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Original Scientific paper

EPHESTIA ELUTELLA HÜB. ON TOBACCO

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ABSTRACT

Ephestia elutella Hüb. is one of the economically most important warehouse moths in the world.

Investigations were carried out during 2011-2013 with Prilep and Yaka tobacco from the 2010 crop. Biological and other investigations of *E. elutella* were performed in laboratory conditions, using a standard methodology.

Imagos are small butterflies, with bodies and wings covered with tiny scales. During our investigations their color varied from light grey brown to dark gray brown. They were 6 to 9 mm long, with a 10-13 mm wingspan.

Eggs are elliptical and less than 1 mm long. During laying they are off-white in color and later, prior to hatching, they turn darker.

After hatching, the larvae are also off-white and as they grow older the caterpillars turn brown. The body of the caterpillar is covered with sparse hairs. The length of the adult larva in our investigation was 8 – 9 mm.

Tobacco moth causes damage to tobacco in larval stage. Larvae feed greedily on dry leaf tissue, skeletizing the leaf, and in case of stronger attack only the main nerve remains.

Caterpillars also cause indirect damage. They wrap the leaves with silky threads and inside the leaf they leave black grainy excrements and remains from molting and metamorphosis.

Larval stage lasts from 30 to 35 days and during this long period it causes significant damage.

The pupa is covered, mummy-formed pupa (pupa obtecta), about 7-8 mm in length, light brown in the beginning and prior to eclosion the butterfly turns darker, almost black.

The pupal stage lasts 6 – 7 days.

Direct and indirect damages caused by caterpillars strongly affect the tobacco value and make it unsuitable for further fabrication and export.

Keywords: tobacco, tobacco moth, *Ephestia elutella* Hüb., damage

EPHESTIA ELUTELLA HÜB. НА ТУТУНОТ

Ephestia elutella Hüb. е еден од економски најзначајните штетници во магацините за тутун во светот.

Проучувањата беа изведени во текот 2011-2013 година во лабораториски услови. За материјал беа користени тутуни од тип Прилеп и тип Јака од реколта 2010 година. За истражување на *E. elutella* во лабораториски услови, за биолошки и други испитувања, беше применета стандардна методологија.

Имагата се ситни пеперутки, а бојата на телото при испитувањата вариреше од светлосивокафена до темносиво кафена боја. Целото тело и крилјата на пеперутките им се препокриени со лушпенца.

Должината на телото, при нашите истражувања во лабораториски услови, изнесува од 6 до 9 mm, а распонот на крилјата изнесува околу 10-13 mm.

Јајцата имаат елиптичен облик со должина помала од 1 mm. При полагањето се валканобели, а покасно, пред пилењето на ларвата добиваат потемна боја.

Исто така и ларвите по пилењето имаат валканобела боја, а кога ќе пораснат гасениците стануваат кафени. Телото на гасеницата е покриено со ретки влакненца. Должината на возрасната ларва, според нашите истражувања, изнесуваше од 8- 9 mm.

Тутунскиот молец предизвикува штети на тутунот во стадиумот ларва. Ларвите многу лакомо се хранат со ткаеницата на сувите листови тутун, го скелетираат листот, а при посилен напад останува само главниот нерв.

Гасениците предизвикуваат и индиректни штети. Нападнатите листови ги замотуваат со свилекасти конци, а во внатрешноста се наоѓа црн зрнест измет, екскременти, остатоци од преслекувањето и метаморфозата.

Стадиумот ларва при нашите истражувања се одвиваше од 30 до 35 дена и за тој долг период таа нанесува значајни ошетувања.

Куклата е покриена, кукла мумија (pupa obtecta). Должината и е околу 7-8 mm. Таа во почеток е светлокафена, а покасно се менува и пред еклозија на пеперутката станува потемна, скоро црна.

Стадиумот на кукла трае 6 -7 дена.

Директните и индиректните штети кои ги предизвикуваат гасениците, мошне го декласираат тутунот, а ваквиот тутун е непогоден за понатамошна фабрикација и извоз.

Клучни зборови: тутун, тутунскиот молец, *Ephestia elutella* Hüb., штетност

INTRODUCTION

The origin of *E. elutella* is probably Europe, wherefrom it has been transported to all parts of the world, even to Australia. Presently, it is a cosmopolitan species, distributed over a wide area, especially in regions with warm and moderate climate in warehouses, food factories and shops.

It is known under common names tobacco moth, mite, cocoa moth or warehouse moth.

E. elutella is a poliphagous species. Its larvae usually infest the food of vegetative origin. Beside tobacco and cocoa, the pest is also found in chocolate, different kinds of cereals, hop, sunflower, dried fruits and vegetables, peanuts, almonds, nuts, hazelnuts, coffee grains, candies, red pepper, flours and various products made of it (bisquits, bran, pasta), dairy products etc.

E. elutella was identified as a pest on cocoa and as a chocolate pest it was first described in France (Radovanovic, 1961). Presently, it is one of the most dangerous pests in chocolate factories, but it is frequently found in warehouses for flour and dried dough.

Less common tobacco moth food includes meat and carrions, insect collections and dry wood.

Tobacco moth has been defined as economically important pest on tobacco at the beginning of the last century. In Europe it was first described in tobacco warehouses by Mokrzecki in 1909. In the USA it was identified in 1897, but was defined as a pest on tobacco in 1930 (Radovanovic, 1961).

Tobacco moth is spread all over R. Macedonia, mainly in warehouses where small-leaf (oriental) tobacco is stored (Boceski, 1984, 2003; Vukasovic, 1962; Jovanovic, 2001).

Very often this pest can make damage even before tobacco manipulation by the

farmers (Todoroski, 1969). The infected tobacco is then transported in bales and stored in warehouses (non-fermented tobacco, tobacco with seasonal fermentation, etc.).

MATERIAL AND METHODS

Two year investigations (2011-2013) were carried out in laboratory conditions with tobacco types Prilep and Yaka from the 2010 crop.

Two year investigations (2011-2013) were carried out in laboratory conditions with tobacco types Prilep and Yaka from the 2010 crop.

Standard methodology was applied for investigations of biological characteristics and other analysis of *E. elutella*.

A part of tobacco samples was placed in cages to monitor the development cycle of tobacco moth. Also, larvae of *E. elutella* were placed with tobacco leaves in Petri dishes until eclosion of adults.

Other samples were placed as a whole into bags to monitor the damage caused by the pest.

RESULTS AND DISCUSSION

Ephestia elutella Hübner (1796) belongs to the order Lepidoptera- butterflies, suborder Microlepidoptera small butterflies, family Pyralidae, subfamily Phycitinae.

The species is known under several synonyms: *Ephestia amarella* Dyar (1904), *E. icosiella* Ragonot (1888), *Ephestia infumatella* Ragonot (1887), *Ephestia roxburghii* Gregson (1873), *Ephestia uniformata* Dufrane (1942), *Homoeosoma affusella* Ragonot (1888), *Hyphantidium sericarium* Scott (1859), *Phycis angusta* Haworth (1811), *Phycis elutea* Haworth (1811); *Phycis rufa* Haworth (1811), *Phycis semirufa* Haworth (1811), *Tinea elutella* Hübner (1796).

The species development undergoes complete metamorphosis (holometabolia).

Imagos are tiny butterflies and the color of their bodies in our investigations varied from light gray brown to dark gray brown. The whole body and wings of the butterflies are covered with scales (Fig. 1).

According to literature data, the color of the wings is not constant and it can vary from dark gray brown, gray to gray yellowish or even brown and it probably depends on the food in which they develop.

In our investigations, the body length varied from 6 to 9 mm and the wingspan was 10-13 mm.

According to other authors, body length is 10 mm and the wingspan is 14- 20 mm (Radovanovic, 1961; Tanasievic, Simova-Tosic, 1985; Tanasievic, Ilic, 1969).

The fore wings are slightly darker and narrower than the hind wings, elongate-triangular, with characteristic transverse stripes.

Some individuals are striped more noticeably than others.

The hind wings are monochromatic, light gray, with long dark brown fringes in the margins.

Fig. 1 Imago

The head is relatively small and round, with well developed compound eyes and two eyes on the top of the head. The antennae are located between the compound eyes.

The body is elongated and spindle-shaped. The thorax segments are fused and carry two pairs of membranous wings with rich innervation. Legs are adapted for walking, with 5–segmented feet.

Ovipositors of the females are telescopic and feromones are secreted from the glands located in intersegmental membrane of the genital segments.

Butterflies are active and fly during the night. During the daytime they hide in various places between the edges of the cages, among dry tobacco leaves etc. They are very photophillic and move to the top of the cages, toward the light.

Butterflies do not feed. They use the food collected previously, at larval stage.

Fig. 2 Mating

Butterflies are oviparous. Egg-laying starts 1-2 days after mating. According to Radovanovic (1961), the females lay their eggs randomly, single or in small groups, in tobacco leaves, bales or in packing material, sticking them firmly to the base.

Fecundity of a single female is 130 to 200 or even 300 eggs (Radovanovic, 1961; Tanasievic, Simova-Tosic, 1985; Tanasievic, Ilic, 1969).

Shortly after laying their eggs, butterflies die.

The eggs are elliptical in shape, less than 1mm long. Immediately after hatching they are dirty- white and later become darker.

Embryonic development, according to various authors, significantly differs and vary from 3 to 17 days, depending on the temperature (Radovanovic, 1961).

The larvae are eucefalic, with well developed mouthparts adapted for biting. They have short antennae and 6 stemmata (larval eyes). The head and neck shield are brown and the jaws are darker (Fig. 3).

They are polypodous, with 16 legs, three pairs of which are thoracic and five abdominal.

During their lifetime, caterpillars shed their skin five times.

After hatching, they are off- white in color and as they grow up the caterpillars turn brown.

The body of the caterpillar is covered with sparse hairs.

Along dorsal and lateral side of the body they have four rows of black spots, with one tiny hair protruding from each spot.

In our investigations the adult larva was 8 – 9 mm long, while literature data report a length of 9 - 15 mm (Radovanovic, 1961, Tanasievic, Simova-Tosic, 1985; Tanasievic, Ilic, 1969).

Fig. 3 Larva

The larvae are phytophagous and they can cause significant economic damage in tobacco production.

Immediately after hatching the caterpillar feeds on dry tobacco leaves. Larvae feed on leaves from the surface layer of samples (Fig 4).

Caterpillars bite the tissue between leaf veins, and later they eat whole pieces of cured leaves, leaving only the leaf nervation (Fig 5).

According to Krsteska et al. (2011), if tobacco is packed in bales, caterpillars bore through them and make tunnels while feeding on tobacco. The tunnels are found mostly at the surface, not going deeper into the bale.

Unlike cigarette beetle, tobacco moth does not infest ready tobacco products.

Fig. 4 Damaged tobacco leaves, from the surface layer of samples

Caterpillars can also cause indirect damage. The affected leaves are wrapped with silky threads and inside the leaf they leave black grainy excrements and remains from molting and metamorphosis (Fig. 6).

Fig. 5 Damaged tobacco leaves (only the leaf nervation)

At higher humidity in warehouses, damaged leaves create good conditions for development of mold which makes serious damage to tobacco (Radovanovic, 1961; Todoroski 1960).

Damages caused by larvae negatively affect the quality and quantity of tobacco. The products made of such tobacco (cigarettes and cigars) have a bad taste and unpleasant aroma.

Caterpillars are especially greedy when they feed on high quality oriental tobacco, but they do not spare tobaccos of lower quality, too (Radovanovic, 1961; Todoroski 1960).

Larvae prefer Virginia and oriental tobaccos with a high sugar content and low nicotine (Alic-Dzemidzic et al. 1999; Radovanovic, 1961; Todoroski 1960).

Fig. 6 Damaged tobacco leaves, with silky threads and black grainy excrements

In our investigations, the larval stage lasted from 30 to 35 days and during that period it caused serious damage.

According to literature data, the caterpillar stage usually lasts 50-60 days. Depending on temperature conditions, duration of this stage varies significantly. The development can be completed in 25-40 days in favorable conditions, but it can be prolonged up to 240 days when the conditions are unfavorable (Radovanovic, 1961;, Todoroski 1960; Tanasievic, Simova-Tosic, 1985; Tanasievic, Ilic, 1969).

Before the caterpillar turns into a pupa, it spins a silky whitish cocoon (Fig 7).

Such cocoons can be found in tobacco samples or in the corners of the cages, under the filter paper or on dry leaves in Petri dishes.

Fig. 7 Pupa

Pupae are also found at different sites in warehouses - in gunny sacks, inside or outside the bale, etc. According to Radovanovic (1961), in severely infected units, tobacco bales can be completely wrapped in a web spun by caterpillars before they turn into pupae.

Fig. 8 Ecloded pupa in a cobweb

The pupae are covered (pupa obtecta) and their appendages are closely bound to the body (Fig. 8). In our investigations they are 7-8 mm long, light brown in color at the beginning and later, before eclosion, the butterfly turns darker, almost black. Pupal stage lasts from 6-7 days.

According to literature data, the pupa can reach 10-12 mm in length (Radovnovic, 1961). Pupal stage lasts from 6 days in favorable weather conditions to10-12 days when conditions are unfavorable (Radovanovic, 1961, Todoroski, 1964).

Tobacco moth prefers warm environment but it successfully develops in areas with moderate climate.

Under suitable conditions, the moth develops and reproduces continuously, so that its eggs, larvae, pupae and adults can be observed simultaneously. In summer, the pest develops faster.

Adult larvae from the last generation are overwintering in tobacco bales, in packing material, hidden in window casings or in various cracks on the walls, floor and other places in warehouses.

Caterpillars turn into a pupa during April. Very often, the pest overwinters in this stage. The first butterflies appear in the warehouses in late April or early May, depending on the temperature conditions

and humidity. In areas with warmer climate they appear earlier.

In unheated warehouses, imagos from different generations appear at warmer temperatures – from late April to October.

In different countries the number of generations varies depending on the climate conditions. According to Dimitrov (2003) and Meng et al. (1990) it is considered that the pest has 2-3 generations annually, and in years with early and warm spring and long autumn it can develop up to 4 generations.

Under climate conditions of the Republic of Macedonia, tobacco moth develops 2-3 generations per year.

CONCLUSIONS

The larvae are phytophagous and they cause significant economic loss in tobacco production.

These pests can cause severe losses in warehouses and they have significant economic importance to tobacco quality and quantity.

In our investigation, larval stage lasted 30 - 35 days and during this long period it caused serious damage.

Caterpillars bite the tissue between leaf veins, and later they eat whole pieces of the cured leaves, leaving only the leaf nervation. In the case of stronger infestation, tobacco is skeletonized and only the main nerve remains.

Caterpillars also cause indirect damage. They wrap the leaves with silky threads and inside the leaf they leave black grainy excrements and remains from molting and metamorphosis. Feeding on tobacco, the larvae decrease its market value.

The investigations will result in timely and successful protection of tobacco from this dangerous pest.

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