# ABSTRACT

**Key words:** tortricides, apple orchards, pests, chemical treatment.

Apple is one of the most important fruit species in the world this primarily due to the nutritional and organoleptic quality of the fruit outstanding and to preserve them for longer periods. High food value of apples is due to their very balanced composition, accessibility biochemical components to the human body and not least to various olfactory, visual and gustatory stimuli.

Only in the composition are flavoring substances identified more than 170 . Because of these characteristics are the most popular fruit apples. Also the therapeutic value of apples is particularly important because tonic effect on the body. A major problem is time, however, the losses caused by the large number of diseases and pests production could be reduced by 20 % - 30 % or even totally compromised. Therefore the protection of plants, currently has a crucial role in limiting the damage caused by pests and pathogens (Lazăr. *et al*, 1980).

Percher has compiled a list which includes no less than 80 pathogens that attack the species, is caused by viruses, mycoplasmosis bacteria, 64 species of insects and mites, 8 species of nematodes and at least three species of rodents.

In apple orchards from Romania are considered as pests that can affect fruit production an estimated 30 species of which 8 species can be considered key pests ( Baicu & Săvescu , 1986).

Apple crop covers the whole temperate zone, between 30° - 60° - 70 ° north latitude and 30° south latitude and subtropical some restricted areas .

Cultivated area in the world currently stands the figure of 4,5 million hectares recorded in 2011 a total production of 75,635,283 tons of fruit and the big apple producing countries are: China, USA, Iran, Turkey, Poland, Italy, France, Germany, Romania, Hungary, etc.

In Romania, apple is the most important fruit tree crop, the main apple producing regions of our country are located in the area of Subcarpathian hills , in the forests of beech and oak, etc.

Top five counties ranked in apple production are Bistrita Nasaud, Arges, Maramures, Suceava, Vâlcea, achieving about 40 % of the total production of the country.

Thesis tackles the main study defoliating lepidopteran species belonging to the family *Tortricidae*, especially *Adoxophyes orana* (Fisch. v. Rosl.) that genus *Cydia*, thanks to the diet of the larvae, is considered the most important pest in orchards apple, (Diaconu *et al*., 2004) using different working methods. The research was conducted in 2011-2013, in the north - eastern Romania, the area of the two counties of Suceava and Iasi .

PhD disertation aims to make contributions to the study of these harmful species by collecting, determination, description, growth and developments in the laboratory and compare some technologies for preventing and fighting .

The thesis is divided into two main parts: the first part entitled **„Current stage of knowledge" „Present stage of research on the lepidopteran pests fauna of apple orchards"** that includes the introduction and three chapters and the second entitled, Contributions which comprises four chapters and bibliography.

**Chapter I, „Present stage of research on the lepidopteran pests fauna of apple orchards"** is divided into two chapters contain a comprehensive description of the research conducted on the fauna of lepidopteran pests of apple orchards, so global and national, referring to issues such as:

- Distribution, biology , and how damaging fight *Adoxophyes orana* in apple orchards ;
- Research on key species that belong to the order *Lepidoptera* insect pests of apple orchards ;
- Research that focused on major pest control methods that belong to the order *Lepidoptera* in apple orchards, especially by chemical, biological and ecological, and other unconventional methods .

**Chapter II** is entitled **„Description and importance of apple culture"** contains importance, origin and range of the apple crop , biological and ecological features of apple, apple requirements to ecological factors. Also a brief description of the situation of culture in the world and in Romania .

**Chapter III**, **„General characterization of wild foliofage carnation leaf-rollers"** contains a presentation of characteristics - rollers, life cycle and development.

**Chapter IV**, entitled **„Characterization of the natural and climatic conditions”** in which the information regarding the description of the natural and climatic conditions of the areas, where they were carried out. Also in this chapter are presented data on the climatic conditions in Fălticeni during 2010-2013.

The research was conducted in apple orchards of the Fruit Growing Research Station Fălticeni Development and Teaching Farm "Vasile Adamachi" Iaşi. Observations and collections were made during the vegetation period of a year in both stationary being studied two groups of apple (chemical treated and untreated chemically lots) .

**Chapter V**, entitled **„Purpose, objectives, material and working methods”.** This study aims to make a significant contribution to scientific data after conducting their own research on the evolution of the main species of insect belonging to the order *Lepidoptera*.

*Tortricidae* family in some apple orchards in U.S. country after applying various methods of fighting .

Main objectives are :

1. Knowing the current state of research on the fauna of carnation leaf - rollers foliofage of apple orchards .

2. Identification and characterization of species of carnation leaf - rollers in apple orchards;

3. Recognizing how damaging the foliofage -rollers .

4. The level of attack in the bud .

5. Indiscriminate collection of biological material .

6. Increasing laboratory collected material .

7. Determining the species of carnation leaf-rollers .

8. Identifying species parasitized carnation leaf-rollers and related parasites .

9. The level of attack fruit .

10. Setting the main reserve hibernating pests of apple orchards.

To achieve the objectives, have conducted several activities, namely:

- preparation of schemes of work in the field and work surfaces each variant;
- observations made directly in the field;
- sampling and analyzes specific quantification of indicators, such as the attack, and the degree of pest;
- preparing material to collect species of carnation leaf-rollers;

- analysis of biological material collected, determining species and calculating ecological indices;
- monitoring the evolution of fauna biodiversity useful for each experimental variant;
- adapting current metodicilor forecasting and warning of plant protection against pests of apple orchards, taking into account both useful fauna protection;
- tracking scheme applied treatments within each experimental group in the two counties, respectively Suceava, Iaşi.

The method used to achieve the research objectives is to achieve non-selective collection method followed by biological material: determining the level of attack in the bud, identifying, analyzing and increasing actual laboratory carnation leaf-rollers species resulting from collections and identification pests and pest related species, thus making the percentage of each species of parasite, determining the level of attack on fruit setting hibernating reserve of the main pests of apple orchards .

Regarding the method of collection of biological material indiscriminate harvesting material was carried out throughout the growing season, but most often repeated in the months from March to July. It consists in a selective collection of caterpillars and pupae of foliofage - rollers from the crown of the tree, gathering being carried along with the leaves on which they feed and shelter where they were feeding and pupae with împupare shelter, taking care to be with the last larval exuvie after samples are taken in the laboratory were identified, labeled and prepared for growth, to observe the evolution of each species and to identify pests and parasites copies of each item, thus making the percentage of each parasite species.

**Chapter VI**, entitled **„Results and Discussion”** contains the results of research in the three years of study and analysis and interpretation of data, the situation is as follows :

The level of attack buds of apple orchards in the SCDP Fălticeni in the two groups (chemically treated) was performed on the following dates, namely: in 2011 on 09.05 in 2012 on 08.05 and 12.05 in 2013, being studied three varieties: Jonathan, Golden Delicious and Starkrimson.

During research degree assault buds under SCDP Fălticeni the chemical group was between 4% and 16 % and hence weak and medium and in chemically untreated control limits the attack were between 14 % and 50 % as medium and strong attack .

The teaching farm "Vasile Adamachi " the attack buds level was performed for both groups (chemically treated) in 2011 on 04.05, in 2012 03.05 2013 08.05 respectively, the varieties studied are the same (Jonathan, Golden Delicious and Starkrimson) .

During research in teaching farm conditions "Vasile Adamachi " degree assault buds was between 4% and 22% chemical group, resulting in weak and strong and chemically untreated control limits are between 11% and 30% are medium and strong attack .

Situation of carnation leaf-rollers species collected, identified and analyzed in apple orchards in staţionarele studied in 2011-2013 :

- Given S.C.D.P. Fălticeni in 2011, the chemical group collected a total of 303 specimens belonging to three species of carnation leaf-rollers, species *Adoxophyes orana* F.v R. recording most specimens collected with a total of 235 samples, and the untreated group were collected 80 samples of which 51 belong *Adoxophyes orana* F.v R. The teaching farm "Vasile Adamachi " in chemical group in 2011 were collected 87 samples and 84 samples of the chemically treated group , most of the species *Adoxophyes orana* F.v R.;

- In 2012 the S.C.D.P. Fălticeni chemical group collected 708 specimens belonging *Adoxophyes orana* (181 samples) *Pandemis heparana* Den. & Schiff. (42 samples) and *Archips podana* Scopoli (490 samples). In chemically untreated sample was collected 244 samples, the species being *Adoxophyes orana* (79 samples), *Rhopobota naevana* Hübn. (117 samples) and *Archips rosana* L. (48 samples).

In the farm teaching „Vasile Adamachi“ belonging to chemical group 197 samples were collected of which 156 belong *Adoxophyes orana* F.v R and the chemically treated lots was collected a total of 265 samples that belong to three different species, most occurring in the species *Adoxophyes orana* F.v R 217 samples;

- Following the six harvests, in 2013 chemical group belonging SCDP Fălticeni 623 samples were collected, the species being *Adoxophyes orana* F.v R., *Pandemis heparana* Den. & Schiff. and *Archips podana* Scopoli, and chemically untreated sample was collected 212 samples belonging *Adoxophyes orana* F.v R., *Rhopobota naevana* Hübn. and *Archips Rosana* L., in didactic farm "Vasile Adamachi" e in chemical group collected a total of 139 samples and the chemically treated group collected 133 samples, sampless in both groups of species *Adoxophyes orana* F.v.R., *Pandemis heparana* Den. & Schiff. and *Archips Rosana* L.

As to the species of parasites identified and the degree of parasitic species of carnation leaf-rollers, the situation is as follows:

- In 2011, the chemical group belonging SCDP Fălticeni identified two species of parasites: *Meteorus versicolor* Wesm. and the degree of parasitic *Itoplectis maculator* F trough being between 14 % - 35 %, and untreated control was identified species *Meteorus versicolor* Wesm. registering a degree of parasite species between 44% to *Adoxophyes orana* Fisch.v.Rosl. and 100% of the species *Archips rosana* L.chemical group, under the teaching farm "Vasile Adamachi" Iaşi, identified parasitoid is *Meteorus versicolor* Wesm., the highest parasitic being registered on *Adoxophyes orana* Fisch.v.Rosl. Harvesting II dated 02.05 and is 25 % in the untreated group were identified chemical species *Itoplectis maculator* F., *Meteorus versicolor* Wesm., the degree of parasitic approximately 50 % parasitized specimens .

- In 2012, the S.C.D.P. Fălticeni chemical group parasitoid species identified are: *Meteorus versicolor* Wesm and *Macrocentrus linearis* Nees. degree of parasitic being between 8% - 32 % and in group species are chemically treated *Meteorus versicolor* Wesm. and rough *Itoplectis maculator* F., the highest parasitic being registered on *Adoxophyes orana* Fisch.v. Rosl. 72 %. With teaching farm "Vasile Adamachi". Science in chemical batch parasitoid species identified are *Meteorus versicolor* Wesm. and *Macrocentrus linearis* Nees and the degree of parasite varies between 16% - 19% and in the group treated species are *Meteorus versicolor* Wesm. and rough *Itoplectis maculator* F., the highest being 50 % parasitic and encountered the species *Pandemis heparana* Den. & Schiff.

- In 2013 the chemical group belonging SCDP Fălticeni parasitoid was identified *Meteorus versicolor* Wesm., The highest parasitic being 25 % in the untreated chemical species were *Meteorus versicolor* Wesm. and rough *Itoplectis maculator* F., and the highest recorded parasitic on *Adoxophyes orana* Fisch.v.Rosl. 61 %. With teaching farm "Vasile Adamachi" University in batch chemical was identified species *Meteorus versicolor* Wesm, 29 % being the highest parasitic, and chemically treated group were identified parasitoids *Meteorus versicolor* Wesm. and rough *Itoplectis maculator* F. ,,varying degree of parasitic collection time limits ranging from 21 % - 55 %

For fruit estimating the attack was carried out in two locations (Fălticeni and Science and teaching farm) both chemical group and in the chemically treated during the 3 years of research targeting three species of carnation leaf-rollers. These are: *Cydia pomonella* L., *Adoxophyes orana* F.v R. and *Adoxophyes reticulana* Hb.

In apple orchards in the SCDP Fălticeni estimating the attack was carried out in both stationary (chemically treated) during 2011-2013 on the following dates: in 2011 on 24.10 in 2012 on 22.10 and 25.10 in 2013.

During research on fruit attack level under SCDP Fălticeni was between 1% and 11% in the untreated group and in chemical chemical attack level had limits between 1% and 5%.

In apple orchards belonging teaching farm "Vasile Adamachi" data are in 2011 on 21.10 in 2012 on 17.10 and 20.10 in 2013 .

With teaching farm "Vasile Adamachi" research during the attack level fruit was between 1% and 84 % in the batch chemical and chemical limits in the untreated attack between 1 % and 8 % .

Hibernate pest reserve in apple orchards was carried out in both stationary and firm SCDP Fălticeni farm, ,,Vasile Adamachi" Iaşi, for both groups (chemical treated and untreated chemically lots), with the entry in the winter but also after winter. At SCDP Fălticeni varieties from which samples were collected were Jonathan, Golden Delicious and Starkrimson (chemical group) and Jonathan, Golden Delicious (untreated lots). Teaching farm ,,Vasile Adamachi" Iasi were studied varieties but the same mixture (chemically treated).

The main target species wintering in various stages under the bark of trees, on the stem, branches and produce significant damage during the growing season are: *Panonychus ulmi* Koch., *Quadraspidiotus perniciosus* Comst., *Lepidosaphes ulmi* L. *Psylla mali* Schmidb., *Aphis trees* De Geer. F., *Ceresa bubalus, Tortricidia* sp.

After establishing reserve pest hibernating during the research, under the SCDP Fălticeni both incoming and out of bounds winter attack level between 0,2 % and 33 % in the untreated control group and the chemical attack chemical limits are between 0,4 % and 144 % .

With teaching farm "Vasile Adamachi " University research during the attack level after hibernating reserve establishment has limits between 0,4 % and 2,8% in the batch chemical, and chemical untreated control limits are between 0 attack, 2% to 30,2 %.

In apple orchards belonging SCDP Fălticeni (chemical group) during the three years of research were monitored most important lepidopteran pests of apple *Cydia pomonella* L., *Adoxophyes reticulana* Hbn., *Phyllonorichter blancardella* Fabr., *Archips podana* Scopoli, *Hedya nubiferana* Haworth and *Tortrix viridana* L. using type specific pheromone traps ATRAPOM,

ATRABLANC, ATRARET, ATRAPOD, ATRANUB and ATRAVIR, on which were issued warnings and chemical treatments were applied .

Regarding the warnings issued for pest and pathogens in apple orchard studied in 2011-2013 the situation is as follows:

- In Suceava County in 2011, were issued by the forecasting and warning center has 11 warnings from first warnings 18.04, 09.08 respectively on last warning in 2012 were issued 11 warnings, and in 2013 they warning issued 13 warnings from 16.04 first. Most warnings were issued for *Venturia inaequalis*, *Monilinia laxa*, *Laspeyresia pomonella* L., *Phyllonorycter blancardella* Fabr., *Adoxophyes* sp., *Eriosoma lanigerum* Hausm., Aphids, mites .

- In the county of Iasi in 2011, forecasting and warning center issued a total of 14 warnings, the first warning was issued on the date of the last warnings 20.09 10.03 respectively in 2012 were issued 14 warnings from 05.03, and 2013 were issued nine warnings from 14.03 25.07 respectively. Pests most commonly found are: *Quadraspidiotus perniciosus* Comst., *Eriosoma lanigerum* Hausm. and *Adoxophyes reticulana*, Hbn., *Anthonomus pomorum* L. *Laspeyresia pomonella* L. and as pathogens: *Endostigme inaequalis* and *Endostigme Pyrenees*, *Erwinia amylovora*, *Monilinia linhartiana* etc .

Chemical treatments applied during research in apple orchards in the staţionarelor studied is as follows:

- The apple orchards of the SCDP Fălticeni in 2011 were applied to a number of 12 chemical treatments in 2012 and 2013 were applied to 13 chemical treatments. Pests and pathogens transmission and treatments that have been applied are: *Adoxophyes reticulana* Hbn., *Eriosoma lanigerum* Hausm., *Hoplocampa testudinea* Klug., *Laspeyresia pomonella* L., aphids, *Venturia inaequalis*, *Podosphaera leucotricha*, *Monilinia laxa*, *Erwinia amylovora*, is used products Clarinet (0,1 %), Karate Zeon (0,015), blue Folimax (0,3) 75 WG Chorus (0,02 %), Reldan EC 22 (0,15 %), Codicevo (0,2 %) Rezistevo (0,03 %), 500 Good BSA (0,25 %), etc.

- In 2011, in apple orchards on the farm staff "Vasile Adamachi " University have conducted a number of 10 chemical treatments, in 2012 13 treatments were conducted, in 2013 9 chemical treatments. Were applied: *Laspeyresia pomonella* L., *Eriosoma lanigerum* Hausm., *Hoplocampa testudinea* Klug., *Quadraspidiotus perniciosus* Comst., defoliating caterpillars, *Venturia inaequalis*, *Podosphaera leucotricha* and the products were used: Folicur (0,1 l / ha) , Atracol (2 kg / ha) , Actel

(1,5 l / ha), Clarinet (1,5 l / ha), Calypso ( 0,2 l / ha), Dithane (2,5 l / ha), Thiovit (4 kg / ha) and Karate Zeon (0,25 l / ha), etc.

**Chapter VII** contains the main **conclusions and recommendations** resulting from the study conducted .