# BIOLOGICAL EFFICIENCY OF SOME INSECTICIDES CONTAINING ACETAMIPRID 200 G/L + LAMBDA-CYHALOMETRIN 150 G/L, IN THE CONTROL OF PLUM PESTS, IN THE CONDITIONS OF THE REPUBLIC OF MOLDOVA

## EFICIENŢA BIOLOGICĂ A UNOR INSECTICIDE CU CONŢINUT DE ACETAMIPRID 200G/L + LAMBDA-CIHALOMETRIN 150 G/L ÎN COMBATEREA DĂUNĂTORILOR PRUNULUI, ÎN CONDIŢIILE REPUBLICII MOLDOVA

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***Abstract.***

*The share of fruit crops in the national economy is due to the role that fruits have in food, in preventing and combating some diseases, as well as in increasing the national income. However, the orchards and fruit production are affected by numerous species of animal pests, which in some years multiply considerably, attack all the organs of the fruit trees and cause considerable damage. Plum plantations are attacked by various species of harmful, sucking, carpophagous or defoliating insects both during the vegetation period. The most dangerous pests, the density of which exceeded the economic damage threshold, were the plum saw wasp, the plum seed wasp, the gray plum louse and the plum worm. In combating plum pests, satisfactory results were obtained by using with the insecticide with the active substance acetamiprid, 200 g/L + lambda-cihalotrin, 150 g/L, with a consumption rate of 0.25 l/ha, which ensures a reduction of the species Hyalopterus pruni Geoffr. (96.32 - 88,11%), Cydia funebrana Tr., (94.50 – 92.56%), Hoplocampa spp. (92.07 - 92.93%) and Eurytoma schreineri Schr., (95.78%).*

**Key words: :** OSR, Hyalopterus pruni Geoffr., Cydia funebrana Tr., Hoplocampa spp., Eurytoma schreineri Schr., Biological and control particularities

***Rezumat.***

Ponderea culturilor pomicole în economia națională se datorează rolului pe care au fructele în alimentație, în prevenirea și combaterea unor maladii, precum și în sporirea venitului național. Însă, plantațiile pomicole cât și producția de fructe, sunt afectate de numeroase specii

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de dăunători animali, care în unii ani se înmulțesc în masă, atacă toate organele pomilor fructiferi și produc pagube considerabile. Plantațiile de prun pe parcursul perioadei de vegetație sunt atacate de diverse specii de insecte dăunătoare. sugătoare, carpofage sau defoliatoare. Cei mai periculoși dăunători, densitatea cărora au depășit pragul economic de dăunare, au fost viespile cu ferestrău a prunelor, viespea semințelor de prun, păduchele cenușiu al prunului și viermele prunelor. În combaterea dăunătorilor prunului rezultate satisfăcătoare au fost obținute prin utilizarea insecticidului cu conținut de acetamiprid, 200 g/L + lambda-cihalotrin, 150 g/L, cu norma de consum 0,25 l/ha, care asigură o reducere considerabilă a speciilor Hyalopterus pruni Geoffr. (96,32 - 88,11%), *Cydia funebrana* Tr.,(94,50 - 92,56%), *Hoplocampa* spp. (92,07 - 92,93%) și *Eurytoma schreineri* Schr., (95,78%).

**Cuvinte cheie:** Rapiţa de toamnă, Hyalopterus pruni Geoffr., *Cydia funebrana* Tr., *Hoplocampa* spp., *Eurytoma schreineri* Schr., Particularități biologice și de combatere.

## INTRODUCTION

Establishment and efficient operation of an orchard plantation, along with an in-depth study of the biology, ecology, and high-performance technologies for cultivating fruit tree species, requires detailed research into the species composition of harmful organisms and the development of integrated pest protection systems for fruit trees. Plum plantations are attacked by various species of sucking pests (plum gray aphid, plum scale insect), which, in addition to causing direct damage, cover all external plant organs with sugary excretions on which different fungi from the *Capnodium* genus develop, forming a layer of sooty mold over the affected areas. Many of these pests also serve as vectors for the transmission and spread of various viral diseases [Croitoru *et al.*, 2022].

Among the more commonly encountered defoliating pests are the plum leaf moth, oak processionary caterpillar, yellow-tailed caterpillar, and tortricid moths, among others. However, the most dangerous are considered to be fruit-eating pests, whose larvae attack the fruits, boring galleries that destroy both the pulp and seeds. After the attack, the fruits display galleries filled with excretions and gnaw marks. Among the most frequently encountered species harmful to plums are the black and yellow plum sawflies, the plum seed wasp, the plum worm, and the oriental fruit moth [Panuța and Pamujac, 2008].

Achieving high yields of plums in climatic conditions favorable to the development of pests is almost impossible without the use of insecticides, even if all alternative methods are followed. In such cases, chemical treatments are necessary to reduce pest population density [Croitoru *et al.*, 2021]. When the economic damage threshold is exceeded, several products with various active ingredients and mechanisms of action are approved for combating the main pests of plum trees. In this context, ongoing research is required to test and approve new

phytosanitary products, specifically to determine the biological efficacy of insecticide Lot No. 3, SC, in controlling plum pests.

## MATERIAL AND METHOD

The investigation regarding the testing of the insecticide containing acetamiprid (200 g/L) + lambda-cyhalothrin (150 g/L) was carried out in 2023 in the northern region of the Republic of Moldova, specifically in the plum plantations of SRL "Agroselect Vasilcău" in the village of Vasilcău, Soroca district. The selected plantation had experienced fruit damage exceeding 2% in the previous year, with the Stanley variety, which is registered in Moldova. The planting scheme was 6 x 3.5 meters, providing 21 m² per tree. The experiment was conducted in three replications with a randomized, compact layout. Each plot was rectangular, consisting of 5 trees, with an area of 105 m². To isolate the plots, one tree was left between them, and the protective strip consisted of an entire row [Croitoru *et al.*, 2022].

The experiment included four variants: Variant 1 – untreated control; Variant 2 – standard, insecticide with acetamiprid (200 g/L) + lambda-cyhalothrin (150 g/L) at a rate of 0.25 L/ha; Variant 3 – insecticide with acetamiprid (200 g/L) + lambda-cyhalothrin (150 g/L) at a rate of 0.2 L/ha; Variant 4 – insecticide with acetamiprid (200 g/L) + lambda-cyhalothrin (150 g/L) at a rate of 0.25 L/ha.

Before treatment, each plot was marked with color-coded labels depending on the variant, attached to a branch of the trees. The label included information about the variant number, its contents, and the number of replications. The chemical treatments for the experimental lot were performed manually using a portable sprayer. To ensure consistency and to prevent plant burn, treatments were carried out on the same day in the morning during calm weather.

The influence of ecological factors on the development of harmful and beneficial fauna was assessed based on meteorological data from the northern region of Moldova. The biological efficacy of the insecticides was determined according to the requirements and methodological guidelines for testing phytosanitary products (Chișinău, 2002).

## RESULTS AND DISCUSSIONS

Both in the northern region of the country and at the agricultural enterprise SRL "Agroselect Vasilcău" in the village of Vasilcău, Soroca district, the climatic conditions, characterized by scorching temperatures and a lack of precipitation that were below the multiyear average, were favorable for the development of pests affecting this crop.

Chemical treatments are most effective for controlling plum sawflies when adult populations and first-instar larvae exceed the economic damage threshold of 10 sawflies per tree or 2-3% of flowers/fruits attacked. Sawflies infest generative organs during flowering or the white bud stage. Female sawflies lay eggs in the sepals or receptacle, covered with a viscous secretion. In 2023, sawfly density exceeded the threshold, and treatments were applied: the first during white bud to early flowering on April 27, and the second to target larvae on May 5.

The assessment of fruit infestation by larvae in the tree canopy was conducted 10 days after the second spraying, on May 15$^{th}$. For this, 100 fruits from four parts of the canopy of each model tree were examined. Additionally, for a more

thorough evaluation of the effectiveness of the treatments, fallen fruits were analyzed. To facilitate this, the area under the tree canopy was cleared of weeds and plant debris, and previously fallen fruits were removed. The monitoring was conducted twice after flowering, with an interval of 10 days (May 15$^{th}$ 2023, and May 25$^{th}$, 2023).

Results from the records and the calculation of the biological efficacy of the chemical products are presented in Table 1. According to the data, the proportion of fruit attacked by plum sawflies in the tree canopy ranged from 1.13% in Variant 4 to 14.25% in the control variant. The lowest number of attacked fruits was found in Variant 4, and this index is at the level of the standard.

The results obtained in Variant 3 (2.93%) demonstrate that the level of fruit attack is 4.86 times lower compared to the control, and this index is significantly lower than both the standard and Variant 4.

In the analysis of fallen fruits attacked by sawflies, it was found that the smallest number of damaged fruits was in Variant 4 (2.88 fruits per tree), which matches the standard (3.00 fruits per tree). In Variant 3, there were 4.25 fruits per tree, which is 9.59 times lower than in the control, but still significantly higher than both Variant 4 and the standard.

The calculation of the reduction in fruit attack compared to the control revealed that the highest biological efficacy was achieved in Variant 4, with a reduction of 92.07% in attacked fruits in the tree canopy and 92.93% reduction in fallen fruits attacked by sawflies. These indices significantly exceed those of Variant 3 and are on par with the standard. In Variant 3, the biological efficacy was 79.44% and 89.57%, which is significantly lower than both Variant 4 and the standard.

Based on the results above, it can be concluded that the most effective treatment for controlling plum sawflies is the insecticide containing acetamiprid 200 g/L + lambda-cyhalothrin 150 g/L, with an application rate of 0.25 L/ha, which ensures a biological efficacy of 92.07% and 92.93%.

The chemical treatments applied in the experimental lot for controlling sawfly larvae were also aimed at managing the gray plum aphid. The results presented in Table 2 show that the density of gray plum aphids was quite high and uniform. ranging from 35.63 aphids per meter of shoot in the control variant to 37.13 aphids per meter of shoot in Variant 4.

The results of observations conducted at various periods after treatment demonstrated that the lowest population of the plum grey aphid was recorded in the 4th variant. which is at the standard level. In the 3rd variant. the aphid density is significantly higher and exceeds both the 4th variant and the standard.

Analyzing the data on the reduction of the plum grey aphid population compared to the control, it can be observed that the highest values were reached in the 4th variant, and this index is at the standard level. In the 3rd variant, a reduction in pest density of over 90% was achieved only on the third day after treatment,

while in subsequent periods, this index significantly fell behind both the standard and the 4th variant.

Thus, it was established that satisfactory results in controlling the plum grey aphid were achieved in the 4th variant, where the trees were treated with an insecticide containing acetamiprid, 200 g/L + lambda-cyhalothrin, 150 g/L, with a consumption norm of 0.25 l/ha. The plum seed wasp is a species with high ecological plasticity, found on more than 60% of the plantations in the Republic of Moldova. Crop losses caused by this pest can reach up to 80%, and in small plantations, it can cause the total loss of fruit. For accurately determining the timing of chemical treatments, observations were made on the appearance of adults, particularly females, who can lay eggs from the first days. In the year of the research, the beginning of flowering at SRL "Agroselect Vasilcău" in the village of Vasilcău, Soroca district, occurred between April 25-27, with 25-75% petal fall recorded on May 1-2. The first egg-laying was observed on April 26. Therefore, the first treatment to combat the plum seed wasp was carried out on April 27, with the second treatment performed on May 5.

It is well-established that mass fruit drop caused by the plum seed wasp, in mid-ripening varieties, occurs before ripening, corresponding to the third decade of June or early July. Based on this information, during this period, fallen fruit was collected to determine the biological efficiency of chemical treatments. To facilitate this process, weeds and plant debris around the trees were removed 25-30 days prior. To determine the degree of infestation, 100 fallen fruits were collected from four sides under the canopy of each tree in the plot.

The results of the observations and the calculation of biological efficacy are presented in Table 3. From the data, it can be seen that the percentage of fruits attacked by the plum seed wasp varied from 2.75% in the 4th variant to 65.13% in the control variant. The lowest number of attacked fruits was recorded in the 4th variant, and this index is at the standard level. The results obtained in the 3rd variant (5.13%) demonstrate that the level of fruit infestation is 12.70 times lower than in the control variant, although this index significantly lags behind both the 4th variant and the standard.

The calculation of the reduction in fruit infestation compared to the control allowed us to conclude that the highest biological efficiency was achieved in the 4th variant, where this index reached 95.78%, aligning with the standard level. In the third variant, this index was 92.12%, which is significantly lower than both the fourth variant and the standard. Based on the results obtained and the conclusions drawn, it can be observed that the most effective method for controlling the plum seed wasp is to perform two treatments with the insecticide containing acetamiprid (200 g/L) + lambda-cyhalothrin (150 g/L), at a consumption rate of 0.25 l/ha, which ensures a biological efficacy of 95.78%.

Table 1

**Biological Efficacy of the Insecticide Containing Acetamiprid 200 g/L + Lambda-Cyhalothrin 150 g/L in Controlling Plum Sawflies**

| | Consumption norm, L/ha | Number of fruits analyzed per 1 tree, e.g. | From these attack, ex | Number of fallen fruits, ex | From this | | Reduction of fruit attack compared to the control, % | |
|---|---|---|---|---|---|---|---|---|
| | | | | | attacked by plum saw wasps | % | in the crown of the trees | of attacking fallen fruit |
| $V_1$ (Control) | Treated with water | 100.0 | 14.25 | 43.88 | 40.75 | 92.87 | 0.00 | 0.00 |
| $V_2$ (Standard, acetamiprid, 200 g/L + lambda-cyhalothrin, 150 g/L) | 0.25 | 100.0 | 1.25 | 3.75 | 3.00 | 80.00 | 91.23 | 92.64 |
| $V_3$ (acetamiprid, 200 g/L + lambda- cyhalothrin, 150 g/L) | 0.2 | 100.0 | 2,93 | 5.88 | 4.25 | 79.44 | 79.44 | 8957 |
| $V_4$ (acetamiprid, 200 g/L + lambda- cyhalothrin, 150 g/L) | 0.25 | 100.0 | 1.13 | 3.50 | 2.88 | 82.29 | 92.07 | 92.93 |
| DEM 95%, p-5% | | | 1.53 | | 1.18 | | 4.88 | 289 |

**Table 2.**

**Results of Gray Plum Aphid Assessment in the Experimental Lot for Testing the Insecticide Containing Acetamiprid 200 g/L + Lambda-Cyhalothrin 150 g/L (2023)**

| The variants of the experience | Consumption norm, L/ha | Aphid density per 1 meter of shoot | | | | | Reduction in adult density as a percentage compared to the control | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Before treatment | On observation days | | | | 3 | 5 | 7 | 14 |
| | | | 3 | 5 | 7 | 14 | | | | |
| $V_1$ (Control) | untreated | 35.63 | 39.13 | 43.50 | 47.63 | 51.75 | 0.00 | 0.00 | 0.00 | 0.00 |
| $V_2$ (Standard, acetamiprid, 200 g/l + lambda- cyhalothrin, 150 g/L) | 0.25 | 36.25 | 1.63 | 2.38 | 3.25 | 5.88 | 95.91 | 94.09 | 91.81 | 87.52 |
| $V_3$ (acetamiprid, 200 g/l + lambda-cyhalothrin,150 g/L) | 0.2 | 36.88 | 3.63 | 4.50 | 5.88 | 7.13 | 91.04 | 89.02 | 85.44 | 83.75 |
| $V_4$ (acetamiprid, 200 g/l + lambda-cyhalothrin,150 g/L) | 0.25 | 37.13 | 1.50 | 2.25 | 3.13 | 5.25 | 96.32 | 94.55 | 92.30 | 88.11 |
| DEM 95%, p-5% | | | 1.89 | 2.07 | 2.48 | 1.69 | 3.27 | 3.89 | 4.07 | 3.04 |

**Table 3.**

**Biological Efficiency of the Insecticide Containing Acetamiprid 200 g/l + Lambda-Cyhalothrin 150 g/L in Controlling the Plum Seed Wasp (2023)**

| The variants of the experience | Consumption norm, L/ha | Number of fruits analyzed per tree, pcs. | Out of these | | | Reduction in fruit infestation compared to the control, % |
|---|---|---|---|---|---|---|
| | | | Attacked by the plum seed wasp | Physiologically fallen | Other factors | |
| $V_1$ (Control) | untreated | 100.0 | 65.13 | 6.38 | 28.49 | 0.00 |
| $V_2$ (Standard, acetamiprid, 200 g/L + lambda- cyhalothrin, 150 g/L) | 0.25 | 100.0 | 2.88 | 11.75 | 85.37 | 95.58 |
| $V_3$ (acetamiprid, 200 g/L + lambda- cyhalothrin,150 g/L) | 0.2 | 100.0 | 5.13 | 12.88 | 81.99 | 92.12 |
| $V_4$ (acetamiprid, 200 g/L + lambda- cyhalothrin,150 g/L) | 0.25 | 100.0 | 2.75 | 11.63 | 85.62 | 95.78 |
| DEM 95%, p-5% | | | 2.17 | | | 3.28 |

To determine the presence of plum worms and the population density of this pest, and to establish the timing for chemical treatments, two pheromone traps were set up in plantation at the end of April. Monitoring the males in the traps ,15.0 males were captured per trap per day.

Subsequent observations showed that the population dynamics of the first generation of plum worms were increasing, reaching a maximum of 40.0 males per trap per day by May 15. Consequently, the first treatment against the plum worm larvae was carried out on May 25.

It is noteworthy that ongoing observations revealed a fairly uniform density of plum worms, with the maximum value not exceeding 5.4 males per trap per day. The subsequent three treatments were performed on June 10, June 25, and July 15.

To evaluate the biological efficacy of the insecticides, after the second wave of fruit drop, all weeds and previously fallen fruits were removed from under the tree canopies, and the soil was levelled. Fallen fruits were collected and analyzed every five days. After the final observation, which was done a day before harvest, the total number of fallen fruits was calculated, allowing for the determination of the average percentage of fruit infestation per model tree.

During the harvest period, 300 fruits were collected from each model tree, and the proportion attacked by the plum worm was determined. The calculation of biological efficacy, based on the percentage reduction of damage compared to the control, was performed using the previously mentioned formula.

The results of the observations and the calculation of biological efficacy are shown in Table 4. From the table, it can be seen that, out of the total number of fruits collected from a model tree (300 pcs.), the highest level of infestation was recorded in the control variant (75.13 pcs.), which constitutes 25.04%. The lowest number of attacked fruits was found in the fourth variant, where this index was 4.13 pcs. per tree, constituting 1.38% and aligning with the standard level. In the third variant, the number of attacked fruits was 7.88 pcs. per tree, which is 9.53 times lower than in the control variant, but this index still falls short of both the fourth variant and the standard.

The analysis of fallen fruits revealed that the lowest number of fruits attacked by the plum worm was found in the fourth variant, and this index is at the standard level. The calculation of biological efficacy showed that the highest reduction in infestation, both for fruits from the tree and gathered from under the tree canopies, was observed in the fourth variant, with these indices being 94.50% and 92.56%, respectively, aligning with the standard level. In the third variant, the reduction in fruit infestation is ssignificantly maller in the fourth variant and the standard. It is worth mentioning that unique instances of scale insects and other pest species identified before treatment were completely eradicated through chemical treatments aimed at controlling carpophagous pests.

**Table 4**

**Biological efficacy of the insecticide containing acetamiprid 200 g/L + lambda-cyhalothrin 150 g/L, in combating plum borer (2023)**

| Experimental variants | Consumption norm, L/ha | Number of fruits collected from one tree, pcs. | Out of these | | | Number of fallen fruits analyzed | Of these, specimens | | Reduction in fruit infestation, % compared to the control at harvest | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Healthy, pcs. | Attacked by the plum worm | In % | | Attacked by the plum worm | Affected by other factors | From the tree canopies | Fallen |
| $V_1$ (Control) | Untreated | 300 | 224.77 | 75.13 | 25.04 | 100.0 | 63.88 | 36.12 | 0.00 | 0.00 |
| $V_2$ (Standard, acetamiprid, 200 g/L + lambda- cyhalothrin, 150 g/L) | 0.25 | 300 | 295.75 | 4.25 | 1.42 | 100.0 | 4.88 | 95.12 | 94.34 | 92.36 |
| $V_3$ (acetamiprid, 200 g/L + lambda- cyhalothrin,150 g/L) | 0.20 | 300 | 292.12 | 7.88 | 2.63 | 100.0 | 7.38 | 92.62 | 89.51 | 88.45 |
| $V_4$ (acetamiprid, 200 g/L + lambda- cyhalothrin,150 g/L) | 0.25 | 300 | 295.77 | 4.13 | 1.38 | 100.0 | 4.75 | 95.25 | 94.50 | 92.56 |
| DEM 95%, p-5% | | | | 3.59 | | | 2.43 | | 4.07 | 3.89 |

## CONCLUSIONS

During the 2023 growing season, conditions favorable for the development of pests on plum plantations were created.

The most dangerous pests, which exceeded the economic threshold of damage, were the plum sawflies, the plum seed wasp, the plum grey aphid, and the plum worm.

To control these plum pests, six insecticide treatments were conducted in the experimental plot throughout the growing season.

Satisfactory results in pest control were achieved using an insecticide containing acetamiprid (200 g/L) + lambda-cyhalothrin (150 g/L) at a consumption rate of 0.25 l/ha. This treatment provided a reduction in plum grey aphid populations ranging from 96.32% to 88.11% over 10-12 days, a reduction in fruit infestation by plum worms at 94.50% and 92.56%, sawflies at 92.07% and 92.93%, and plum seed wasps at 95.78%.

Based on the conducted research and obtained results, it is recommended to include the insecticide containing acetamiprid (200 g/L) + lambda-cyhalothrin (150 g/L), with a consumption rate of 0.25 l/ha, in the State Register of Phytosanitary Products and Fertilizers. It should be applied in 1-2 treatments against sawflies, plum grey aphid, plum seed wasps, and 2 treatments for controlling plum worms when pest density exceeds the economic threshold.

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