УДК 632.7:632.937:634.1/.2

BIOLOGICAL PROTECTION OF APPLE ORCHARD FROM *CARPOCAPSA POMONELLA*

K. A. Yahodina, student
L. P. Yushchenko, Candidate of Agricultural Sciences

Examples of major groups of pome garden pests are given. Morphological and biological characteristics of the main pest of apple plantations - the codling moth are presented. The role of Trichogramma in the garden protection and the effectiveness of its action.

Horticulture, biological protection, codling moth, Idared, feromonitoring, trichogramma, efficiency.

Ukraine is a powerful agrarian state with ancient farming traditions. Getting the third of world's black soil, it has high potential for agricultural development and certain implements it. For this purpose Ukraine has all prerequisites: fertile soils, favourable geographical position and climate, human resources and the proximity of the key markets of East, North Africa, and the former Soviet Union countries. Ukraine is extremely attractive for investment in an agricultural sector.

Crop production is the main strategic sectors of agriculture in Ukraine. Standard of living and prosperity of the state depends on crop production condition.

Horticulture is an important sector of plant growing. This branch includes a group of mostly woody and shrubby cultivated plants grown for fruit, berries and nuts [1].

Due to the mild climate and availability of fertile soil Ukraine has large areas for gardens. Apple tree is a major fruit crop in Ukraine. It is rather undemanding crop, which can be grown almost all over Ukraine [3].

The wide distribution of apple tree is explained by valuable economic and biological properties as well as health properties of its fruits due to the presence of bioactive substances in it. The special value of apples will freshness the whole year if grows late ripening varieties.

Ukraine has all the conditions for increasing the production of quality horticultural products, but annually pests cause the considerable gardening damage.

The use of pesticides can significantly reduce yield losses from pests, but it provides short-term effect and leads to environmental pollution and many adverse changes in agricultural ecosystems and surrounding natural biocenoses. In addition, continuous chemical processing causes the emergence of resistant forms of pests [4]. According to the scientists, 500 species of insects have already become resistant to pesticides, and their

adaptability to pesticides occurs in 10-30 generations. Therefore there is a need for an alternative plant protection will be effective, environmentally friendly and safe.

The strategy for plant protection in the third millennium is characterized by its ecologization that the following methods of plant protection will at the first positions: physic-mechanical method – the use of physical and mechanical pest control methods (collecting of insects, the use of sticky trapping bands, solar disinfection), agrotechnical – the use of agro activities aimed at improving of plant productivity (all types of tillage, fertilization, irrigation). It should pay special attention to biological methods of plant protection [2].

Biological method of plant protection is a modern fundamental applied discipline whiche objective is to obtain a high quality ecological production and the protection of natural diversity of crops [5].

Several groups of pests are distinguished among the pests of pomegarden:

1) pests that damage the buds and flower buds. These are species, in which spring development and maximum harmfulness coincides with the beginning of apple tree active vegetation. They destroy buds, leaves and ovary of fruit trees, which significantly reduces fruiting. They include: weevils (nephritic gray, apple blossom weevil); attelabus (leaf-roller beetle, rhynchites).

2) Leaf-eating species feed on leaves and shoots of plants, which reduces leaf surface and weakening of nutrients supply to different organs of trees. This group mainly includes caterpillars of lepidopterans pests: gypsy moth, common lackey, leaf rollers, ermine moth, gold-brindled purples, and cutworms.

3) Sucking species weaken growth processes; reduce the supply of nutrients in different organs of trees, cause leaves and fruit falling. This group includes aphids, psyllas, scale coccines, leafhoppers, bugs and mites.

4) Pests damage the skeletal branches and trunks of trees. They cause the extinction of some branches, flat-headed growth, that reduce yield and leading to tree death. They are wood-fretter, common goat moth, apple clearwing, cherry bark tortrix, bark beetles and buprestid beetles.

5) Pests damage tree roots cause significant damage to gardening. Beetle larvae (worms) seriously damage the roots of apple tree in young orchards, especially on sandy soils. The cycle of the larvae in the soil is three years. Biennial worms bring the greates tharm eating up young plant roots. Damaged trees stop growing and die. Tree roots are also damaged by wireworms, larvae of weevils, cutworm caterpillars, and mole cricket.

5) Pests that damage the fruits: moth – codling moth, oriental fruit moth, some types of leaf rollers, fruit sawflies. They cause direct yield losses – break the flow of nutrients to the seeds, damaged fruits fall off, and the remain derby commercial qualityis considered defective.

The dominant pest is the codling moth (*Carpocapsa pomonella*). Codling moth belongs to a number of butterflies (*Lepidoptera*), leafroller family (*Tortricidae*) (Fig.1).

It is common in all regions of apple cultivation. Besides apple trees, it damages fruits of pear, plum, apricot, quince, peach, walnut.

A butterfly with a wingspan of 18-22 mm, front wings are brownish-gray, with numerous cross wavy lines; at the ends of the wingsthere are dark brown oval spots; back wings are brownish-gray; in a quiet condition wings are folded roof-like. Caterpillar length is 17-20 mm, from above it is pink, on each side and below it is light yellow.

Caterpillars overwinter in cocoons under the bark, in cracks, fruit storages, crop residues and other places. A significant number of caterpillars overwinter in the top (3 cm) soil layer. Pupation begins at temperatures above 10° C (developmental threshold). Caterpillars pupate of a population takes 5-40 days. This lengthiness is typical for the following stages of the development. Beginning of flying often coincides with the end of apple blossom. Intensive flying of butterflies occurs in quiet dry weather from 19 to 24 hours at a temperature of 15° C. Butterflies feed on drop moisture. Puberty of females takes 2-3 days, and then they begin to secrete pheromones that attract males. Egg laying begins in 2 - 3 days after mating. Females lay eggs on the leaves and fruits. Codling moth lays up to 62-68% of the eggs on the peripheral part of the crown.

Figure 1. Codling moth (Carpocapsa pomonella)

Figure 2. Apple damaged codling moth

The fecundity is 60-120 eggs. For some time regenerated caterpillars stay on the surface of the fruit, then penetrate into the flesh, reach the cutting and gnaw fibro vascular bundle, so the flow of nutrients is disrupted and fetal growth ceases (Fig. 2).Feeding under the skin of the fetus 2-3 days, a caterpillar gnaws a small camera, where it sheds first, then gnaws a rivulose canal, where it sheds for the second time. The third molting occurs in an ovary cell, where a caterpillar eats seeds. One caterpillar can damage 3, sometimes 4 fruits. Fetus loss may reach 80%.

Insect parasites play an important role in limiting the number of moth. One of these parasites is trichogramma (Fig. 3).

Systematic position of a trichogramma: series – Hymenopterous (*Hymenoptera*), superfamily – Chalcids (*Chalcidae*), family – Trihogramatids (*Trichogrammatidae*), genus – Trichogramma (*Trichogramma*).

Trichogramma is an insect-parasite of microscopic size (from 0,25 to 0,9 mm), which eliminates about 80 species of insects harmful for plants. Trichogramma's feature kill pests on the egg stage. Trichogramma female lays its eggs in the eggs of the pest, where the development of the parasite takes place. As a rule, trichogramma lays usually 2-4 eggs in the eggs of cutworms, codling moth. Born adult individuals gnaw a hole in the shell and come to the surface. Females are revived as mature individuals ready for immediate parasitism of host eggs. During vegetation period in the north-western zone of the country trichogramma develops in 3-4 generations, in the south – in 9 generations. The life span of adults' trichogramma, which are bred under laboratory conditions, without replenishment is limited to 3-4 days, with replenishment (sugar syrup, honey) –to 8-8 and more days.

Figure 3. Trichogramma pintoi

Representatives of 25 series families of lepidopteran insects are hosts of trichogramma in natural conditions. Hosts of trichogramma are cutworms (winter moth, exclamator moth, black cutworm); leaf-eatingcutworms (cabbage moth, silver moth, cotton budworm); pyralidmoths (beet moth, corn worm); shieldmoths (cabbagewhitebutterfly, rapeblossombeetle); budworms and pea moths.

In fruit orchards of Ukraine there are such species of the Trichogramma genus as *T. dendrolimi, T. pintoi, T. evanescens.* These species are environmentally plastic and are reproduced in a wide range of temperatures and humidity.

Trichogramma in Ukraine is able to reproduce for 5-6 months, whereas egg lying of the main hosts lasts 2-2.5 months. Therefore, continuous reproduction of the parasite depends on additional hosts during the periods of absence or low number of major hosts [6].

Figure 4. Feromonitoring in apple orchards

Location. Laboratory researches were conducted on the basis of educational, scientific and industrial laboratory of Biological Plant Protectionof National University of Life and Environmental Sciences of Ukraine and Limited Liability Company of Research and Production Center «Agrobiotechnology», Kamyanka, Cherkasy region. Observation, field research and commercial application of trichogramma were conducted at apples tands against codling moth on the base of LLC RPC «Agrobiotechnology», village Plyakivka, Cherkasy region.

Procedure. The objects of research are apple pests, in particular codling moth, and various types of *Trichogramma.*

The research and appraisal of results of traditional techniques for bioecological experiments were used. Experimental plots of 0,1 ha have been taken.

Researches were conducted on winter apple tree Idared. Idared is a sort of American selection. In 1986 it was regionalized in in the steppe and forest steppe. The tree is medium-grown with a rounded crown. Crop yield comes quickly; 6-7-year-old trees provide 25-30 kg, 10-13-year-old trees – 50-90 kg of fruit. The fruits are usually larger than the average size (145-190 g); flat-rounded with smoothed edges, greenish-yellow, with bright blurry erubescent. The flesh is light cream, thick, juicy; sweet-sour taste. Harvest maturity comes at the beginning of October, consumer maturity – in February. The fruits are kept in the store until March, in the fridge – until June. Transportability is high. They are used fresh fruits and for the manufacture of juices.

To account the number of codling moth butterflies feromonitoring is conducted using traps Atrakon-A, where one side was covered with glue «Pestyfiks».Pheromone capsules were placed in the trap with tweezers and hung on a tree at a height of 1.5 m. Accounting on butterflies is held once a week.

Efficiency of egg parasitoid was studied at background cards. Trichogramma was released in plantations for 12-24 hours before the adults' flight. Background cards were made of heavy paper (5x7 cm), on - 20% sugar solution grain moth eggs glued, in an amount of 100 pieces on each. The cards were placed in the middle stand around the perimeter of a tree crown. Three cards were in accounting trees and two – in the neighboring trees.

Indicators of trichogramma effectiveness was revitalization of Trichogramma from host eggs on the background cards in model trees,%.

Effectiveness of trichogramma according to the decline in number of pests compared with their amount before treatment was calculated using the formula:

$$E_д = \frac{100 \times (A - B)}{A},$$

Where $E_д$– pest reduction after treatment,%

A –pest density before using of trichogramma, parts / plant;

B – pest density after using of trichogramma, parts / plant;

Results. To determine the pest flight pheromone traps were used, that have been hung in April 30, 2014at the ends of branches on the north side of the crown at the rate 1 trap on 1.5 hectares of a garden (Fig. 4).

Accounting of butterflies was held every 7 days.

During the first 7 days the number of caught moths was 5 individuals. A week later the number had increased up to 12, thus on May 17 release of trichogramma was conducted. After another 7 days the number of codling moth individual sreached a peak and was equal to 21 individuals per trap for a week.

For May 28amount of butterflies reached 15 individuals. From June codling moth population began to decline. So on June 4 was 7 moths, 7 moths were trapped, and on June 10 – only 2.

During the mass flight 05.14.14 first release of trichogramma was held, and a week later – 21.05.14 – the second release was held.

Approximately a day before the revival of trichogramma(at the first single insects in the package) we put cotton balls into 3-liter jars.

Having expanded a package, we swept trichogramma into the jar and tied its neck with a thick cloth to avoid dispersion of trichogramma. It needs 3-4 hours to spread on paper in a jar. After this period it could be spread. In the garden we carefully removed paper balls of egg parasitoids from the jar and put them in the branch forks. Trichogramma against moth should be leased to each tree into the lower part of the crown on the shady side.

Within 7 days after the first release of trichogramma background cards with grain moth eggs were placed in the model trees to determine the effectiveness of trichogramma.

After analyzing the background cards it was determined that their trichogramma infection was 61%.

As a result of this study the analysis of damaged apples by codling moth was carried out (11.06.14) using 10 harvested fruits from each 4 sides of model trees. Apples damage was 18,1%, at the same in the control plot it was 35,5%. Effectiveness of trichogramma was 48.6%.

The efficiency of trichogramma using (*Trichogramma dendrolimi*) against codling moth (*Carpocapsa pomonella*), 2014.

Indicators	Investigated site	Control site
Infection of grain moth eggs by trichogramma in the released consignment	86	–
Released date of trichogramma	17.05.2014	–
The rate of trichogramma release	1,25	–
Infestation of grain moth eggs by trichogramma in background cards on the 7th day after the release,%	61	–
Apple damage by codling moth,%	18,1	35,3
Effectiveness of the action,%	48,6	–

Conclusions. Thus, the use of trichogramma is an efficient measure in the apple orchards against codling moth and its using makes it possible to significant save the harvest of apples and get environment safe horticulture production.

List of literature

1. Биологическая защита растений. Под ред. М. В. Штернис. – М: Колос, 2004 – С 250-255.

2. Застосування біологічних засобів захисту рослин на овочевих та плодово-ягідних культурах // Агрооглядник. – 2004. – № 4. – С. 62-65.

3. Державна служба з карантину рослин України // Карантин і захист рослин. – 2009. – № 6. – С. 26-28.

4. Дрозда В. Ф. Трихограма над полями: проблеми та перспективи використання / В. Ф. Дрозда // Захист рослин. – 1997. – №3. – С. 8-10.

5. Ющенко Л. П. Пропозиція: Інформаційний щомісячник. Український журнал з питань агро бізнесу / Л. П. Ющенко// Біологічні засоби в захисті рослин – 2013. – № 1. – С. 72-74

6. Довідник із захисту рослин / Л. І. Бублик, Г. І. Васечко, В. П. Васильєв [та ін.]; за ред. М.П.Лісового; Ін-т захисту УААН. – К.: Урожай, 1999. – С. 743.

Наведені приклади основних груп шкідників зерняткового саду. Представлена морфологічна та біологічна характеристика основного шкідника яблуневих насаджень – яблуневої плодожерки. Показана роль трихограми в захисті саду та визначено ефективність її дії.

Садівництво, біологічний захист, яблунева плодожерка, Айдаред, феромоніторинг, трихограма, ефективність.

Приведены примеры основных групп вредителей семечкового сада. Представленная морфологическая и биологическая характеристика основного вредителя яблонневых насаждений - яблонной плодожорки. Показана роль трихограммы в защите сада и определена эффективность ее действия.

Садоводство, биологическая защита, яблонная плодожорка, Айдаред, феромониторинг, трихограмма, эффективность.