

INDISPENSABLE HYGIENIC-TECHNICAL MEASURES IN TOBACCO PROTECTION FROM STORAGE PESTS

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Abstract

Tobacco in warehouses can be attacked by tobacco moth *Ephestia elutella* and cigarette beetle, *Lasioderma serricorne*. These pests cause extensive damages and have a significant economic importance on tobacco quality.

Larvae of *E. elutella* feed on dry leaf tissues and only leaf veins remain after stronger attacks. The pest occurs more frequently on the surface of tobacco bale, not penetrating deeper.

L. serricorne attacks tobacco leaves and tobacco products - cigarettes, cigars, pipe tobacco etc. It makes round holes on cigarettes and cigars and feeds on their contents, which makes them unsuitable for use. Its attack is especially strong on finest and most aromatic tobaccos.

The most important preventive measure in the control of storage pests is to keep the warehouse clean. It is recommended to thoroughly clean the warehouse when it is still empty, before tobacco is placed in it.

Disinsection of empty warehouses is carried out by cleaning of floors, ceilings, walls, stairs, doors and windows with lime wash and petroleum ether emulsion. Good results in disinsection of empty warehouses are obtained with Actellic or with Phostoxin fumigation.

After tobacco is stored in warehouses, disinsection of tobacco bales or cigarettes is carried out with Phostoxin. Phostoxin fumigation must be performed by trained and authorized persons, in strictly controlled conditions. Fumigation shall be done in hermetically sealed objects at controlled temperature, with proper application of all hygienic-technical measures.

Key words: Tobacco, storage pests, disinsection.

1. Introduction

Stored-product's pests are responsible for tremendous damage and economic losses to post-harvest and

stored grains and seeds, packaged food products, tobacco, animal and plant derived items and commodities. Besides causing direct damage by their feeding, they also elicit disgust, annoyance, and anger in those who find them infested these products.

In the region of Macedonia tobacco is grown in large quantities and it has socio-economic importance for the entire economy of Macedonia.

Tobacco in warehouses can be attacked by tobacco moth or warehouse moth- *Ephestia elutella* Hbn. and cigarette beetle or tobacco beetle- *Lasioderma serricorne* F.

The control of pests on stored tobacco dates back quite some time. Of all the methods used for control of storage pests (preventive, mechanical, biological and chemical methods) the chemical one is used predominantly.

Disinsection of empty warehouses is carried out by cleaning of floors, ceilings, walls, stairs, doors and windows with lime wash and petroleum ether emulsion. Disinsection of empty warehouses with Actellic 50 EC or with Phostoxin (magnesium phosphide) fumigation. After tobacco is stored in warehouses, disinsection of tobacco bales or cigarettes is carried out with recommended rate of Phostoxin.

2. Tobacco protection from storage pests

Control of the tobacco moth and the cigarette beetle is very serious problem in the modern tobacco industry, especially in the years when in warehouses are kept annual and perennial reserves of stored tobacco. Modern warehouses for stocking of dry tobacco, especially the chambers for maturation with fixed temperature, mean special ecological factors that are significantly favorable condition for development of the kind of insects.

2.1 Tobacco moth- *Ephestia elutella*

Tobacco moth or warehouse moth *E. elutella* is a small moth of the family Pyralidae (Lepidoptera, Pyralidae, and Phycitinae). Quite a common and widespread moth. It is probably native to in Europe, but has been transported widely.

The adult moth has brownish grey forewings crossed with two light bands. The hindwings are paler and plain grey. The wingspan is 14-20 mm. Larva is dark to start with, becoming yellow with a dark line down its back, and a dark brown head. It shelters in loose silk web amongst the food source. The pupae are light brown turning black before the adult emerges.

This moth flies throughout the warmer months, e.g. from the end of April to October, and most often found (June - October) in warehouses and the like, although sometimes are encountered outdoors.

Adult moths do not feed. Caterpillars feed on dry plant produce, such as tobacco and cocoa beans, as well as cereals and dried fruit and nuts. Less usual foods include dried-out meat and animal carcasses, specimens in insect collections, and dry wood (*Ephestia elutella* [7]).

The female lays eggs on or near the products. The eggs hatch into larvae which feed on the product, producing large webs of silk.

In tobacco warehouses, larvae of *E. elutella* feed on the dry leaves tissues and only the leaf veins remain after a stronger attack. They occur more frequently on bale surface, not penetrating deeper. Beside direct damages, *E. elutella* contaminates tobacco with its excrements, remnants of their shedding and metamorphosis, and it has adverse impact on cigarette quality. The larvae move off the food to pupate in the storage packaging or in the storage structure.

2.2 Cigarette beetle - *Lasioderma serricorne*

Cigarette beetle or tobacco beetle, *L. serricorne* (Coleoptera, Polyphaga, Anobiidae) is cosmopolitan; origin probably is Africa. It is a commonly encountered stored-product's pest in the home and has long been associated with humans. The cigarette beetle is pan-tropical but can be found worldwide, especially wherever dried tobacco in the form of leaves, cigars, cigarettes, or chewing tobacco is stored.

Cigarette beetles adults are quite small, measuring about 2 to 3 mm, and are reddish brown. They have a rounded, oval shape and the head is often concealed by the pronotum when the beetle is viewed from above. The elytra (wing covers) are covered with fine hairs. Older larvae are white, scarab-like, and hairy. The head is evenly rounded dorsally and has a dark marking with a convex boundary that extends halfway

up the frons. An arolium is also present and extends beyond the middle of the claw on each tarsus.

Adults do not feed but will drink liquids. Besides the dubious honor of being the most damaging pest of stored tobacco, the cigarette beetle larvae also is a major pest of many stored food products including flours, dry mixes, dried fruits such as dates and raisins, cereals, cocoa, coffee beans, herbs, spices, nuts, rice, dry dog food and other products kept in kitchen cabinets, hurricane food supply storage containers, and other areas in the home. Non-food products that it infested include dried plants and herbarium specimens, dried floral arrangements, potpourri, decorative grapevine wreaths, prescription drugs and pills, medicinal herbs, pinned insects, furniture stuffing, papier-mâché, and bookbinding paste (*Lasioderma serricorne* [6]).

Females lay eggs in the food. The hatching larvae are active and will move around on and bore into the product, feeding as they go.

In tobacco warehouses, *L. serricorne* attacks tobacco leaves and tobacco products - cigarettes, cigars, pipe tobacco etc. It makes round holes on cigarettes and cigars and feeds on their content, after which they become unusable. When feeding on shredded tobacco, they contaminate it with their excrements, dead larvae, remnants of shedding and metamorphosis. Its attack is especially strong on finest and most aromatic tobaccos.

The larvae excavate a protective cell in the feeding substrate or build a protective cocoon from bits of food and debris. Cocoons are often attached to a solid substrate and in severe infestations form large clusters. Larvae will sometimes bore their way through cardboard boxes and other packaging in search of a place to pupate.

It is very difficult to definitely determine the annual quantity of tobacco made unfit for use as a result of the usual storage pests *E. elutella* and *L. serricorne*.

2.3 Pest management

Integrated pest management (IPM) programs are often implemented to control infestations at processing, distribution, and storage facilities.

Locating the source of infestation is the first and most important step. Insect monitoring sticky traps are available for *L. serricorne* and *E. elutella*, which contain specific female sex pheromones to attract male, and help detect and monitor infestations.

Biological control of tobacco stored pests could be very important (use of microorganisms, viruses, entomophagous and parasites as biologic modality in the control of insect pests). Biological control for

stored-product pests, however, has not been widely adopted. Part of the problem is that although it reduces the amount of pesticides used for control, the release of insects to control cigarette beetles and tobacco moth increases contamination of foodstuffs with potentially more insects and insect parts.

Insect growth regulators (IGR) also are used as part of an IPM program. The use of methoprene on stored tobacco was one of the first uses of an IGR on a stored commodity. Larvae that contact or ingest the active ingredient are unable to complete their life cycle.

Preventing and controlling insect infestations in the home is relatively simple; insecticides should be used only as a last resort. Heavily infested items should be wrapped in heavy plastic, taken outside and thrown away. All food containers and items should be checked for infestation. Items can be placed in the refrigerator or freezer to kill all stages. Place items in a plastic bag to reduce condensation problems during thawing. Heating small quantities of infested material in an oven also is effective.

The most important preventive measure in the control of storage pests is to keep the warehouse clean. It is recommended to thoroughly clean the warehouse when it is empty, before tobacco is accepted from tobacco producers.

Disinfection of empty warehouses is carried out by cleaning of floors, ceilings, walls, stairs, doors and windows with lime wash and petroleum ether emulsion. With the very dynamic development of the chemical industry-phytopharmacy, methods for control of tobacco harmful entomofauna in warehouses, change with the time, with many additions and improvements.

Good results in disinfection of empty warehouses are obtained with Actellic 50 EC or with Phostoxin (magnesium phosphide) fumigation. Always be sure to read and follow the label of applied pesticides.

Actellic 50 EC is a conventional pesticide which is used for control of entomofauna in the course of the crop vegetation. It is also very effective against some kind of insects which attack the stored products. But here, appears an especially important problem - in their application. The stored products can not be treated directly because of their eventual harmful residues. It can be applied only in empty warehouses (treat around the storage areas to kill off any remaining insects after removal of stored products).

2.3.1. Fumigation

The significant characteristic of fumigations which are used for warehouses disinsection is their molecular movement that is, as they gaseous bodies, their molecules are free and in their constant movement they aspire to fill the whole free space, penetrating

even in the smallest cracks. In that way, they destroy all of the pests in the objects where disinsection is done.

It is well-known that in earlier time, different fumigants were used as: CH_3Br , HCN, ethylene oxide, ZYKLON, methyl bromide and other. Their application was very complicated and frequently difficult to carry out, mainly because of the necessary sealing of the storage, equipment and others, which really caused a lot of problems (Todorovski [1] and Todorovski and Vasilev [2]).

Phostoxin

Phosphine (PH_3) has been used to fumigate tobacco since 1959. Because of their simplicity in their use and their high efficiency Phostoxin has been used in the control of numerous pest insects in warehouses.

Phosphine gas penetrates a tobacco mass, it is possessing the ability to kill all life-stages of insects, at all depths in packaged tobacco (e.g. hogsheads, cases, bale, etc.), at atmospheric pressure (when applied correctly at adequate dose/ exposure). Furthermore, phosphine has been proven to have no effect on the flavor, color, or taste of tobacco, whether cased or uncased (Coresta [3, 4]).

Magnesium phosphide which generates phosphine gas is the fumigant of choice to fumigate our tobacco. This chemical today has large applications in the control of tobacco warehouse pests as *E. elutella* and *L. serricornis*.

Detia-Degesch (Germany) manufactures two magnesium phosphide formulations called:

Fumi-cell (R) plates

Fumi-strip (R) strips.

These two formulations have a polyethylene matrix which is impregnated with magnesium phosphide along with some inert ingredients. Strips and plates are packed individually in gas-tight aluminum foil pouches. These pouches are not re-sealable. The pouches are in turn packed in tins, and case. Fumi-cel and fumi-strip are supplied in gas-tight containers and their shelf-life is unlimited as long as the packing remains intact. Once pouches are opened for fumigation, the plates and strips must be used following label instructions (Bond [5]).

Phosphine gas is generated when the metal phosphide reacts with atmospheric water. When magnesium phosphide is exposed to air, phosphine gas is produced at a rate proportional to air, existing humidity and temperature.

When to fumigate

-when a significant cigarette beetle and/ or tobacco moth infestation is known to be present.

-when it is desired to free tobacco from suspected infestation prior to storage or manufacture.

-when tobacco must be certified to be free of insect infestation in order to be shipped or received.

Fumigation techniques

Fumigation is carried out in a closed space which is at atmospheric pressure at all times. Such a closed space may be: a warehouse, the volume under a gas-tight polyethylene sheet, tent or tarpaulin, a specially constructed chamber, freight containers, trailer bodies and etc.

In warehouses all windows, vents, doors and ventilators must be sealed. Seals must be made each time the fumigate is building. Heavy masking tape, at least five centimeters wide, or polyethylene tape (102 microns minimum thickness) may be applied over closures. Alternatively, sheets of polyethylene may be placed over the entire opening, and secured around the edges with tape. The building should be inspected for holes in walls and roof. Any openings must be sealed.

If it is necessary to fumigate a building to which sealant application is impractical the whole structure may be wrapped with polyethylene sheeting (at least 102 microns thick). Over lap sheets by at least five centimeters. Secure one edge to the roof with either latex cement or heavy plastic tape; be certain that the tape will adhere to roofing material under all ambient conditions (i. e., heat, rain, wind etc). Push the film against the building, at the ground, and seal by placing canvas or plastic tubes, filled with sand, on top of the film.

Care must be taken during the draping of the film over the tobacco warehouses or containers that it is not torn by any sharp corner or edge.

Gas concentration monitoring tubes can be introduced into the air space under the film or into the tobacco containers by means of a small slit in the tarpaulin, which would then be taped tight and other safety staff.

Safety procedures and precautions to follow in a specially constructed chamber, freight containers, trailer bodies, tent or tarpaulin are similar to those practiced in warehouses fumigation. The procedure to be followed is identical for fumigating stored tobacco or fumigating cigarette stocks.

Fumigation safety and security procedures

Several rules must be followed when used the fumigant:

- At least three gas masks and self-contained breathing apparatus (SCBA) must be on hand and maintained in good repair. At least two

appropriate canisters must be kept on hand at all times for each mask.

- Equipment for measuring fumigant concentration must be kept at the work site from the beginning of fumigation until the end of aeration.
- No fumigation may be performed unless the supervisor is trained in the use of the specific fumigant, including procedures for first aid treatment of poisoning.
- Trained persons must wear special gas masks, protective clothing, etc.
- Never fumigate alone.
- At least one guard must be posted for the duration of fumigation and aeration of warehouse, and periodically check of fumigation areas.
- All fumigation areas must be thoroughly posted with warning signs.
- No person is to be allowed in the structure during fumigation, except personnel making the application.
- Containers of fumigant should be opened in the open air.
- Local police, fire and health authorities must be notified of all fumigations.
- First aid equipment and procedures must be on site.
- Bath and change clothing as soon as possible after having been exposed to a fumigant. All clothing worn should be laundered and other safety data.

Fumigation with Magnesium fosfid Degesch plate

Magnesium phosphid plate - active ingredient magnesium phosphide. It is very toxic, dangerous for environment, highly flammable. Three parameters influence fumigation effectiveness: Tobacco temperature, Exposure-time, Phosphine concentration (DEGESCH America [8], Fumigation [9], and Fumigation Alternatives [10]).

Phostoxin is used on T above 16 °C in the stack. Due to the fact that stores have been humidity for air conditioning of tobacco 1-2 days previous to tobacco treatment with Phostoxin, humidification has been stopped. Place where that Magnesium phosphid plates are to be located must be completely dry.

Dosage: calculate the volume of the structure. Do not subtract the volume of the tobacco which is to be fumigated.

Applicate all safety procedures and precautions practiced in warehouses fumigation. Ensure that all personnel are clear of the warehouse, trailers etc

before placing fumigant. Turn off electricity within warehouse. Sealed and locked the exit door.

Exposure-time of Magnesium phosphide in warehouses last 6 days (144 hours), minimum 96 hours after applications. Four hours after application measure the concentration of phosphine in the structure, to be sure that there are not leaks in the structures, and the plates are not faulty.

Ventilation-time last 2 days (48 hours). To aerate warehouses and atmospheric chambers, remove any wrapping and open vents, windows and doors. If exhaust fans are available, they should be turned on. Post guards to prevent accidentally entry prior to full aeration.

The concentration of phosphine within the warehouses airspace and within the tobacco containers should be determined during the course of fumigation and aeration, measured by gas Auer taster with indicator tubes. Readings should be made at 4, 6, 12, 24, 36, 48, 60, 72, 96 and 144 hours.

The residue formed during phosphine evolution is magnesium hydroxide, a non-poisonous substance. However, trace may still be contained in the original starting material, and it is for this reason that great care must be taken in disposing of the collected waste. Residue disposed- wet deactivation.

Placement and removal of fumigant will not be done in inclement weather (wind, rain, hail, atmospheric inversion).

3. Conclusions

- The major insect pests of tobacco in warehouses are the cigarette beetle or tobacco beetle - *Lasioderma serricorne* and the tobacco or warehouse moth - *Ephestia elutella*.
- These pests cause extensive damages and have a significant economic importance on tobacco quality.
- Larval feeding causes direct damage to foodstuffs and non-food items. These products are contaminated by the presence of adult- insects, larvae, pupae, cocoons, excrements, and insect parts. Larvae chewing through cardboard boxes and containers, and packaging cause indirect damage.
- Integrated pest management (IPM) programs are often implemented to control infestations at processing, distribution, and storage facilities.
- Microorganisms, viruses, predators and parasites as biologic modality in the control of insects' pests, insect growth regulators (IGR), pheromone traps also are used as part of an IPM program.

- Disinfection of empty warehouses is carried out by cleaning of floors, ceilings, walls, stairs, doors and windows with lime wash and petroleum ether emulsion.
- Good results in disinfection of empty warehouses are obtained with Actellic 50 EC or with Phostoxin (magnesium phosphide) fumigation.
- Fumigating the stored tobacco with phosphine gas gives effective control. Phostoxin completely destroys all pest insects in all their developmental stages, and it has no chemical contact with the treated foods.
- Phostoxin fumigation is carried by trained and authorized persons, in strictly controlled conditions. Objects to be fumigated have to be hermetically sealed, temperature conditions controlled and all hygienic-technical measures properly applied. Trained persons must wear special gas masks, protective clothing, etc. Must notify the fire service, police, and ambulance.

4. References

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