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SUMMARY
OF
PhD THESIS

Studies regarding the morphology, bioecology and integrated control of the Eurytoma schreineri Schr. species in the condition of Transilvania

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**Key words:** *Eurytoma schreineri* Schr., monitoring, external morphology, bio, chemical control, bury seeds, integrated control.

**INTRODUCTION**

The plum tree plantation, often cannot highlight the genetic potential of production, since many organisms have a restrictive role. Of these, the complex of pathogens and pests have the greatest importance. The plum tree is attacked by many diseases and pests that cause significant damage especially fruit, both by reducing production and commercial aspect. Among them is plum seed wasp *Eurytoma Schreineri* Schr., harmful studied in this paper.

In our country, in the summer of 1979, plum tree orchards in the Iasi county, has identified a high degree of infestation by larvae of the plum seed wasps (T. PERJU si M. PEIU, 1980), (B. BOBARNAC si colab., 2001).

Currently the insect has a wide area of distribution. Recently, it was reported in Wallachia (COPAESCU VALERIA, 1996; GAVA ADINA, 1998) and in 1995 in Transylvania (T. PERJU, 1995 a, b), (I. OLTEAN and colab., 2001).

After 1998 it spread throughout the country, damage was considerable. It is seen as harmful to economic weight in almost all areas of plum tree culture in Mures County.

**CLIMATIC CONDITION OF THE AREA FOR 2008-2010**

Studies on the bioecology of plum seed wasps, *Eurytoma Schreiner* Schr., were performed in Mures county.

The climate is broadly representative of fruit growing region of the Central Plateau of Transylvania. The general climate is temperate - continental. Multianual average temperature per 16 years is 9.4 °C and the multianual average rainfall is 652.3 mm.

![Fig. 1. The thermal regime in 2008-2010 and multiannual (°C)](image-url)
Comparing the monthly average temperatures for the three years of study, as seen in the graphic (Fig. 1.), they are very similar in each month. A certain difference is observed in March and April, during which the temperature is important in pest biology studied in this experience, plum seed wasp, Eurytoma Schreiner Schr. Thus, significant difference shows in 2009, when despite the fact that the average temperature in March is lower by 2.2 ° C compared to March of 2008 and by 0.6 ° C compared to March of 2010, in April the situation reversed. Average temperature in April 2009 is higher than the other two years and to annual average, with influence in the pace of biological development of pest Eurytoma Schreiner.

THE RESEARCH OBJECTIVES

Taking into account the losses due to this pest of fruit production in the period 2006-2011, the plum plantations in Mures county, but also scattered plum, I proceeded to make some remarks (comments from employees who took part and Phytosanitary Unit Mures) and the location of experimental research fields, which had the following objectives:

1. Monitoring of plum plantation surfaces and infested trees (to evaluate biological reserve) and the frequency of attack produced by species *Eurytoma Schreineri* Schr.;

2. Studying the biological cycle and ecology of the plum seed wasps, *Eurytoma Schreineri* Schr.;

3. Studying of the external morphology aspects of the development stages of plum seeds wasps, *Eurytoma Schreineri* Schr.;

4. Testing effectiveness of different control methods against of plum seeds wasps, *Eurytoma Schreineri* Schr.

These objectives are aimed at assessing the level of this harmful populations to detect trends in population dynamics and then establish strategies to prevent and combat *Eurytoma Schreineri* Schr. species.

MATERIALS AND RESEARCH METHODS

- Monitoring of infested areas and frequency of attack produced by *Eurytoma schreineri* Schr. Species;

To achieve this objective, during the six years of study were inventoried the plum orchards in the county's five geographic areas: Tarnaveni, Ludus, Targu Mures, Sighisoara and Reghin. The climatic conditions presents some differences between these areas which are implications for growth and development of harmful. The controlled areas were 232 ha in 2006, 199 ha in 2007, 273 ha in 2008, 239 ha in 2009, 258 ha in 2010 to 275 ha in 2011. Control was performed in August, checking the fallen and attacked fruits by Eurytoma Schreiner Schr. The check was made assess the attack rate.
Tracking of the ecology and the biological cycle of plum seeds wasp, *Eurytoma schreineri* Schr.;

To establish the biological cycle of the species Eurytoma Schreiner, annually I collected samples by fallen fruits (1000 / sample), which were kept and stored on a platform, under climatic conditions similar to those in the field. Then, at 10 different periods (from the middle of April and early June) were analyzed the seeds from fruits collected. The sample at each observation consisted of 100 fruits. At each observation was set the frequency of attacked fruit, the number of dead larvae existing in biological reserve in the sample analyzed, and were determined the biological status of biological reserves: larvae, pupae, adults and number of abandoned seeds. At each observation was made the correlation with the plum trees phenophase and the evolution of climatic factors.

Study of aspects external morphology of the development stages of plum seeds wasp, *Eurytoma schreineri* Schr.;

To study aspects of external morphology, the biological material (adults, larvae and pupae) was taken from Mures County orchards. All life stages were taken from infected seeds and kept on the meteo platform.

The larvae were conserved in glycerine, for 24h; after this period, they were photographed together with the pupae and adults, in the Electronic Microscopy Centre of USAMV(Cluj-Napoca).

For photographing of adults and pupae, they were studied in binocular magnifying glass, observing the differences between the length of antenna sheaths and such were separated in vessels according to presumed sex. Reached at complete metamorphosis, the adult out of exuvia pupala was killed by two methods: suffocation with acetone vapors or freeze, introducing the container with biological sample in the freezer.

All non-conductive samples were covered with a thin layer of conductive material, a necessary measure for the elimination or reduction of electrical charge, which appears at the surface of a non-conductive sample, after the surface is swept by a flow of high energy electrons. If the covering layer is absent, the non-conductive samples will be charged, image is distorted and a significant part of the biological material will be lost.

The layer used to cover the non-conductive material is made of gold or silver. The metal is evaporated under vacuum, thus the metal is connected to the positive pole and the biological sample at the negative pole; at the ends a continuous tension of 1-3 kV is appiend. This devide is placed in a space which maintains a vacuum level sufficient for the deposition of gold or silver atoms in a thin, continuous layer (several hundred nanometers).

For SEM examination the samples are mounted on copper substrates using conductive carbon adhesive discs on both sides. The biological material was placed each on a single stand, using an Olympus binocular microscope. The prepared samples were covered with a this layer of metal. After this step, structural and morpho-structural studies were conducted, using the SEM microscope Jeol – Joe 4B Vacuum Evaporator (for samples covered in silver) and Agar Auto Sputter Coater (for samples covered in gold) at each 10s . The samples were placed in the microscope and were examined at different magnifications.
Testing the effectiveness of various methods to combat the plum seeds wasps, *Eurytoma schreineri* Schr.

To combat this pest have checked two methods:

- chemical method
- agrotechnical methods by incorporating infected seeds at different depths.

Testing the effectiveness some insecticides

To the study of chemical control of plum seeds wasp *Eurytoma Schreiner Schr.* were performed experiments to test the effectiveness of insecticides with the active ingredient in different chemical groups.

The existing plum varieties in orchards and on which were made the experiences are: Stanley plum and Bistrita NM122 plum, on mirobolan rootstock.

The research was organized on monofactoriale field experiences after blocks method on three rows.

For each year of study has worked with 6 variants of treatments of three repetitions each, applied on three rows of plum tree, the intensive culture system, at the fruit growing farm Laslau, Suplac locality on different lots.

In 2008 experience was made on the Stanley variety, in 2009 on the Bistrita variety plum and in 2010 and 2011 again Stanley variety.

Each repetition contains five trees, and between rehearsal were left untreated two fruit trees, protection area on row.

The insecticides used for the 6 experimental variants are:

- CYPERGUARD 25 EC
- CALYPSO 480 SC
- ACTARA 25 WG
- REGENT 200 SC
- TALSTAR 10 EC
- DECIS 25 WG

To determine the effectiveness of treatments with insecticides tested, we analyzed an average of 80 fruits / fruit tree, namely 400 fruits / variant for each yearly of study.

Checking of the effect of incorporation depth on the biological reserve hibernating

To achieve this experience were harvested infested fruit and seeds under trees crown. These were constituted in samples of 100 seeds and incorporated in pits at four different depths: 5 cm, 10 cm, 15 cm, 20 cm and the sample at surface to notice the difference.

These pits have been isolated individual frames and wire mesh in which were placed the adhesive panels to capture wasps that could emerge.

In spring the biological material was analyzed order to evaluate induced mortality of hibernating material and to verify the induction a prolonged diapauzante period.
RESULTS REGARDING THE SPREAD OF WASP

_Eurytoma Schreineri_ Schr. IN MUREŞ COUNTY

The plum seed wasp, _Eurytoma Schreineri_ Schr., has a wide spread area that coincides with that occupied so organized orchards and the scattered fruit trees in households. From 2006-2011 was verified with plum growing areas in order to identify areas that are infested by wasp, _Eurytoma Schreineri_ Schr. Checking plantation was made in August.

- In each plantation, annual were analyzed the fallen fruits under the crown projection of trees (by breaking the seeds).

After observations made with Unit staff Phytosanitary Mures between 2006-2011 it found that existing plum plantations in Mures county were controlled in a proportion between 29% (in 2007) and 40% (in 2008 and 2011) in order to detect attack produced by plum seeds wasp, _Eurytoma Schreineri_ Schr. It finds that the utimii 5 years of observation, the infested area exceeded 62% of the area controlled. The area infested by this pest has shown fluctuations from one year to another, which is between 45.3% (in 2006) and 76% (in 2010).

Regarding attack frequency produced by this pest is found that during 2009-2011 increased middle attack surfaces, and in 2010 it signals a growing and areas with strong attack. Weak attack has been reported on the surfaces between 56.9% (in 2011) and 78.7% (in 2007) of total those controlled; middle attack on the surfaces between 18.6% (in 2007) and 36% (in 2011) of total those controlled, and strong attack on the surfaces between 2.7% (in 2007) and 7.1% (in 2010 and 2011) of the total controlled.

Presenting the percentage of the infested areas (area controlled), the situation on the 5 fruit tree areas of Mures County is the following:

- In the Tarnaveni area this percentage varied between 38.1% (in 2006) and 83.9% (in 2010);
- In the Ludus area this percentage varied between 44.4% (in 2006) and 96.4% (in 2010);
- In Targu Mures area this percentage varied between 35.4% (in 2007) and 75.4% (in 2010);
- In the Reghin area this percentage varied between 37.8% (in 2006) and 93.7% (in 2007);
- In the Sighisoara area this percentage varied between 65% (in 2010) and 95.5% (in 2007).

- The attack of plum seed wasp, Eurytoma Schreiner Schr., was followed at the sporadic plum trees existing on the territorial area of the Mures County. Number of sporadic plum trees on the households, is 439120 trees, according to data extracted from the records of AGR 2011 Agricultural and Rural Development Department.

During the experimental years were verified between 2500 and 13000 of plum trees scattered was establishing the number and frequent of attacked fruit and was found the attack produced by plum seeds wasp was reported on a very high percentage of plum trees monitored.
So in 2006 64.5% of the plum trees were attacked in 2007 65% of plum trees were attacked in 2008 61.9% of plum trees were attacked in 2009 were attacked 61.5% of plum trees in 2010 were attacked 68% of plum trees, and in 2011 were attacked 66.3% of plums.

- The attack of plum seeds wasp, Eurytoma Schreineri Schr., has been observed in other species of stone fruits. These observations were made during the years 2008-2011 on samples of 1000 fallen fruit and harvested under the crown sporadic trees of Prunus cerasifera (wax cherry tree) Armeniaca vulgaris (apricot) and Prunus spinosa (blackthorn) in the area study.

Making a classification of these species, it was found that the biggest attack was reported in Armeniaca vulgaris with a multi-year average of 59.7% and lowest Prunus spinosa with an annual average 40.2% . Frequency of attacks on Prunus cerasifera was averaged 57.47%.

After analyzing of fallen fruit of sour cherry and sweet cherry, not found attacked fruits of plum seeds wasp Eurytoma Schreineri plum.

**RESULTS REGARDING THE STUDY OF ASPECTS OF EXTERNAL MORPHOLOGY**

The adult of *Eurytoma schreineri* Schr. specie, presents Eurytomidae family characteristics, with a ribbed abdominal insertion and a strong developed oviposition.

After biometric measurements performed on biological material removed from the Tarnaveni, we found that body length is between 4.7 to 6.3 mm, with an average of 5.2 mm data are consistent with autochthonous literature (T. Georgescu, 2006, specifies size of 4-6 mm at male and female from 7 to 7.5 mm; P. Pasol and colab., 2007, say that adults are 3.5 to 6.2 mm; I. Oltean and colab. in 2001, say it is 4-6 mm).

- Body color is black, but in the appendix to appear brown or brown-yellow color.
- On the head and the thorax presents a reticular or rough sculpture, while the abdomen is smooth and glossy (Fig. 2.).
- The head is large, wider than long, the length averaging about 1 mm, oval brown eyes. The cheeks are elongated.
- The eyes are very large, with numerous hexagonale omatidii.
- Mandibles are well developed and are tridintate.
- The antennas are long, approximately 2100 μm (at male is longer), consisting of 10 articule, the last two forming the bat. Insertion is done in pits dish antennas, which is very obvious.
- The thorax is well developed, rectangular pronotul being widened. On the thorax presents a deep and very pronounced punctuation.
- The wings are normally developed, earlier wings are slightly darker, with thickened ribs. The wings are transparent, slightly iridescent, covered with fine hairs.
- The feet are brown. Coxa is short and the femur is long and slightly widened. The tarsus of legs are made of 5 articule. On the tibia and tarsus are dense, long hairs and sharp at the top. Components of the previous and middle legs are less developed than the hind legs.
RESULTS REGARDING THE BIOECOLOGY OF *EURYTOMA SCHREINERI* SCHR. SPECIES IN 2008-2010

In 2008-2010, in experimental fields placed in plum plantations of Mures county, to watch the adult flight activity *Eurytoma Schreineri* Schr. species through analyzing biological reserve hibernating for the entire life cycle of the specie. Thus, were determined the moment when triggering flight from hibernating generation, and sequence of different stages of development during the period of plum seeds wasp activity.

In 2008, the observations on gathered fruit from the previous year were made in the period 13 April to 6 June, during which the plum tree was in phenophase white button until the fruit has reached one third of normal size. La cele 10 observatii efectuate, procentul de fructe atacate a fost cuprins intre 16% si 29%.

The natural mortality detected in biological reserve of pest was between 10.5% and 50%. The larvae was signaled in attacked fruit until the last decade of April, during which corresponded to flowering plum tree.

The first pupae were reported in the second decade of the month of April, when the plum is in phenophase the white button. Pupae were found in fruits attacked until the May 29, during which the fruit had a size about one third of normal size. As such, the pupal stage was a period of about 45 days.

The first adults were found in fruits analyze, on May 2, when the plum trees were in the starting phenophase shaking petals. The first orifices to abandoned the seeds of the adults were reported on May 9, after a week their notification in the seeds. The literature consulted is shown that the interval between adult emergence in seed and the biting of the wall to leave the attacked fruit is 5-6 days.

Period of adult emergence was spread over the last two decades of May and the first decade of June, that the separation of calyx and until the phenophase fruit growth to about a third of normal size. The observation of June 6, all adults were exit out of the attacked seeds.

In 2009, in terms of temperature, was a warmer year than last year. In April and May, during which develops its activity hibernating biological reserve of species studied,
temperatures were well above multiannual average. In April 2009, the average temperature was 12.8°C, 10.8°C front in 2008 and 10.4°C, the multiannual average, and in May 16.0°C to 15.6°C, as was last year.

This year, on fruit samples collected last year and analyzed in spring, frequency of attacked fruit was between 21% and 29% (higher than on samples from the previous year). This aspect is due to the upward trend to the level population of plum seeds wasp in the monitored area.

Natural mortality of hibernating biological reserve this year ranged between 21.9% and 30.8%.

The first pupae was reported on April 11, when plum trees were in phenophase the white button. Compared to the last year, the pupae stage has triggered quickly as three days. Pupal stage was spread over a period of 41 days compared 45 days in the last year. Last pupae was reported on May 21. End of the pupal stage was 8 days early compared last year.

On April 21 were signaled the first adults in the infested seeds, compared of May 2, when they reported in the previous year. This year, the adults have appeared 10 days earlier. Flight adults broke out on April 26th (from May 9 last year), period corresponded with shaking petals. Last adults have left the seeds attacked on May 26, compared June 6 from the previous year.

In 2010, the biology of this pest was very similar to that of 2008, the years are alike in terms of climate. In this year the frequency of attacked fruit was between 18% and 30%. The hibernating biological reserve was destroyed by ecological factors at a rate of 19.1% and 29%, is detected the lowest mortality in three years of observation.

Larval stage was prolonged until the April 26, but the first pupae were reported on April 14., in the phenophase of white button. The last pupae were found at the observation of May 22, so the pupal stage was spread over a period of 39 days (the shortest period of years of study). The first adults were found in seeds on May 2 and in May 6 was the first flight of adults. Leaving of seeds by adults was completed on June 6.

In the monitored area, the adults appear in the seeds in the last decade of April - the first days of May, depending on the temperature factor. The seeds are abandoned by adults after 4-7 days. Leaving the fruit is spread over a period of approximately one month.

Can be seen that the adult flight begins when has made an amount of effective temperatures of about 62.1° - 72.6°C (from 10°C thermal threshold). Calendar the flight start date was the earliest on April 26, 2009, and the latest on May 8, 2008. This activity was spread over a range between 30 days (in 2008) and 34 days (in 2010).

Maximum flight curve was recorded after 12-18 days from onset flight (12 days in 2008, 17 days in 2009 and 18 days in 2010), to achieve an amount of active degrees of about 140°C -160°C.

The last adults which came out of infested seeds were reported to achieve an amount of active degrees about 246°C -255 °C, the calendar on May 26 in 2009 and 6 June in 2008 and 2010.

RESULTS CONCERNING EURYTOMA SCHREINERI SCHR.

SPECIES CONTROL
The obtained results on testing the effectiveness of a variety of insecticides

The research were made in 2008-2011. According to current requirements and perspective, chemical protection of plum plantations against pest Eurytoma Schreiner Schr. must be achieved to the warning and by using of a variety of products relatively selective, less polluting.

To combat this species were made annually by 2 treatments with insecticides proposed for testing. The first treatment was applied on: May 24, 2008, May 16, 2009, May 22, 2010 and May 21, 2011. The second treatment were made after 10-13 days. For each insecticide were each 3 repetitions.

Checking insecticide efficacy tested was made by controlling the frequency of the attack in each experimental variant. This action was done in the second half of July: July 24, 2008, July 16, 2009, 24 July 2010 and July 30, 2011.

There has been a centralization of the effectiveness of insecticides on the 4 experimental years. In the four experimental years, the highest effectiveness in combating species Eurytoma Schreiner, was a product Calypso 480 SC 0.02%, with an efficiency of 94.69% (with oscillations between 93.54% in 2009 and 95.91% in 2008), followed closely by product Actara 25 WG 0.01%, with an efficiency of 94.50% (with oscillations ranging from 93.97% in 2010 and 94.93% in 2008).

Insecticide Regent 200 SC a 0.01% had a average efficiency of 92.03% (with oscillations ranging from 91.53% in 2011 and 93.34% in 2008).

The lowest efficacy were reported in synthetic pyrethroids insecticides group, Cyperguard 25 EC 0.02% with an efficiency of 88.63% (with oscillations ranging from 87.61% in 2011 and 89.38% in 2009) and WG 25 Decis 0.025% with an efficiency of 88.85% (with oscillations ranging from 87.11% in 2008 and 89.91% in 2009).

The insecticide Talstar 10 EC 0.04% caused a mortality of 90.10% of pest monitoring (with oscillations ranging from 89.58% in 2010 and 90.66% in 2009), but this product is important because is a insecticide-acaricide.

The results obtained by combating agrotechnical

Agrotechnical methods used to reduce much of the biological reserve of insects. Making reference only to the pest Eurytoma Schreiner (plum seed wasp), incorporation of infested fruit orchards can be done in the land is maintained as a black field, by deep plowing carried out in autumn or early spring, dug by one or the crown of trees. Thus much of fallen fruits get under unfavorable conditions for survival of hibernating larvae (Perju T, 2002).

To achieve this experience were harvested fruit and seeds infested under the trees crown. They were constituted in samples of 100 seeds and incorporated in pit at the four different depths: 5 cm, 10 cm, 15 cm, 20 cm and the sample surface to notice the difference. By the version with seed placement at the soil surface was examined and the percentage of mortality of hibernating biological reserve specific environmental factors each year.

These pits have been isolated individual with frames and wire mesh in which were placed adhesive panels to capture wasps that could get out.
By burying of attacked seeds at different depths was recorded a part of biological reserves in prolonged hibernation.

Depending on the depth which they are incorporated, only 10-15% of the wasps manage to exit to surface, 15-20% of larvae enter in prolonged hibernation and 70-80% of pest die in the inside of seeds or after leaving seed not manage to pass through the soil.

Experiments conducted in 2008-2010, at The Unity Phytosanitary Mures, to determine the influence of incorporating depth of plum seeds in combating this important pest, bring us real conviction that the practice of this method is very effective.

► Develop an integrated control scheme

In the combating program I have past performing of 9 chemical treatments, but they will fit in each plantation according to biological reserve of each species to be combated.

For the study of species *Eurytoma Schreiner* Schr. I recommended two treatment, treatment 3 and 4. The plum seeds wasp is dangerous to strengthening of seed.