POTENTIAL OF MICROBIOLOGICAL PREPARATIONS IN THE REDUCTION OF PEST POPULATIONS IN WALNUT CROP IN THE REPUBLIC OF MOLDOVA

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Abstract. Potential of microbiological preparations in reducing pest populations in walnut crop. The article presents the results of research on the action of organic processes on the growth and productivity of Chandler walnut. Walnut has only a few insects that could be considered important pests. Of the leaf-feeding insects, the apple apple maggot, *Cydia pomonella* L. (Lepidoptera: Tortricidae) and the mulberry hairy caterpillar *Hyphantria cunea* Dr. (Lepidoptera: Erebidae), are the most likely to cause significant defoliation and damage to trees. Scientific data on the biological effectiveness of the system of measures for the use of bioinsecticides are presented. The data demonstrate that the biological preparation Virin ABB-3 used in the control of *H. cunea*, which has a high effect of 89.23%, stops the increase in the number of nests on a tree and provides a high degree of protection of walnut trees. From the analysis of the results obtained from microbiological control of the apple maggot, *Cydia pomonella* L. with suspensions of different concentrations, the following observations can be made. The codling moth mortality, shows different values depending on the dose of the preparation. Thus, at the dose of *Bacillus thuringiensis* var. *kurstaki* 5,0 l the efficacy is 77,1%; at the dose of *Bacillus thuringiensis* var. *kurstaki* 10,0 l/ha - 82,8%. The obtained results confirm the possibility of using entomopathogenic bacteria and baculoviruses to create biological preparations that can replace pesticides and to develop biological methods of walnut crop protection.

Keywords: *Hyphantria cunea* Dr., *Cydia pomonella* L., entomopathogenic bacteria, bioinsecticides, walnut crop.

Rezumat. Potențialul preparatelor microbiologice în reducerea populațiilor de dăunători în cultura nucului în Republica Moldova. Articolul prezintă rezultatele cercetărilor privind acțiunea procedeelor ecologice asupra creșterii și productivității nucului din soiul Chandler. Nucul are doar câteva insecte care ar putea fi considerate dăunători importanți. Dintre insectele care se hrănesc cu frunze, viermele mărului, *Cydia pomonella* L. (Lepidoptera: Tortricidae) și omida păroasă a dudului *Hyphantria cunea* Dr. (Lepidoptera: Erebidae), sunt cele mai susceptibile de a provoca defolieri și daune semnificative arborilor. Sunt prezentate date științifice privind eficiența biologică a sistemului de măsuri pentru utilizarea bioinsecticidelor. Datele demonstrează că preparatul biologic Virin ABB-3 utilizat în controlul *H. cunea*, asigură un efect ridicat de 89,23%, oprește creșterea numărului de cuiburi pe un pom și asigură un grad ridicat de protecție a nucului. Din analiza rezultatelor obținute în urma controlului microbiologic asupra viermelui mărului (*Cydia pomonella* L.) cu suspensii de diferite concentrații, se pot face următoarele observații. Mortalitatea viermele mărului prezintă valori diferite în funcție de doza de preparat. Astfel, la doza de *Bacillus thuringiensis* var. *kurstaki* 5,0 l eficacitatea este de 77,1%; la doza de *Bacillus thuringiensis* var. *kurstaki* 10,0 l/ha - 82,8%. Rezultatele obținute confirmă posibilitatea utilizării bacteriilor entomopatogene și baculovirusurilor pentru a crea preparate biologice care pot înlocui pesticidele și să dezvolte metode biologice de protecție a culturii nucului.

Cuvinte cheie: *Hyphantria cunea* Dr., *Cydia pomonella* L, bacteria entomopatogenă, bioinsecticide, cultura nucului.

INTRODUCTION

Persian walnut cultivation has a long tradition in the Republic of Moldova. Nut-growing began with the domestication of seed-propagated French varieties in the years, which was unsuccessful. Walnut plantations were established in Moldova in the 1990s, until then walnut growing was practiced only in peasant households and along buffer strips. The Greek walnut got its name because in ancient times it was brought to Russia from Greece. The name Walnut derives from the old Welsch name Welsh, because it comes from the present-day territory of France and Italy.

The Persian walnut (*Juglans regia* L.) is Central Europe's most grown nut tree crop; its planting area and harvested yield are increasing annually in this region. The worldwide production of walnuts in between the years of 2022-2023 is estimated at 2 million tons, this demonstrating the importance of the crop (***. The Foreign Agricultural Service. 2023).

According to the National Program for the Development of Walnut Crops, by 2025 the area of walnut plantations will reach at least 14 thousand ha, and the harvest of unpicked walnuts will amount to 60 thousand tons, at present it is 25-35 thousand tons. In 2023, the state has invested 26 million lei in expanding and modernizing orchards, and by 2030 it plans to replant 3,900 hectares of orchards with more productive varieties, modernize processing and expanding access to foreign markets.

The worldwide production in 2024, the main walnut producer leaders were: People's Republic of China (1,780,000 tonnes), United States of America (707,000 tonnes.), together they produce more than 60% of the world's nuts. They are followed by Iran (565,962 tonnes), Turkey (295,234 tonnes), Mexico (141,590 tonnes) Ukraine (111,000 t.) Romania (100,834) (***. Atlas Big World Walnut. 2022).

In the Republic of Moldova, walnut culture is given more special attention. Enumerating the benefits that the walnut has for humanity, they are: medicinal, food, industrial and last but not least, cultural. More than that, walnut has a personalized Law No. 658-XIV of 29.10.1999, which regulates the activities 129 related to the cultivation of walnuts, the production, collection, processing and marketing of its fruits and derived products, regardless of the type of ownership, the legal form of the economic entity and the location of the plantations (***. LAW No. 658 of 29-10-1999 on nut crops). Here is the list of top-10 walnut producing countries in the world in 2024 (Table 1).

Table 1. Top-10 Walnut Producing Countries in the World, 2025.

Rank	Countries	Walnut Production (in metric tonnes)
1.	China	1,780,000
2.	United States of America	707,000
3.	Iran	565,962
4.	Turkey	295,234
5.	Mexico	141,590
6.	Ukraine	111,000
7.	Romania	100,834
8.	Chile	98,800
9.	India	85,500

In 2022, Moldova exported 8,167 tons of walnut kernels, generating revenue of 896 million lei. In 2023, exports fell to 7,492 tonns, and their value dropped significantly to 649 million lei as a result of lower prices on the international market.

In 2025, the decline in volume continued, reaching 18,800 tonns, but the value of exports increased slightly, reaching 693 million lei.

In 2023, Turkey is the biggest buyer of walnut in shell exports, according to information from BNS. Turkey is a very big buyer that is interested in those varieties that would be more difficult to commercialise on the European market, especially our older varieties, the French varieties (Franquette, Fernor). One kilogram of walnut, the Chandler variety, from the USA was selling for $2.1 (according to information dated 7 December 2023), while the Chilean walnut was selling for $2.42 per kilogram and the Chinese walnut - $2.27. Global walnut production is anticipated to decline by 2%, totalling 2.59 million metric tons for the 2022/2023 season compared to the previous year. Additionally, total supply is expected to decrease by 0.9%, amounting to 2.81 million metric tons. Despite this, end-of-season stocks are forecasted to increase substantially by 16%, reaching 216,900 metric tonnes (***. The Foreign Agricultural Service. 2023).

The Persian walnut (*Juglans regia* L.) in Republic of Moldova has an array of insects that feed on its leaves and developing nuts, and tunnel into buds, shoots, twigs, and through bark into the wood. However, only a few insects would be considered significant pests. Loss of leaf tissue is referred to as defoliation. The impact that insect caused defoliation has on a tree can include growth loss, mortality, and increased susceptibility to other insects and pathogens. In addition, there are several very large caterpillars that feed on walnut, the adult moths are some of our largest native insects. They include the fall webworm, *Hyphantria cunea* (Drury), the codling moth (*Cydia pomonella* L.) (SURMELI, 2020; SURMELI & DEMIR, 2022).

The fall webworm, *Hyphantria cunea* (Drury), (Lepidoptera: Erebidae), is a the most serious pest of walnut. Larvae have been recorded from >400 species of forest and shade trees. It is a polyphagous species that attacks trees (mulberry, plane, walnut etc.) as well as fruit trees. When alarmed, all larvae within the web jerk in rhythm, apparently as a defence mechanism. At high densities, multiple branches may be enclosed and defoliation may reach 100% over areas up to several square kilometres. Pupation occurs in thin cocoons in bark crevices, under stones, in the duff or just beneath the soil surface. This pest causes defoliation of the trees and a decrease in fruit production. They also build a kind of nest in which they feed. This species is not considered a problem in forests, because it primarily attacks tree species with little economic value, but damage to orchards and urban shade and ornamental trees may warrant control measures (SCHOWALTER & RING, 2017; EDOSA & JO, 2019; KAÇAR & KOCA, 2022; ZHAO & GENG, 2023; ***. FAOSTAT. 2024).

The codling moth, *Cydia pomonella* L. (Lepidoptera: Tortricidae) is the most serious pest of apple, pear, peach, plum, quince and walnut Codling moth larvae directly feed on walnut fruit. The first instar larvae feed inside of the fruit. The second and third instar larvae generally feed on the green peel of the fruit. Therefore, crop loss of up to 20-50% may occur if no management strategy is applied (SCHOWALTER & RING, 2017; ***. ANONYMOUS, UC IPM Pest Management Guidelines: Walnut. 2022). It is a polyphagous pest that attacks several species of fruit trees, including walnut. It overwinters as a larva in sheltered spaces (bark cracks, soil, leaves, etc.). Females lay eggs on or near the fruit, and the larvae enter the fruit.

The damage caused by *Cydia pomonella* varies from generation to the next. First generation larvae directly reduce production by causing small nuts to fall from the tree.

There are two types of attack: primary attack, where the fruit is gnawed shallowly and the wounds suberialise; and secondary attack, where the fruit has large galleries up to the seed chambers. The galleries are full of excrement and feeding debris and are considered the most damaging (SURMELI, 2020).

According to APO Research the global *Bacillus thuringiensis* market is anticipated to witness consistent growth, starting at USD 0,29 billion in 2024, reaching USD 0,309 billion in 2025, and climbing to USD 0,329 billion by 2033, with steady CAGR of 7.8% during 2025 to 2033.

Therefore, leaf feeders do not always need to be controlled. Control activities should be limited to protecting young trees and trees weakened by previous defoliation or drought stress. Though not well documented in walnut, reduced treevigour can make trees more susceptible to wood boring insects and some pathogens. A number of problems in the field of plant protection and the growth of organic products can be solved with the help of three major groups of biological agents: insects, microorganisms (viruses) and bacteria (*B. thuringiensis*, etc.), bioactive substances (ANONYMOUS. 2020).

As regards the development of biological products as an alternative to chemical ones in the Republic of Moldova, these are still at the stage of research into natural microbiological agents for regulating pest populations, concentrated in the Institute of Genetics, Physiology, and Plant Protection of the USM. The key aspects of biotechnology for microbial agents for plant protection against pests and diseases are: the selection of the most suitable biological control agents, the mechanism of their interaction with pest species and the environment, production methods and the form of preparations, increasing the efficiency of use in agriculture and forestry. It should also be noted that these preparations are based on both live cultures of microorganisms and their metabolic products (toxins, enzymes, etc.).

In order to develop biological products that meet all the basic criteria for efficacy and safety, it is necessary to select active, competitive, and technologically advantageous strains of microorganisms. The creation of broad-spectrum biological products based on the obtained agents is very relevant (SOKOLOV, 1990; VORONIN, 1998; ROMANOVSKAYA et al., 2002).

Currently, promising preparations for biological pest control based on various subspecies of the sporogenic bacterium Bacillus thuringiensis are widely used. The advantages of biological bacterial preparations over chemical ones are: the absence of polluting residues, high specificity of action, which makes them safe for non-target organisms, and the relatively low cost of the procedures required for their registration as plant protection products (DOBRICA et al., 2001). In addition, B. thuringiensis is a natural component of soil microflora and, therefore, the use of the bacterium in protective measures does not significantly disrupt the structure of species in biocenoses.

The action of BT on pests is determined by its entomotoxic, entomopathogenic, and metathoxic effects due to the presence of endotoxin, exotoxin, phospholipase C, and spores. Such a set of virulence factors acts to varying degrees and in different combinations on insects of different species. The bacteria cause diseases that are accompanied by septicemia, in which the hemolymph and its phagocytic and nonspecific immune mechanisms are no longer able to suppress the reproduction of microorganisms that continuously penetrate it. The cells of the affected tissues break down, and bacteria pass into the hemolymph in large quantities, causing septicemia.

The *Cydia pomonella* and *Hyphantria cunea* control in nut orchards involves the use of pheromone traps and bioinsecticides. The choice of the appropriate option for a particular orchard will depend on the size of the trees and the infestation level of *Cydia pomonella* and *Hyphantria cunea*. In all cases, a monitoring and control programme using pheromones is necessary to track codling moth generations and determine the extent of infestation and the effectiveness of control measures. Programmes that use disruption of the mating cycle alone or in combination with the use of bioinsecticides and other pesticides have lower rates of damage to water quality and the environment. Interesting results have been obtained with the use of biopreparations based on baculoviruses and entomopathogenic bacteria of insect pests that cause epizootics over large areas, with some evidence of a residual effect (***. ANONYMOUS, UC IPM Pest Management Guidelines: Walnut. 2022).

For these reasons, the importance of combating harmful organisms is imposed as a necessity. The importance of the control is accentuated by the use of microbiological and harmless methods to the entire biodiversity.

MATERIALS AND METHODS

The studies were carried out on the basis of the Institute of Genetics, Physiology and Plant Protection of the State University of the Republic of Moldova and the company SRL ”Monicol”. The objects of research were the pests *Cydia pomonella* L and *Hyphantria cunea* Dr. under laboratory and field conditions.

The codling moth (CM) (*Cydia pomonella L.*) is the major pest infecting the apple, both in Republic Moldova and abroad. Besides apple this pest attacks pear, walnut, quince and some stone fruits causing economic losses in fruit production.CM adults are ashy gray, with a wingspan of 15-22 mm. They can be distinguished from other moths associated with fruit trees by their dark brown wing tips with shiny, coppery markings. The eggs are about 1 mm in size, disc-shaped and transparent white when first laid. As they mature, eggs become opaque white and develop a red ring. Caterpillars are white to pink with a mottled brown head and shield at the top of the first segment behind the head. Anal shield is pale and without anal comb. They have small dark warts with light brown hairs on their sides. Adult caterpillars can grow up to 18-20 mm (JU et al., 2021)

The fall webworm, *Hyphantria cunea* (Drury) (Lepidoptera: Erebidae: Arctiidae), is globally recognized as a notorious invasive quarantine pest originating from North America, now extensively invading regions such as Europe and East Asia. The adult fall webworm moth is bright white, with a hairy body. In the southern part of its range, the moth is white with dark wing spots while in the northern part of its range it is nearly always pure white and was once thought to be a separate species from the southern populations.

The caterpillars larva is light yellow in color, with a black head and a body covered with fine hairs. Older larvae are pale yellow or light green with a dark longitudinal dorsal stripe and a pale yellow longitudinal lateral stripe, the latter being covered with whitish hairs aligned along rows of 12 yellow-orange tubercles on each side. The color of the larvae varies in terms of tones and shades.

Laboratory experiments were conducted on *H. cunea* caterpillars (Lepidoptera: Arctiidae). Adult specimens were obtained from larvae collected in the wild from various locations in the Republic of Moldova. The collected larvae were raised in laboratory conditions on natural food (walnut leaves). For larval rearing, the insects were placed in glass

containers (crystallizers, jars). These were placed in aviaries on fragments of mulberry, maple, walnut, cherry, and rowan branches, etc.

Field experiments were conducted on Lepidoptera larvae using the *Bacillus thuringiensis* var. kurstaki CNMN-BB-11 bacterial strain isolated from natural conditions. The efficacy of the tested products based on the indicators of frequency and intensity of pest attack, expressed as a percentage (Methodological guidelines for testing chemical and biological plant protection products against pests, diseases, and weeds in the Republic of Moldova.

For the selection of strains with insecticidal action, cultures of *Bacillus thuringiensis* var. kurstaki isolated from larvae collected from natural conditions of the order Lepidoptera were used. The microorganisms were cultivated according to (SYLVESTRE, 2002). Sampling of larvae and their preparation for sowing was carried out according to the literature and classical methods. (HUMASON et al., 2006).

The titter is determined using the Goreaev chamber by washing the bacteria in 1 litter of water from the nutrient medium or diluting the liquid medium to 1 litter.

The titter was calculated using the formula

T= 25.104 x A x D,

A-average number of bacteria in a large square

D-dilutions

T-titter of the bacterial suspension at 1 ml

The isolation was performed (Patel KD, Bhanshali F, Ingle SS 2011; Ketan D. Patel; Sanjay S, 2012). Females killed by *Bacillus thuringiensis*, suspected of dying from a pathological process, were treated on the body surface with ethyl alcohol (70%) and then cut in half. One part was placed in 1 ml of saline solution and the other in a test tube at a temperature of 4°C for further examination. The part of the larva kept in saline solution was incubated for 2 hours at a temperature of 36°C, after which the fluid was inoculated on a Petri dish and incubated at a temperature of 36°C. For the bacterial culture, Columbia agar with 5% SB will be used.

The identification of the bacterium *Bacillus thuringiensis* var. kurstaki was performed using the D. H. Bergey method (Бурцева Л. И. 2001; Bergez Manual of Systematic Bacteriology, 2002). Identification and sowing of microorganisms according to the working techniques recommended in the literature, in strict compliance with safety rules. The metabolites of the antagonistic bacteria were separated from the cells by centrifugation at 200 r/m for 20 minutes at 30 °C, followed by washing the rest of the medium with 0.85% physiological solution. Purification was performed by loop purification in three test tubes with slanted culture medium and condensate liquid.

The researches have been realised on the caterpillars of 2-3 ages of the *Hyphantria cunea* and *Cydia pomonella L* In the study, we used the microbiological preparation, for each caterpillar. The monitoring of the insects lot and the estimation of the dead caterpillars has been carried out daily, beginning from the 3 rd day of the contamination.

The effectiveness of the microbiological preparation action was established according to the Abbot formula, which provides the insects ' natural death:

$$E_{ab} = \frac{Mo - Mc}{100 - Mc} * 100$$

Where Eab- – is the death rate, %; Mo – the number of dead specimens in the experiment; Mc- - the number of dead specimens in the control.

Laboratory investigation of the sampled material attacked the pest of insects under experiments were carried out, in correspondence with the norms in power, in order to establish frequency, intensity, and attack degree of them. To establish the influence of trophic factor on the insect development, larvae (from the same sites), were reared on a number of 12 species of host-plants (ornamental, forest and fruit trees): mulberry (*Morus* L), Persian walnut (*Juglans regia* L.) maple, (*Acer negundo* L.) willow (*Salix* L.), poplar (*Populus alba* L.), lime (*Tilia cordata* Mill.), apple-tree (*Malus domestica* L.), pear-tree (*Pirus sativa* Lam. et Dc.), apricot tree (*Armeniaca vulgaris* L.), plum tree (*Prunus domestica* L.). The statistical processing of the obtained data will be carried out according to Statistica 13.3 and Statgraphics 19.

RESULTS AND DISCUSSIONS

In addition to diseases, there are also a number of pests that can affect the walnut crop. The invasion of insect pests is a major problem that can cause significant losses and negatively affect the walnut crop. In the following, we present some of the pests of walnut, as well as the most effective methods to control them. Climatic conditions have been and are favorable for the occurrence and development of pests. It is worth mentioning that the frost, increased temperatures (35 - 40ºC) have seriously affected the populations.

The pests the fall webworm (*Hyphantria cunea* Dr.), the codling moth (*Cydia pomonella* L.) have two generations per year, the first generation of adults in April-May and the second in July-August, sometimes an optional third generation occurs.

In the case of the fall webworm (*Hyphantria cunea* Dr.), the polyphagy of the pest was also emphasised. We have identified 124 host plant species that can serve as a nutritional basis for H. cunea larvae under the agroclimatic conditions of the Republic of Moldova (Table 2).

Table 2. Species of plants attacked under natural conditions by *H. cunea* or experimentally accepted in the laboratory as hosts for *H. cunea* larvae rearing.

No. crt	Plant	Family	Nature	Accepted as laboratory feed
1	*Âgropyrum repens* Beauv.	GRAMINEAE	+	+
2	*Hordeum vulgare* L.		+	
3	*Lolium perenne* L.		+	
4	*Zea mays* L.		+	+
5	*Asparagus officinalis* L	LILIACEAE	+	
6	*Iris germanica L.*	IRIDACEAE	+	
7	*Gladiolus imbricatus L.*		+	
8	*Populus alba* L.	SALICACEAE	+	
9	*Populus italica* Mnch.		+	+
10	*Populus nigra* L.		+	
11	*Populus tremula* L.		+	
5	*Asparagus officinalis* L		+	
6	*Iris germanica L.*		+	
7	*Gladiolus imbricatus L.*		+	
8	*Populus alba* L.		+	
9	*Populus italica* Mnch.		+	
10	*Populus nigra* L.		+	
11	*Populus tremulaL.*		+	
12	*Salix alba* L.		+	+
13	*Salixcaprea* L.		+	
14	*Salix* fragilis L.		+	
15	*Salix triandra* L.		+	
16	*Juglans regia* L.	JUGLANDACEAE	+	+
17	*Juglans nigra* L.		+	
18	*Alnus glutinosa* Gaertn.	BETULACEAE	+	
19	*Betula verrucosa* L.		+	
20	*Corylus avellana* L.		+	
21	*Fagus silvatica* L.	FAGACEAE	+	
22	*Castanea saliva* Mill.		+	
23	*Quercus petraea* Liebl.		+	
24	*Quercus roburh.*		+	
25	*Quercus rubraL.*		+	+
26	*Celtis occidentalis* L.	ULMACEAE	+	
27	*Ulmus campestris* L.		+	
28	*Ulmus scabra* Mill.		+	
29	*Morus alba* L.	MORACEAE	+	+
30	*Morus nigra* L.		+	+
31	*Maclura aurantiaca*		+	
32	*Ficus elastica* Rorb.		+	+
33	*Âmaranlhus retrqflexus* L.	AMARANTHACEAE	+	
34	*Clematis vilalba* L.	RANUNCULACEAE	+	
35	*Paeonia* sp.		+	
36	Papaver sp.	PAPAVERACEAE	+	
37	*Brassica oleracea* L.	CRUCIFERAE	+	+
38	*Ribes nigrum* L.	SAX1FRAGACEAE	+	
39	*Platanus orientalis* L.	PLATANACEAE	+	+
40	*Crataegus monogyna* L.	ROSACEAE	+	+
41	*Cydonia oblonga* Mill.		+	+
42	*Fragaria vesca* L.		+	
43	*Cerasus avium* Mnch.		+	
44	*Prunus domestica* L.		+	+
45	*Primus spinosa* L.		+	
46	*Pirus sativa* Lam. et Dc.		+	
47	*Pirus salicifolia* L.		+	
48	*Rosa canina* L.		+	+
49	*Rubus caesius* L.		+	
50	*Rubus idaeus* L		+	
51	*Cercis siliquastrum* L.	LEGUMINOCAE	+	
52	*Gleditschia triacanthos* L.		+	
53	*Laburnum anagyroides* Medik.		+	
54	*Medicago sativa* L.		+	
55	*Phaseolus vulgaris* L.		+	
56	*Pisum sativum* L.		+	
57	*Robinia pseudacacia* L.		+	
58	*Sophora japonica* L		+	
59	*Vicia faba* L.		+	
60	*Trifolium pratense* L.		+	
61	*Pelargonium zonale* Ait.	GERANIACEAE	+	

62	*Geranium* sp.		+	
63	*Buxus sempervirens* L.	BUXACEAE	+	
64	*Ilex aquifolium* L.	AQUIFOLIACEAE	+	
65	*Acer campestre* L	ACERACEAE	+	+
66	*Acer negundo* L.		+	+
67	*Acer platanoides* L.		+	+
68	*Acer pseudoplalanus* L.		+	+
69	*Acer saccharinum* L.		+	+
70	*Aesculus hippocastanum* L.	HIPPOCASTANACEAE	+	
71	Vitis *vinifera* L.	VITACEAE	+	+
72	*Parthenocisus tricuspidata* Planch.		+	+
73	*Parthenocisus quinquefolia* Planch.		+	
74	*Tilia cordata* Mill.	TILIACEAE	+	+
75	*Tilia platyphyllos* Scop.		+	+
76	Althea roşea Cav.	MALVACEAE	+	
77	*Hibiscus syriacus* L.		+	
78	*Tamarix* sp.	TAMARICACEAE	+	
79	*Begonia* sp.	BEGONIACEAE	+	
80	*Eleagnus angustifolia*	ELEAGNACEAE	+	
81	*Daucus carota* L.	UMBELIFERAE	+	
82	*Petroselinum hortense* Hoff.		+	
83	*Cornus mas* L.	CORNACEAE	+	
84	*Cornus sanguinea* L.		+	
85	*Cornus excelsior* L.	OLEACEAE	+	
86	*Fraxinus ornus* L.		+	
87	*Forsythia* sp.		+	
88	*Ligustrum vulgare* L.		+	
89	*Syringa vulgaris* L.		+	
90	*Jasminum* sp.		+	
91	*Lamium purpureum* L.	LABIATAE	+	
92	*Salvia pratensis* L.		+	
93	*Petunia hybrida* Hort.	SOLANACEAE	+	
94	*Solanum nigrum* L.		+	
95	*Solanum tuberosum* L.		+	
96	*Paulownia tomentosa* Sieb. et. Zucc	SCROPHULARIACEAE	+	+
97	*Catalpa bignonioides* Watt.	BIGNONIACEAE	+	+
98	*Catalapa bignonioides* Aurea			
99	*Catalpa ovata* G. Don.		+	+
100	*Catalpa speciosa*			
101	*Campsis radicans*		+	
102	*Plantago major* L.	AGINACEAE	+	
103	*Plantago lanceolata* L.		+	
104	*Sambucus nigra* L.	CAPRIFOLIACEAE	+	
105	*Viburnum* sp.		+	
106	*Chrisanthemum* sp.		+	
107	*Cichorium intybus* L.		+	
108	*Helianthus annus* L.		+	
109	*Taraxacum qfficinale* Web.		+	
110	*Zinnia elegans* L.		+	
111	*Sambucus nigra* L.		+	
112	*Viburnum* sp.		+	
113	*Chrisanthemum* sp.	COMPOSITAE	+	
114	*Cichorium intybus* L.		+	
115	*Helianthus annus* L.		+	
116	*Taraxacum qfficinale* Web.		+	
117	*Zinnia elegans* L.		+	
118	*Cotinus coggygria*	ANACARDIACEAE	+	
119	*Bérberis vulgáris*	BERBERIDACEAE	+	
120	*Canna spp.*	CANNACEAE	+	
121	*Chenopodium album*	CHENOPODIACEAE	+	
122	*Spinacia oleracea*		+	
123	*Ailanthus altissima*	SIMAROUBACEAE	+	
124	*Cephalanthus occidenalis*	NAUCLEACEAE	+	

Experiments on large-scale control of other defoliating larvae using the biological preparation Virin-ABB-3 with contaminated larvae of *H. cunea* on different plant species with the same concentration and the same number of larvae, as well as biological efficacy became a necessity for determining the percentage of mortality. From the results obtained it can be concluded that in this method of control, in addition to the doses of baculoviral preparation, the choice of the most favourable times of treatment, with respect to larval development and budding of trees, is of particular importance. Treatments should only be applied when larvae are in their first two instar and trees are in bud (Table 3).

Table 3. Biological efficacy of microbiological preparations in population reduction of *H. cunea*, generation I, II.

No d/r	Variant	Surface area, ha	Consumption standard kg / ha	The generation	Caterpillars in the colonies		Biological efficacy, %
					until	after 10 days	
1	Virin ABB-3	3	0,1	I	740	112	85,86
2	Virin ABB-3	3	0,1	II	650	231	89,23
3	Lepidocid	4	1,0	I	683	87	87,26
4	Lepidocid	4	1,0	II	518	62	89,2
5	Control	-		I	620	598	-
6	Control			II	645	621	-
	$DEM_{0,05}$	2,9					

The later application of treatments requires an increased amount of viral preparation, which may negatively affect the economic efficiency of these treatments. In-depth study of the mechanisms that determine the epizootic character of baculoviruses has made it possible to elucidate the horizontal and vertical transmission routes of entomopathogenic microorganisms, which has led to an increase in the volume of production and the areas of application. The data presented in the table demonstrate that the used preparation provides a high effect of 89.23% in the control of *H. cunea*, Virin ABB-3 *Bacillus thuringiensis* var. *kurstaki* 89,2 stops the increase in the number of nests on a tree and provides the high degree of protection of walnut.

Treatment with the strain *Bacillus thuringiensis* var. *kurstaki* against the codling moth (*Cydia pomonella* L) was organized and carried out by us at the beginning of the first decade of May in walnut crops (Table 4).

Table 4. Biological efficacy of the bioinsecticid *Bacillus thuringiensis* var. *kurstaki* against the codling moth (*Cydia pomonella* L.), (Number of fruits recorded per tree - 300).

№	Variant	Consomption rate, l/ha	Number of fruits taken for analysis		Degree of fruit damage, %	Biological efficacy, %
			Fruit deterioration, buc	Healthy, buc		
1.	Control untreated		64,0	236,0	28,3	
3.	*Bacillus thuringiensis* var. *kurstaki*	5,0	16,0	284,0	3,0	77,1
4.	*Bacillus thuringiensis* var. *kurstaki*	10,0	13,0	287,0	3,3	82,8
HCP 05			1,2			

From the analysis of the results Table 3 obtained from microbiological control of the Codling moth (*Cydia pomonella* L.), in walnut with suspensions of different concentrations, the following observations can be made. The codling moth mortality, shows different values depending on the dose of the preparation. Thus, at the dose of *Bacillus thuringiensis* var. *kurstaki* 5,0 l the efficacy is 77,1%; at the dose of *Bacillus thuringiensis* var. *kurstaki* 10,0 l/ha - 82,8%. The conducted researches show us the positive influence of the strain *Bacillus thuringiensis* var. *kurstaki* against apple maggot (*Cydia pomonella* L.) on bacterial basis on the development and multiplication of harmful organisms in the process of vegetation in walnut crop.

CONCLUSIONS

There are several very large caterpillars that feed on walnut, the adult moths are some of our largest native insects. They include the fall webworm, *Hyphantria cunea* (Drury), the codling moth (*Cydia pomonella L*).

Experiments on large-scale control of other defoliating larvae using the biological preparation Virin-ABB-3 with contaminated larvae of *H. cunea* on different plant species with the same concentration and the same number of larvae, as well as biological efficacy became a necessity for determining the percentage of mortality. The data demonstrate that the used preparation provides a high effect of 89.23% in the control of *H. cunea*, Virin ABB-3 stops the increase in the number of nests on a tree and provides the high degree of protection of walnut.

The analysis the results obtained after microbiological control with suspensions of different concentrations, the following observations can be made. Mortality of the Codling moth, shows different values depending on the dose of the preparation. Thus, at the dose of Bacillus thuringiensis var. kurstaki 5,0 l the efficacy is 77,1%; at the dose of *Bacillus thuringiensis* var. kurstaki 10.0 l/ha - 82.8%

The obtained results confirm the possibility of using entomopathogenic bacteria and baculoviruses biological preparations that can replace pesticides and develop biological methods of protection walnut plant.

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