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SUMMARY OF PhD THESIS

Studies Regarding the Bioecology and Integrated Control of Summer Fruit Tortrix Moth Adoxophyes Reticulana Hübner., in Dorohoi Area

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INTRODUCTION

Apple orchards, often can not fulfill their genetic production potential, because a variety of factors interfere with a restrictive role. Among these factors, the complex of pathogens and pests have the greatest importance. Apple is attacked by many pests and diseases that cause significant damage, at the leaves level also at fruits level, thus reduces the production and affected their commercial aspect.

Among them there is also the Summer Fruit Tortrix Moth Adoxophyes reticulana Hübner. pest studied in this paper. Today the insect has a wide area of distribution, Adoxophyes reticulana Hbn. it is common in our country, especially in Transylvania and Moldova orchards plantations. In most counties of the country the pest has been detected since 1996 in apple orchards, but until 2002 did not exceed the economical damage threshold, this species had until then only faunistic interest in apple orchards. Since 2003 there was an attack of medium intensity to very strong, mainly at the second generation, which prejudiced the fruits, which must be preserved and valorised. Into a report of one team of group researchers from U.S.A.M.V. Bucharest, it shows that in 2008, in orchards the species was present on 47% of the areas controlled. (ROŞCA şi colab. 2008).

CLIMATE CONDITIONS OF THE AREA DURING 2009 -2012

Studies on the Summer Fruit Tortrix Moth Adoxophyes reticulana Hübner. were performed in Botosani County, near Dorohoi town.

Located midway between the north of the equator and the north pole, as well as geographical conformation, make the Dorohoi area to enjoy a temperate – continental climate, characterized by frequency of winter blizzards and summer long drought. Annual average temperature has an increasing trend during the study period. Thus, in 2009 the temperature was 9.23 °C, in 2010 was 9.45 °C, in 2011 was 9.77 °C and in 2012 was 10.31 °C, compared to an average multiannual temperature of 8.77 °C.

In terms of rainfall 2009 was a normal year, the year that have made 514.9 mm, 2010 was a wet year, with 676.4 mm, and the years 2011 and 2012 were very dry years, the rainfall was 289.4 mm and 309.9 mm. Annual average for this area is 586.8 mm.

RESEARCH OBJECTIVES

Having in regard the production losses due to this pest in apple orchards in 2009-2012, in an apple orchard in Botosani County we carried out some observations, which had the following objectives:

- Observation of biological cycle of Summer Fruit Tortrix Moth Adoxophyes reticulana Hbn., in the climatic conditions of Dorohoi area.
Testing the biological efficacy of sex attractant pheromone, AtraRET, in control of Summer Fruit Tortrix Moth Adoxophyes reticulana Hbn., using the method of mass capture of males and the pheromonal disruption technique.

Testing the biological effectiveness of AtraPOM sexual attractant pheromone to control the codling moth, Cydia pomonella L., using the method of mass capture of males and the pheromonal disruption technique.

Testing the biological effectiveness of the product Mesaj AR (Message AR) to control Summer Fruit Tortrix Moth Adoxophyes reticulana Hbn., using the “attract and kill” method.

Testing the biological effectiveness of the product Mesaj CP (Message CP) to control the codling moth, Cydia pomonella L., using the “attract and kill” method.

Testing the biological effectiveness of the product Semnal AC (Signal AC) to simultaneously combating Summer Fruit Tortrix Moth Adoxophyes reticulana Hbn. and codling moth, Cydia pomonella L., using the “attract and kill” method.

Testing the effectiveness of a range of insecticides used to control Summer Fruit Tortrix Moth Adoxophyes reticulana Hbn.

The proposed objectives are aimed to assess the level populations of this pest, and early warning of trends in population dynamics and then the establishment of strategies to prevent and control Adoxophyes reticulana Hbn. Among these strategies an important role has, the use of semiochemicals products, so the production of ecological apples.

MATERIALS AND RESEARCH METHODS

In order to accomplish the above goals of the research plan were used entomological specific methods, with adjustments required by particularities of the studied species.

Observation of biological cycle on Summer Fruit Tortrix Moth Adoxophyes reticulana Hbn., in the climatic conditions of Dorohoi area.

Observations were made in an apple orchard of Sendriceni-Dorohoi, Botoșani county, during 2009-2012 years. Annually was specified the starting moment of the activity of hibernating larvae. For flight curve of Adoxophyes reticulana Hbn adults, were used pheromone traps with sexual attractant ATRARET.

Oviposition was monitored throughout the evolutionary cycle of the species, the observations were made in the crown of the trees.

Larval evolution was determined by examining the leaves and fruits that were attacked and observations on the state of pupa were made on the biological material collected from the crown of the trees.

The occurrence of different developmental stages were corroborated by dynamic thermal factor, especially the emergence of hibernating stage.
Testing the biological efficacy of sex attractant pheromone, AtraRET, in control of Summer Fruit Tortrix Moth Adoxophyes reticulana Hbn., using the method of mass capture of males, and using the pheromonal disruption technique.

For mass capture of males were placed 30 traps at each generation of the species and pheromone bait was changed twice. The traps were installed on 10 June 2009, 26 May 2010, 20 May 2011, and 17 May 2012 and pheromone capsules were changed at an interval of 6 weeks, the catches were read every week.

The rating of method was performed by comparing the frequency of attack produced by Summer Fruit Tortrix Moth Adoxophyes reticulana Hbn., in experimental variants with the attack of a nearby plantation, where have not been applied combating methods for this species, as well as with the attack reported in the orchard were have been applied chemical treatment to control the pathogens and pests complex.

Testing the biological effectiveness of AtraPOM sexual attractant pheromone to control the codling moth, Cydia pomonella L., using the method of mass capture of males and the pheromonal disruption technique.

For mass capture of males were placed 30 traps at each generation of the species and pheromone bait was changed twice.

The rating of method was performed by comparing the frequency of attack produced by the codling moth, Cydia pomonella L., in experimental variants with the attack of a nearby plantation, where have not been applied control methods for this species, as well as with the attack reported in the orchard in which have been applied chemical treatment to combat pathogens and pests complex.

Evaluation of the effectiveness of method was performed also by tracking the number of Larvae who have sheltered for pupation in the collars traps placed on the trunk of three trees of each experimental variant.

Testing the biological effectiveness of the product Mesaj AR (Message AR) to control Summer Fruit Tortrix Moth Adoxophyes reticulana Hbn., using the “attract and kill” method.

Experimental product is composed of two active components: (Z)-9-tetradecen-1-yl acetate (1) and (Z)-11-tetradecen-1-yl acetate (2), at a rate of 8:2, The active substances were dispersed incorporated in hydrophobic gelling, at which was added a synthetic pyrethroid. The name of experimentally product is Mesaj AR (Message AR). Experimental product was distributed uniformy on the surface of 0.5 ha of experimental lot, being applied as drops, on the trunk or branches of the tree, at a height of about 1.5 m, as far as possible on the north and on the underside of branches, as much as possible to protect against the rain droplets. Date of application of the product was: June 7 and 18 August 2009 and 29 May and 30 July 2010, 14 May and 31 July 2011, and 19 May and 20 July 2012.

Treatment effectiveness was monitored in an operative way and with 3 control traps with bait ATRARET, located inside the pheromone treated plot, estimating that attract and kill technique is effective, as long as no capture is recorded.
Testing the biological effectiveness of the product Mesaj CP (Message CP) to control the codling moth, *Cydia pomonella* L., using the “attract and kill” method.

The active substance of codling moth sex pheromone is acetate (8E, 10E) -8,10-dodecadien-1-yl, was incorporated into a hydrophobic gelling with an added pyrethroid.

The product conditioned is called Mesaj CP (Message CP) designed to combat codling moth *Cydia pomonella* L. Experimental product was distributed uniformly on the surface of 0.5 ha of experimental lot, being applied as drops, on the trunk or branches of the tree, at a height of about 1.5 m, as far as possible on the north and on the underside of branches, as much as possible to protect against the rain droplets. At each pheromonal treatment was applied 200g lure / treatment.

Monitoring the flight activity of adults was performed using specific sex pheromone ATRAPOM located in traps Tetratrap. In each experimental variant were placed three traps, at these traps readings were done three times a week. The biological efficacy of attract and kill technique was assessed by frequency of *Cydia pomonella* pests on fruit and was compared with the untreated control, respectively with conventionally treated control with chemotherapy. Determining the frequency of the attack, was made by checks at two of 1000 fruit harvested randomized. Observations were made also at 500 fallen fruits from various factors.

Testing the biological effectiveness of the product Semnal AC (Signal AC) to simultaneously combating Summer Fruit Tortrix Moth *Adoxophyes reticulana* Hbn. and codling moth, *Cydia pomonella* L., using the “attract and kill” method.

The objective pursued by this experience is to fight simultaneous on both species of Torticidae: *Cydia pomonella* and *Adoxophyes reticulana* through biotechnology attract and kill in order to reduce the number of treatments applied to protect the production of apple orchards.

The experimental Product AC signal contains two active substances acetate, Z-9-tetradecen-1-yl acetate (8 parts) and acetate, Z-11-tetradecen-1-yl acetate (2 parts), so the synthetic sex pheromone of the species *Adoxophyes reticulana* respectively acetate (8E, 10E) -8,10-dodecadien-1-yl acetate (10 parts), synthetic sex pheromone of the species *Cydia pomonella*.

The biological effectiveness of the investigational product AC signal, was appreciated through the frequency of pest attack at *Cydia pomonella* and the *Adoxophyes reticulana* on fruit and was compared with untreated control, respectively with the control treated with conventional chemotherapy.

To achieve the objectives of the efficacy of applying various pheromone variants to combat *Cydia pomonella* and *Adoxophyes reticulana* species, annually were placed the following experimental variants:

- **V1 =** Mass capture of males of *Adoxophye orana* with AtraRet.
V2 = Mass capture of males of *Cydia pomonella* with AtraPom.

V3 = Mesaj CP (Message CP) by applying “attract and kill”.

V4 = Mesaj AR (Message AR) by applying “attract and kill”.

V5 = Semnal AC (Signal AC) by applying “attract and kill”.

V6 = Chemically treated.

V7 = Untreated control.

The analysis of fruits attacked by larvae of the two species was carried out in September.

**Testing the effectiveness of a range of insecticides used to combat Summer Fruit Tortrix Moth *Adoxophyes reticulana* Hbn.**

Researches were conducted in 2010-2012. According to current and future demands, chemical protection against the attacks of pest *Adoxophyes reticulana*, in apple orchards, should be carried out at warning by using a relatively selective range of less polluting products.

Warning moments of intervention with insecticides, can be determined by classical criteria (biological, phenological and ecological), but lately it is proved the superiority of the curve flight method, plotted on basis of data for the supervision of pests populations.

During the period of research the following insecticides were tested: Insegar 25 WG; Karate Zeon; Affirm 095 SG; Actara 25 WG; Decis Mega 50 EW; Calypso 48 and Coragen.

**RESULTS REGARDING THE BIOLOGICAL CYCLE OF SUMMER FRUIT TORTRIX MOTH *ADOXOPHYES RETICULANA* HBN., IN CLIMATIC CONDITIONS OF DOROHOI, BOTOȘANI COUNTY**

A summary is made in relation to the period of occurrence of different stages of development for *Adoxophyes reticulana* Hbn. and the minimum length of a stage, we found differences from one year to another, the differences between these elements demonstrates how important are climatic factors specific to each calendar year, to the growth and development of this pest.

Hibernating larvae begin their activity, during April 10 to 20, period which the apple variety Jonathan is in the budded phenophase, the minimum duration of their development, until puppation, is between 22-33 days.

The pupal stage occurs in the period May 6 to 18, and they go through this stage of development minimum 15-22 days, so hibernating generation adults appear from the last decade of May and the first decade of June. The flight of these adults is between 51-56 days.

First egg masses have emerged during June 5 to 26, and was incubated for 10-14 days, the larvae of the first generation occurring between June 15 to July 5, and they are feeding until pupation a minimum interval of 29-34 days.

The first pupae of the first generation were reported in the period July 14 to August 8, and the minimum pupal stage was 8-18 days, the adults appear in the period 22 July to 20 August. These adults were flying on an interval of 39-69 days (2012 is a special year, a year in which he was able to fly the adults of the third generation).
Egg masses began from August 10-September 1, and the emergence of larvae occurs after 10-15 days, between August 21 to September 16. These larvae are fed at least 10 to 23 days after entering into hibernal diapause, starting from September 14 to 25.

**RESULTS REGARDING TESTING THE BIOLOGICAL EFFICACY OF PHEROMONE PRODUCTS IN COMBATING THE SUMMER FRUIT TORTRIX MOTH *ADOXOPHYES RETICULANA* HBN.**

Hibernating larvae of *Adoxophyes reticulana* led to an annual average of attack frequency at inflorescences, shoots and leaves, in the four experimental years, comprised between 20.25% and 24.50%.

By applying a chemical treatment to control hibernating larvae, attack frequency was reduced at a rate of 91.30%. To fruit, hibernating larvae resulted a annual average of attack frequency comprised between 7.65% and 11.55%. By applying a chemical treatment to control hibernating larvae attack frequency was reduced at a rate of 92.80%. Summer generation larvae (G1) of *Adoxophyes reticulana* at the untreated control, produced an average frequency of attack at 28.8% in fruit. By mass captures of males, attack frequency was reduced by 72.63% and by applying pheromone products through the "attract and kill" the frequency decreased by 80.03% at MESAJ AR and by 78.47% at Semnal AC.

Chemical treatments had an average efficiency of 92.78%.

Larvae of autumn generation (G2) of *Cydia pomonella* to the untreated control, produced an average frequency of 33.23 of attack at fruits, with 10.73 higher than the previous generation.

By mass captures of males, attack frequency was reduced by 72.53%, and by applying pheromone products through the "attract and kill" the frequency decreased by 79.54% at MESAJ CP and by 80.74% at SEMNAL AC.

Chemical treatments had an average efficiency of 92.78%.

During the period of elaboration of this thesis, has been tracked the level of captures of *Adoxophyes reticulana* made in 2009-2012 in each experimental variant and for their two flights of adults.

During the 4 years of capture were made 2676 captures. Is a tendency of increase in number of species in the investigated area for this pest population. Every year the flight of hibernating adult generation had a slightly higher intensity than the first generation adult flight.

This level of records was aimed at *Cydia pomonella*. For this species during the 4 years of capture were made 2786 captures, at codling moth is observed an increasing trend in the population numbers of the species investigated, but the increase it is much larger than at fruit peel moth. The period 2011-2012 is almost a doubling of number of catches compared to the 2009-2010. In every year adult flight of hibernating generation had a slightly lower intensity than the first generation adult flight, and this phenomenon is reflected in attack frequency, which increased to larvae of the second generation.

Effectiveness of of different products and methods of their application in controlling the codling moth, was examined using the number of larvae removed each year from the two girdles trap generation. These have been 266 in the control untreated variant (113 at G1
and 153 at G2), 61 in the variant of mass capture of males (30 at G1 and 31 at G2), 38 for Mesaj CP variant (22 at G1 and 16 at G2), 32 for Semnal AC variant (15 at G1 and 17 at G2) and 10 in the variant chemically treated (6 at G1 and 4 at G2).

It is noted that the maximum number of larvae for pupation, is lower in the variants where pheromone bait was applied by the "attract and kill" method, in relation to the classical method of application of pheromone (mass capture of males).

**RESULTS REGARDING CHEMICAL COMBATING OF SPECIES *ADOXOPHYES RETICULANA* HB.**

For evaluating the effectiveness of various insecticides that can be used in fruit peel moth control, we proceeded to calculate the average effectiveness of the products tested during the experimental period, regarding the reducing attacks in those three periods of attack.

The best results in all periods of observation were made by the product Affirm 095 SG + Silwet, a product which had an efficiency between 97.3% and 99.33% in reducing the attack on leaves and between 98.8 % and 99.57% in reducing the attack on fruits, followed by the mixture Affirm SG 095 + Mineral Oil.

A more than 90% efficacy at all periods of observation, it was noted also at insecticide Coragen, both at the leaves as well as for fruits, an efficacy comprised between 94.03% and 97.07% to reduce the attack on the leaves and between 96 1% and 97% in reducing attack for fruit.

The lowest efficacy had the product Insegar 25 WG, comprised between 84.03% and 90.27% in reducing the attack on leaves and between 81.43% and 90.93% in reducing the attack on fruits.

From the data presented it can be seen that during the first generation of larvae attack (June to July), during which, the untreated control recorded the highest values of attack frequency, all insecticides had an efficiency of more than 90% in reducing the attack on leaves and fruits.

The products tested can be introduced in treatment schemes applied for the control of *Adoxophyes reticulana* Hbn. given the obligation of insecticides alternation, in order to avoid the appearance of some insecticide resistant species.