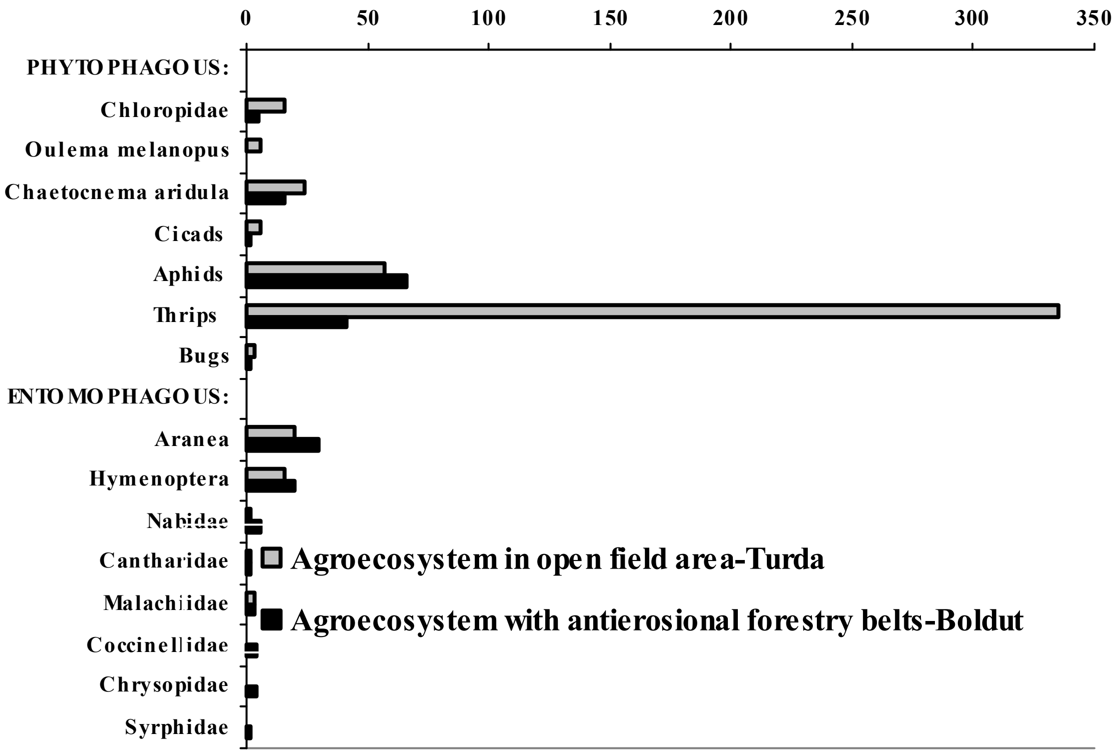
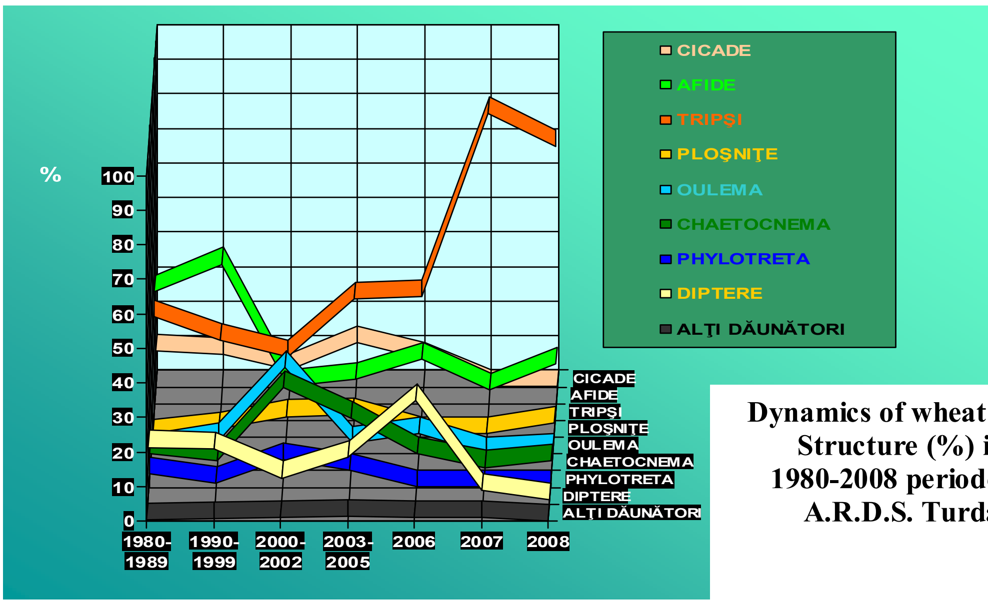


Fig. 2. Comparative abundance of wheat pests and entomophagous in two agricultural systems: in open field area with conservative minimum tillege technology and in agroecosystem with antierosional forestry belts, ARDS Turda (May, 2007, in entomological sweepnet catches samples).

Aspects of the protective agroforesty belts in Cean-Bolduţ (A.R.D.S.Tutda). (Fotos 4.05.2008, ing.Adina Ivaş).

Aspects of the protective agroforesty belts in Cean-Bolduţ (A.R.D.S.Tutda). (Fotos 30.10.2008, ing. N.Tritean)

Aspects of the farming system with protective agroforesty belts in Cean-Bolduţ (A.R.D.S.Tutda).
(Fotos 25.10. 2008, ing.R. Serbănescu).



Dynamics of wheat pests Structure (%) in 1980-2008 periode at A.R.D.S. Turda

4.3. Planning prevention measures and control strategies

The strategy of wheat pest control under the present conditions of regional aridization and climate warming takes into consideration the importance of the preventive measures: sampling planning, attack prognosis, planning of preventive measures and the required treatments.

Under the conditions of the climate unbalanced years, dry and warm or arid, pest dynamics occurring in autumn and especially in spring should be studied through periodical test sampling, invasion prognosis and tracking taking into account the previously infested lots vicinity, dominant wind direction, phenological development and crop densities preferred by the pests. Field record and mapping with significant pest densities and preferred for attack should be made by each farm. Limitation of small grain cereals cultivated areas and the delay of spring crops emergence is another special aspect of regional pest attack, that is the more abundant and preferential occurrence in the existent cereal lots or newly emerged which may ensure the development of pest biological cycle.

The strategy of integrated regional cereal farms-specific pests control has particular aspects deriving from: the structure of main pests, the regional agroecological and technological conditions, the use of adequate pest control methods and efficient insecticides, the importance of entomophagous useful fauna in the crops.

a) The structure of the main pests include diptera larvae, cycads, ground pests affecting young plants; aphids, thrips, other pests affecting the spike; some crysomelidae - *Oulema melanopus*, and wheat flea-*Chaetocnema, Phyllotreta* and others. These pests become more and more abundant due to aridization and microclimate warming, incorrect crop technologies, limitation and spreading of the agricultural cultivated areas etc., which required insecticide control, through seed and vegetation treatments.

The lack of pest control application in the attack points and the crops severely attacked leads to the increase of attack potential for the other crops (corn, successive forage crops etc.), and for the following cereal vegetation year.

b) Due to the **regional agroecological and technological conditions** area crop-specific agrophytotechnical measures having an overall role in pest attack prevention and diminishing have been recommended within SCI.

The planting of quality seeds, their treatment with insecto-fungicides - if needed –and the **optimal time sowing** in the second half of October has been important to provide prevention against diptera, aphid and cycad attack.

Late sowing in November may cause the occurrence of aggressive black fly (*Phorbia*), wheat fleas, cycads attack in early spring.

c) The use of the adequate pest control method and efficient insecticides. The insecticide treatments applied on seeds and vegetation has been carried out using approved products for cereal pest control and the application time to ensure the prevention and control of the dangerous pest complex, yield increases and the protection of auxiliary activity.

d) The presence of useful entomophagous fauna in the crops has been recorded since spring until autumn being a significant natural resource for agriculture. Active entomophagous predatory species cause a massive pest diminish, feeding on eggs, larvae, adult pupae of phytophagous insects, with exceptional voracity.

The experimental data have shown that the positive effect of the natural biological control in the decrease of ear pests (aphids, thrips) caused significant yield increases.

Insecticide control treatments of the pests exceeding EDT levels applied without paying attention to the dynamics and amplitude of the natural entomophag reserve activity have often been economically inefficient, without yield increases in comparison with the unattacked control as a result of the negative effects on the useful fauna.

Field and laboratory test experiments on the efficiency of some modern insecticides in diptera control in spring, thrips and aphids at ear heading have lead to the creation of insecticide control technological models, taking into account the protection of the activity carried out by the useful fauna, achieving yield increases. The conclusions of these experiments have shown that in the regional cereal-based farms the active populations of entomophags in the crops has been important, even efficient, in pest limitation. Consequently, the dynamics of the interactions between phytophags and entomophags should be recorded, and the optimal and adequate time

of insecticide application should be established, in order to protect the valuable auxiliary activity, and allow the natural biological control of the pest carry on. Protection and enrichment measures for the useful fauna in the crops has been suggested by planting agroforestry belts and simple methods of planting diversified flora, flowered grasses, shrubs, trees at the field borders, the avoidance of herbicide treatment in these crop margins, the planting of aromatic plants attractive for entmophags, enrichment measures for the natural entomophag reserve by launching species from the nurseries (on the occasion of crop biological treatments).

4.4. Optimization of integrated wheat pest management technologies under the dynamics of agroecological changes in Transylvania

During 2000-2008, at the ARDS in Turda studies on the wheat pests such as diptera, aphids, cycads, thrips, bugs, cereal leaf beetles etc, the levels of attack and the present integrated pest control strategy as part of the agroecological technological system of the sustainable development of wheat in Transylvania have been conducted.

♦ 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 favored by monoculture single crops and regional cereal agroecosystems presence (*Delia coarctata, Opomyza florum, Phorbia penicillifera, Haplothrips tritici, Oulema melanopus*, *Chaetocnema aridula, Eurygaster maura, Aelia acuminata, Zabrus tenebrioides* and others, or diptera Chloropide - *Oscinella frit, Elachiptera cornuta, Meromyza nigriventris etc.* and Anthomyiide polivoltine - *Phorbia securis, Delia platura)*, cycads, aphids and others).

♦ Due to aridization and climate warming, the critical attack moments of different species have been recorded 3-4 weeks earlier than normal, and overlapped.

♦ In order to provide a sustainable developement 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 unfavorable agroecological and technological factors in the agricultural exploitations, the appraisal and planning of the adequate prevention and control measures have bee required at the very moment of crop planting. The knowledge concerning the integrated pest management system achieved in accordance with the contemporary expectations regarding the optimization of the relations between environment, agriculture and sustainable development have been delineated.

A complex technology as part of the integrated pest control system has been recommended, comprising the use of crop agrotechnical measures, having an overall role in the prevention and diminish of the pest attack, virtually achieved by: - crop rotation ensuring the optimum precursory plant and avoidance of monoculture single crops; - soil preparation and maintenance, soil activities (tilling, discing, wheat volontiers destruction, other conservative technology - specific of minimum tillage technology). They diminish mechanically part of the biological pest reserve; - keeping density and optimal sowing time (October 10-20), so that wheat crop emergence avoid massive infestation by pests (diptera, aphids, cycads) and provide good plant growing rhythm and vigor; balanced application of fertilizers, herbicides and disease control treatments which provide a good plant growth.

The application of special insecticide treatments for the prevention and control of risk situations due to pest abundance and aggressiveness is required especially under unfavorable agroecological conditions of excessive heat and draught during the critical attack periods and plant growth, and in the case of crops with incomplete or incorrect technology related to the use of single crops and early sowing, before the regional optimal time.

The use of the integrated control system (ICS) requires the understanding of the biological and attack potential levels of the main pest species, the use of adequate crop technology including agrotechnical and phytosanitary preventive measures, and the use of quality seeds especially from the regional varieties with good compensatory capacity and tolerance to the area-specific pest attack.

The conservation and use of the natural reserve activity of the auxiliary entomophags in the crop by understanding the important place they have in the natural limitation of the pests is also important. This should be achieved by insecticide application at the optimal time, and selective to auxiliary activity by protecting fauna diversity and crop bordering flora against pesticides, especially herbicides and insecticides, enrichment of these belts with plants favorable to auxiliary occurrence. Special attention should be given to agroforestry belts or curtains which provide auxiliary entomophag conservation and development and the natural biological pest limitation, not to mention the antierosion role.

The effect of the treatment applied on seeds has ben studied through experiments with systemic and plant penetrating insecticides less pollutant than those containing Lindan. Seed treatment with insecticides is less polluting than the generalized treatment with spraying on vegetation. The experimental products have lasting remanence, and protect the plants in autumn after emergence, and in spring against cycad, diptera and other pest attack. Moreover they are less aggressive to the ground useful fauna (carabids, aranea and other entompphagous groups). Seed treatment with insecto-fungicides provide crop protection in the first vegetation stages against the attack of ground pests, and partial diptera control efficiency of 50-75%, being recommended for the areas with attack points and monoculture conditions. In the attack risk situations the seeds may be treated with the insecticides Gaucho-0,6 l/t (imidacloprid), Yunta 246 FS, 2 l/t (thiacloprid), Tonic 20CS (tefluthrin); Cosmos 250 FS (fipronil) etc.

The treatments applied on vegetation have been used for the prevention and control of the pest complex under the conditions of the last years. Two critical attack moments and risk situations have been reported to require treatment application when the economic damaging threshold values have been exceeded.

1. Insecticide treatments applied in April at the same time with the herbicide treatment for diptera and wheat fleas control (*Chaetocnema)*, bug and *Oulema* adults also surprise and reduce thrips, cycad attack potential in the crop. The treatments for diptera larvae control in April, at the end of plant tillering in the 25-33 DC stage (at herbicide treatment), or earlier in some years have been carried out by using organophosphorous insecticides such as chlorpirifos methyl-RELDAN 40EC-1250 ml/ha, chlorpirifos-ethyl-PYRINEX 25 ME-3000ml/ha, dimetoate–DIMEZYL 40EC-2000 ml/ha; mixtures of organophosphorous and pyrethroids: fenitrotion and fenvalerat-ALPHA-COMBI 26,25 EC-500 ml/ha; systemic insecticides: tiacloprid-CALYPSO 480 EC-100ml/ha, thiametoxam-ACTARA 25 WG-70 g/ha, other chemicals: fipronil - REGENT 200 SC-90 ml/ha, bensultap-VICTENON 50 WP-500 g/ha and others, which achieved control efficiencies of 40-58% and yield increases of 7–21 % (300-900 kg/ha), the average output being 350 kg wheat/ha (Table 74). The insecticides Reldan, Pyrinex, Regent, Alpha-Combi have been reported for their efficiency and economic benefit. The treatment has limited the attack of wheat fleas, cycads, Lema adults, bugs etc., which proved to be more and more significant. At present, the entomophagous auxiliary fauna has been at the beginning of its occurrence in the crops and less exposed to insecticides.

2. Treatments in the flag-leaf apparison and ear emergence, in the 45-59 DC stage, in May 15-25 have been applied to control wheat thrips adults (*Haplothrips tritici* Kurdj.), aphids, bugs an others. The insecticides chlorpirifos-methyl - RELDAN40EC-1250ml/ha, fenitrotion-fenvalerat - ALPHA-COMBI 26,25-500ml/ha, thiametoxam - ACTARA 25 WP 70g/ha, tiacloprid - CALYPSO 480 EC-100ml/ha, bensultap - VICTENON 50 WP-500 g/ha, fipronil-REGENT 200 SC-90 ml/ha have achieved immediate control of the pest complex with efficiencies of 63–83% against thrip larvae development of the ears and yield increases of 9–24% (500–1200 kg/ha). The average profit was 600 kg wheat/ha. 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 (table 75).

The control of the cereal leaf beetle (*Lema*) has been addressed mostly against the larvae in the attack points and coincides with the flag leaf stage. For the pest complex control in the excessively warm and dry years some test treatment have been applied, containing synthesis pyrethroids: Decis 25 WG - 0,03 kg/ha, Mavrik 2 F - 0,2 l/ha, Karate Zeon - 0,15 l/ha, Sumi-Alpha 5% - 0,2 l/ha, Alphametrin - 0,1 l/ha, Fastac 10 CE - 0,1 l/ha, Cipertrin 10 CE - 0,1 l/ha, Faster 10 CE -0,1 l/ha, approved for the cereal leaf beetles and cereal bugs. They were efficient by reducing regional attack caused by the specific pest complex: wheat thrips, lice, diptera, aphids etc., having less impact on the auxiliaries.

After ears heading, during the milky-wax phenophase, abundant populations of bug and thrips larvae, abundant aphids colonies may emerge, against which insecticide treatments have been recommended especially in the wheat lots for seed production to avoid yield losses, especially in the case of wheat late maturation. During this period cereal bug populations have been kept under control for the danger of their stings on the grain and embryon.

The treatments applied in the milky-wax grain ripening (stage 77-87 DC) for the immediate thrips larvae control (especially for seed crop protection) using the insecticides fipronil (Regent 200 SC: 90 ml/ha), bensultap (Victenon 50 WP: 500 g/ha), acetamiprid (Mospilan 20 SP: 100 g/ha), tiacloprid (Calypso 480 EC: 100 ml/ha), thiametoxam (Actara 25 WG: 60 g/ha), deltametrin (Decis 25 WG: 30 g/ha), lambda-cihalotrin (Karate Zeon: 150 ml/ha), novaluron (Rimon 10 EC: 250 ml/ha), lufenuron (Match 050: 300ml /ha), fenitrotion-fenvalerat (Alpha-Combi 26,25: 500 ml/ha), oxidemeton methyl-betaciflutrin (Enduro 258 EC: 1000 ml/ha), clorpirifos-cipermetrin (Nurelle D: 400 ml/ha) have had good immediate efficiency of 61-79% against thrips larvae and provided an increase of 10-23% grain yields, representing 400-900 kg grains/ha. The insecticides had also good immediate efficiency in the case of other dangerous pests such as aphids, cycads, wheat fleas and diptera, by diminishing their biological potential. Applied a month before wheat ripening, in June 20-25, the insecticides come after the maximum useful activity of the entomophag complex, and had no negative effect on the auxiliary population activity.

Tab. 74.

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	**%**	**Differ.**
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***
Average			4842	111.5	499
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					

Tab. 75.

Effect of insecticides treatment on wheat thrips (Haplothrips tritici Kurdj.) control at heading-ears phase, May,2001-2002, ARDS Turda.

Insecticide product and dose/ha	Efficiency %	Grain yield		
		Kg/ha	%	Difference
Mospilan 20 SP 100 g	44	5887	116	806*
Alpha-Combi 25,26EC 500ml	78	5657	111	576
Victenon 50 WP 500 g	66	5657	111	576
Actara 25 WP 60 g	57	5696	112	615
Calypso 450 SC 100 ml	62	5555	109	474
Nurelle D 400 ml	68	5788	114	707*
Reldan 40 EC 1250 ml	70	5946	117	865*
Regent 200 SC 90 ml	72	6330	124	1249***
Average		5805	114	724
Check (9,2 larvae/ear)	-	5081	100	-
DL p 5%-641, DL p1%-883, DL p 0,1 %-1216				

As a conclusion, in the agricultural practice the elaboration of specialized studies of entolomogy and applied agroecology have proven necessary in a complex approach for pest monitorization, evaluasion and planning of the adequate prevention and control measures. In order to achieve this goal the knowledge of the integrated pest management system has been crucially important in accordance with the contemporary needs regarding the optimization of the relation between environmental problems, agriculture and sustainable development. The economic and ecological efficiency of the integrated pest management sytem in the cereal-based farms 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 researches ensure the optimization of the integrated pest management in the agricultural practice and the implementation of complex elaborated knowledge required in practice to observe the pests ant their attack potentials; to the systematic and bio-ecological study of pests; to conduct new applicative, experimental researches adapted to new agroecological conditions, and to the integration of the adequate technological and biological control methods such as: special chemical methods – biologically, economically and ecologically efficient insecticides, agrotechnical and phytosanitary methods; natural entomophags, tolerant varieties etc., significant elements for the practical achievement of a optimal and adequate control of the studied pests. The insecticide application should be performed in accordance with the optimal time, maximum biological, economic and ecological efficiency within the technological phytosanitary crop system.

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