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MULTIANNUAL INVESTIGATIONS ON MORPHOLOGY AND BIOLOGY OF *EPITRIX HIRTIPENNIS* MELSH ON TOBACCO

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ABSTRACT

Tobacco flea beetle (*Epitrix hirtipennis* Melsh) is one of the most important pests of the Solanaceae family. It can be found in tobacco throughout the whole period of vegetation, causing severe damages both on seedlings and on transplanted tobacco. In the Republic of Macedonia, investigations on the morphology, biology and eradication of this pest were carried out by Krsteska, Stojanoski (5, 6 and 7).

Presently, *E. hirtipennis* is one of the major pests on tobacco in Macedonia, spreading in almost all tobacco producing regions in the country.

Having in mind the high consuming ability and expressed poliphagia of *E. hirtipennis*, the longevity of adults, the great number of generations and resistance to the atmosphere effects, it is necessary to perform protection against tobacco flea beetle. The struggle should be precise in order to achieve visible results.

Key words: tobacco, *Epitrix hirtipennis*, damage, protection

ПОВЕЌЕГОДИШНИ ИСПИТУВАЊА НА МОРФОЛОГИЈАТА И БИОЛОГИЈАТА НА *EPITRIX HIRTIPENNIS* MELSH КАЈ ТУТУНОТ

АПСТРАКТ

Тутунската лисна болва *Epithrix hirtipennis* Melsh е еден од економски најважните штетници на фамилијата Solanaceae. Болвата е присутна на тутунот низ целиот вегетационен период и предизвикува големи штети како на расадот така и на расадениот тутун. Крстеска, Стојаноски вршеле проучувања за морфологијата, биологијата и сузбивањето на овој штетник во Република Македонија (5, 6 и 7).

Денес, *E. hirtipennis* е еден од економски најважните штетници на тутунот во Македонија и е констатиран во скоро сите тутуно-производни реони во земјава.

Сузбивање на тутуновата лисна болва се покажа како неопходност, имајќи го во предвид големата консумативна способност и изразитата полифагност на *E. hirtipennis*, долгиот активен живот на имагата, големиот број на генерации, отпорноста кон атмосверските влијанија. Борбата треба да биде прецизна за да се добијат видливи значајни резултати.

Клучни зборови: тутун, *Epitrix hirtipennis*, оштетувања, заштита

INTRODUCTION

Intensification and concentration of tobacco production in many regions of the Republic of Macedonia, as well as its growing in monoculture, make favorable conditions for frequent mass attacks of harmful insect species on tobacco culture.

E. hirtipennis is one of the most important pests, which has been in large expansion on tobacco producing regions of the south Balkans over the past few years.

Originating from North America, this species has a wide area of distribution and is highly adaptable. Today, tobacco flea beetle is present almost everywhere in the world.

The beetle causes severe damages on cultures of the Solanaceae family, especially on tobacco. In years of massive attack it produces serious economic losses.

According to the *Handbook of quarantine plant diseases* of ex Yugoslavia, it belongs to the group of non-European species of quarantine pests of the genus Epitrix. Beside *E. hirtipennis,* tobacco can be attacked by other species of this genus, like *E. cucumeris* Harris (Eastern parts of North America, mainly a pest on potato) *E. parvula* F. (USA- potato and tomato), *E. fascata* Dur. (Puerto Rico – potato, eggplant and tomato) *E. nicotiana* Bryant, *E. argentinensis* Bryant (South America), etc. (4)

A strong infestation of this pest in Italy was first observed in 1983, in the region of Benvento (Sannino et al., 1984) (11, 12).

A detailed study of the pest was made by Sannino et al, in 1985, and afterwards by Sannino L., Piro F., Balbiani A., Biondi M., Piro F., Milano D., Fiorentino F. A variety of commercial foliar insecticides (alphamethrin, esfenvalerat, lambda-cyhalothrin, endosulfan, fluvalinate, carbaryl, acephat etc), granulated soil insecticides (carbosulfan, phorate, chlorpyriphos, phorate+ terbufos, etc), and microbiological products (bioproducts) based on Beauveria bassiana, Bacillus thuringiensis were investigated for control of the pest (1, 10, 13, 14,17).

According to references, investigations on tobacco beetle control in USA are dating from 1970, with organophosphorous and carbamate insecticides (Mistric W.J., Smith F.D.; Semtner P.J., Reed T.D.), to the present days with application of systemic product Admire 2F (a.i. imidacloprid) (9, 15). Its commercial name in our country is Confidor SL 200 \Kohinor R 200.

In Albania, *E. hirtipennis* was first reported by Gixhari in 1986 (2) and today it is present in almost all tobacco producing regions. Investigations with foliar application of seven commercial insecticides (alphamethrin, esfenvalerat, lambda-cyhalothrin, deltamethrin, endosulfan, carbaryl, acephat) were carried out for control of this pest on oriental tobacco.

Likouresis D.P., Mentzos G. (1991) the first occurrence of the pest was reported in west Greece, where it was supposed to be transported from Italy. Today it is widely distributed on tobacco plantings in central Greece, too (8).

In Bulgaria, A. Dimitrov (1997) made investigations for successful control of tobacco beetle with Sumi-alpha (a.i. esfenvalerate) (3).

The first report on *E. hirtipennis* in the Republic of Macedonia was made in 1996 (by researches of Scientific tobacco institute Prilep) in the region of Strumica, the village of Kosturino. During 1997/1998 the pest was reported in the regions of Strumica, Radovis, Veles and Prilep, and presently it is distributed in almost all tobacco producing regions in the country.

MATERIAL AND METHOD OF WORK

The occurrence of *E. hirtipennis* on tobacco was monitored from March to October during 2001-2011. Investigations were made during the whole growing period, from seedlings through field tobacco to suckers in the post-harvest period.

Investigations were made on morphology and biology of the pest and its relationship with soil and climate conditions of the region.

Field trials were carried out for the control of *E. hirtipennis* on oriental tobacco with insecticides. The inspection of tobacco plants before treatments revealed a heavy infestation with the pest.

Chemicals were applied foliary, with knapsack sprayer, and the treatment included 400 tobacco plants in flowering stage.

The first field trial was performed in 2001-2002. Two synthetic pyrethroids were applied foliary on the Experimental field of Scientific Tobacco Institute-Prilep: Karate 2.5 EC (a.i. lambda-cyhalothrin) -0.02%, Sumi-alpha 5 EC (a.i. esfenvalerate)- 0.04%.

Effectiveness of the applied insecticides was estimated 1, 4, 7, 13 and 20 days after.

During 2007-2008, second field trials were carried out on the Experimental field of Scientific Tobacco Institute-Prilep, with three

systemic insecticides: Confidor SL 200 (a.i. imidacloprid) -0,03%, Bubastar 20 SP (a.i. acetamiprid) 0,02% and Actara 25 WG (a.i. thiamethoxam)-0,02%.

Effectiveness of the applied insecticides was estimated 1, 4, 9, 17 and 24 days after.

RESULTS AND DISCUSSION

Tobacco beetle *Epitrix hirtipennis* Melsh. belongs to the order Coleoptera, family Chrysomelidae, subfamily Halticinae.

The pest is known under different common names among the authors, mostly as tobacco flea beetle or tomato beetle.

It is oligophagous pest, attacking the plants of the Solanaceae family: tobacco, pepper, potato, tomato, egg-plant, etc., and could be find on the weeds of spontaneous flora: *Datura stramonium, Phytolocca decandra, Vigna sinensis, Artropa* sp., *Hyoscyamus* sp., *Lycium* sp, *Petunia* sp., etc (according literature data).

During our investigations, the beetle was also determined on a number of weed species around tobacco plantings, like: *Amaranthus retroflexus*, *Chenopodium album*, *Sinapis arvensis*, *Datura stramonium,* etc.

The pest is present on tobacco during the whole growing period and attacks seedlings as well as transplanted tobacco.

The imago of *E. hirtipennis* is small coleoptera 1.2 -2 mm long, dark-brown to reddish, ovoid in shape. Antennae consist of 11 segments and the mouthpart is adapted for nibbling. Elytrae are spotted along the entire length and darkening is present in their middle part and toward the ends. Legs are modified for jumping and the femur is darker (Fig. 1).

Fig. 1 Imago of *E. hirtipennis*

According to Sannino L. and Balbiani A., female lays in average 150-200 eggs in the soil, in the vicinity of host-plant, individually or in small groups (3-5) The eggs are oval and elongated, 0.43 x 0.16 mm in size. At the moment of emerging they are white, and with time they turn to strawy-yellow. The surface of the horion is smooth and elastic (11).

Hatching takes place after a week. Newly hatched larvae are small and tiny, in white color. The mature larva has cylindrical form, the body is moderately wrinkled and segmented, reaching a size of 3.5 - 4.5 mm. Its color is dirty white and the head is light brown. It has three pairs of short thoracic legs and a pair of abdominal prolegs on the last segment.

The larva goes through three stages and larval development lasts 4 to 5 weeks.

The mature-larva leaves the root system and makes a soil chamber at a depth of 2-4 cm, where it becomes a pupa (pupa liberta), sized 1.9 x 0.75 mm.

The imago eclodes in 4 to 7 days.

Development of each generation from egg to imago lasts approximately 6 weeks.

The adults have a considerably long active life - about 8 weeks (17).

Due to this, their population rapidly increases and causes losses throughout the whole period of tobacco growing.

It usually has 3-5 generations a year, and the adults of different generations mix together. After harvest, the beetle easily adapts to tobacco suckers and shelters underneath leaf debris or other organic matters near tobacco or other plantings where it hibernates.

E. hirtipennis causes three types of damages:

- Damages caused by larvae to underground part of plants;
- Damages caused by imagos feeding on tobacco plants;
- Indirect damages – the pest appears as a vector of a number of viruses.

Larvae feed on the underground parts of plants, boring choridors through the roots and stalks. They cause more severe damage to younger plants.

The most severe damages are caused by adult insects. These damages are characterized by small round holes that give the leaf a sieve-like appearance (Fig. 2).

When higher population of the beetle is present, the little holes on the seedlings and young transplants coalesce and the leaf can disappear in a short time (Fig. 3).

Fig. 2 Adults of *E. hirtipennis*

Fig. 3 Damage caused by tobacco beetle

Gixhari,1983, reports that tobacco beetle in Albania has destroyed the whole yield of transplanted tobacco in only two days (2).

The beetle can consume food ten times of its own weight a day and is easily adaptable to various environmental conditions (12).

Imagos can cause economically important damages both to young seedlings and to plants transplanted in field.

Fig. 4 Damage caused by tobacco beetle

Fig. 5 Damage caused by tobacco beetle

Holes in the leaf present an entrance for a great number of pathogenic microorganisms. For damaged plants it is difficult to adapt after transplanting and very often they die. The damages are particularly pronounced in dry and windy weather.

Damages on plants transplanted in field depend on the intensity of attack. The increased number of leaf holes reduces the assimilation capacity of leaves, by which they slow down plant growth and reduce the quality of tobacco.

Fig. 6 Damage caused by tobacco beetle

The most severe damages are expected the first three weeks after tobacco transplanting.

Unfortunately, tobacco beetle attacks all leaf insertions, including the suckers and the top leaves – the best for their aroma and quality.

Tobacco beetle can be potential vector of the virus disease TRSV (tobacco ring spot virus).

E. hirtipennis hibernates as adult insect under plant debris or in the stalks remaining in tobacco fields after harvest. In spring, the imagos emerge and feed initially on weed plants and then migrate to tobacco seedbeds. They attack the germinated plants and lay their eggs on soil surface near the roots of the plants.

Tobacco beetle in field is spread through transplantation of seedlings attacked by larvae. In the same manner, the ecloded imagos from tobacco seedbeds and those from adjacent weeds continue to hatch on transplanted tobacco in field. The attack proceeds to the end of harvest.

The control of this pest is very difficult, not only because it is Coleoptera (sheathed wings) but also because it is Halticinae, finding food by hopping from one plant to another in short jumps. Regarding the climate effects, cold winters result in higher morbidity of the hibernating adults. In the growing period of tobacco, in sunny days, when the temperature is moderate, the adult of *E. hirtipennis* is active and dwells both on front and reverse side of leaf (preferring the latter one). In a period of strong heat (about 35^0C), it hides in shady places or in the soil.

For successful protection of tobacco from this harmful pest and, which is more important, for obtaining higher yields of a good qualty tobacco, it is necessary to have basic knowledge on its morphology, life cycle, dwelling place and environment, damages caused on tobacco, presence or absence of natural enemies and, finally, monitoring. Continuous visual monitoring is necessary during the vegetation period, after tobacco transplanting in field.

Preventive measures are of major importance in the control or reduction of beetle attack. Monoculture production of tobacco should be avoided and crop rotation is recommended instead. Crops in which tobacco beetle can hibernate and survive, should not be used as a precrop. Wheat or sunflower are good precrop for tobacco.

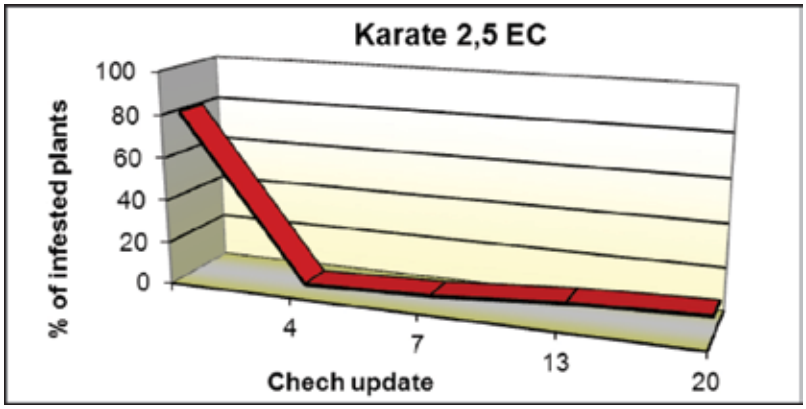
Plants of the Solanaceae family should be avoided to be grown near tobacco seedbeds and plantings.

Chemical control is still indispensable in keeping the population rate in economically acceptable frames.

In the first trial (2001-2002) plot treated with Karate 0.02%, infestation was noticed on 315 plants, i.e. the beetle was identified on 78.75% of the treated stalks.

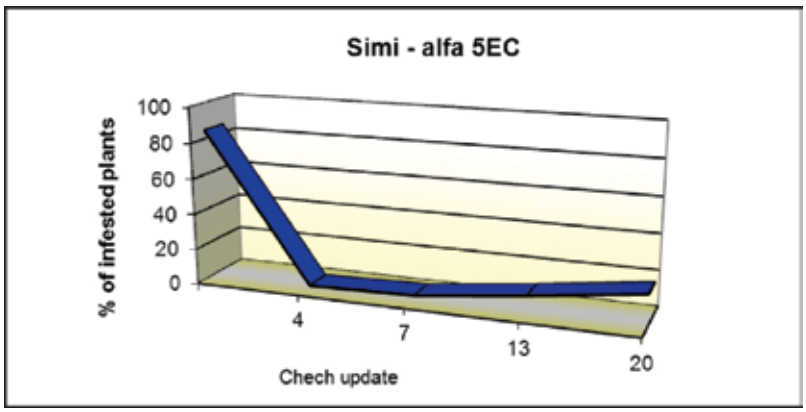
In plot treated with Sumi-alpha 0.04%, the infestation was observed in 339 out of the 400 plants (84.75%).

The percentage of effectiveness was high. Thus, four days after treatment with Karate tobacco beetle was observed in 1.75% of the plants, and 20 days after in 9.75% (Graph 1).



Graf. 1 Control of *E. hirtipennis*- plot treated with Karate 2,5 EC

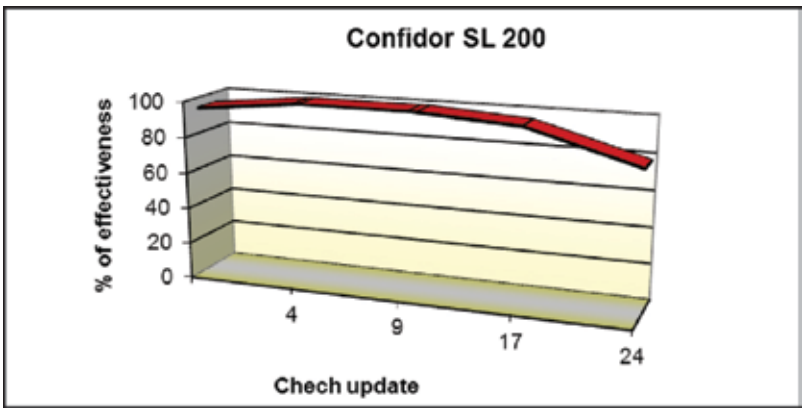
With Sumi-alpha, four days after treatment tobacco beetle survived in only 1% of tobacco stalks, and 20 days after in 17.75% (Graph 2).



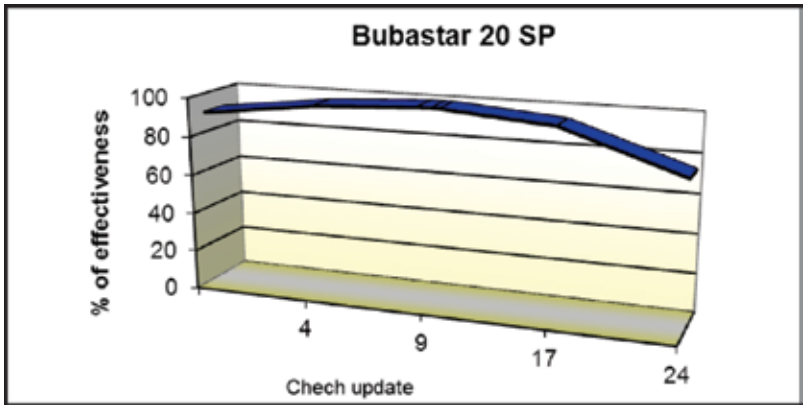
Graf. 2 Control of *E. hirtipennis*- plot treated with Sumi-alpha 5 EC

In about 24 hours, with this active ingredient, the reduction of infestation is 94 - 99%, which is in accordance with data reported by Sannino et al. (13) and Gixhari (2).

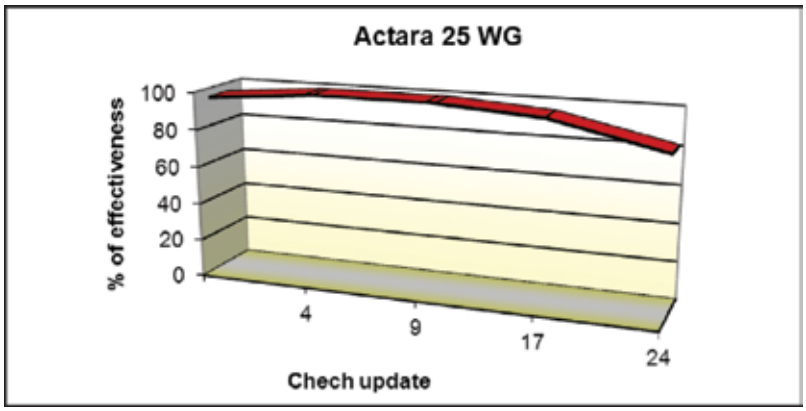
In the second trial (2007-2008), the applied insecticides showed high effectiveness in tobacco beetle control, which was visible from the first check 35 hours after their application up to the 24-st day (Graf 3, 4 and 5).



Graf. 3 Confidor SL 200- effectiveness in tobacco beetle control



Graf. 4 Bubastar 20 SP- effectiveness in tobacco beetle control



Graf. 5 Actara 25 WG- effectiveness in tobacco beetle control

Our investigations on the effectiveness of chemicals in the control of *E. hirtipennis* correspond to those of other authors in the world (from America, Italy, Greece, Bulgaria, Albania).

To avoid the possibility of resistance, a change of chemicals during the same growing period is recommended.

In spring, weeds near tobacco seedbeds and in tobacco farms should be treated with adequate insecticides. Pest treatment with insecticides should be made when first holes appear on leaves in seedbeds or in field and when first imagos are observed.

For treatment of tobacco in seedbeds or during its transplantation in field heavily infested with tobacco beetle in the previous year, it is necessary to apply systemic insecticides (imidacloprid, acetamiprid, or thiamethoxam) in order to provide a long-term protection of young plants in the most critical moment of transplantation.

Similarly, if strong attack of adults is observed in field during the growing period, a treatment with pyrethroid (esfenvalerate, lambda-cyhalothrin), is recommended, which will provide immediate initial control.

In the repeated occurrence of the pest, some of the systemic products (imidacloprid, acetamiprid, or thiamethoxam) can be applied.

CONCLUSION

The high consuming ability and expressed poliphagia of *Epitrix hirtipennis*, the longevity of imagos, the great number of generations and resistance to the atmosphere effects make this insect difficult for control.

Having in mind that imagos are present on tobacco throughout the whole period of growing (April - October), it is necessary to perform a multiannual integral protection of tobacco, making great efforts and applying precise measures to achieve visible results.

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