

THE EFFICACY OF PROTECTION

by modern insecticides in the industrial cherry plantations against cherry fruit fly pest

Goal. To investigate an efficacy of the insecticides Aktelik 500 EC, (pyrimyphos-methyl 500 g/l), Calipso 480 SC (thiacloprid, 480 g/l), Proclaim 50 SG (emamectyn benzoat, 50 g/kg), Movento 100 SC (spirotetramate, 100 g/l), Exirel, CE (cyantraniliprole, 100 g/l) and bio products Actofit, EC (aveseptyn C, 0.2%), bitoxybacilyn — BTU, (insecticide), (Bacillus thuringiensis endospores, endotoxyn, exotoxyn) and Lepidocyd-BTU, (insecticide), (Bacillus thuringiensis var. Kurstaki, endospores, endotoxyn) on a reduction of a number and a harmfulness of cherry fruit fly (*Rhagoletis cerasi* L.) it impact on yields in industrial cherry orchards. **Methods.** A field method, in the industrial orchards in educational production department of university. A type of cherry trees — Regina and Alfa. Planting scheme — 4.0 × 5.0 m. Year of planting — 1996. Crown shape — sparsely (improved) — tiered. Rootstock — antipka. Phases of plant development at application timing — «fruit development, (fruits about 90% of the final size)» (BBCH 81) and («fruits ripening phase») (BBCH 85). Soil — shallow, low — humus dusty — loamy podzolic leached black soils: humus content — 1.3—2.5%; pH 4.8—5.2; mobile compounds P₂O₅ — 130—180 mg/kg and K₂O — 8.9—9.2 mg/kg (by Chirikov method). The measures for care of the experimental site — loosening a soil in the stem strips during the growing period, an application of organic and mineral fertilizers, a pruning, a splaying of grass between the rows (row spacing), a protection from pests and diseases. The technical effectiveness of applications was determined in different rates against blood-red aphids and their impact on yields in commercial apple orchards. Calculations were made according

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to generally accepted methods in in horticulture, plant protection and entomology. **Results.** The use of insecticides Aktelik 500 EC, Calypso 480 SC), Proclaim 50 SG, Movento 100 SC Exirel, CE against cherry fruit fly helped to decrease number of pests on 91.4—98.9% — 93.7—97.6% accordingly. It allowed to obtain a high — grade cherries product with a yield of 1.7—1.9 times and 1.4—2.1 times higher comparing to control. The outcome of non-

standard products did not exceed 0.4—0.6% compared to 34.9—44.3% in the control (water treatment). The efficacy of bio products was 32.9—40.4%. It confirms their low efficacy against this pest. **Conclusions.** The use of insecticides Aktelik 500 EC, Calypso 480 SC, Proclaim 50 SG, Movento 100 SC, Exirel, CE allows to achieve high efficacy of cherry fruit fly control in industrial plantations, to manage it number and population during whole month (the period of larva development). A limitation of pest number in cherry orchard by using the studied treatments provided a yield increase and a marketable quality of the obtained fruit products.

cherry; plantation; pest; cherry fruit fly; insecticides; bio products; technical efficacy; yield; fruits marketability

The importance of fruit crops, in particular sweet cherry and cherry, which are an important product of baby and dietary food, is well-known. Their fruits have a large set of vitamins A, B1, B2, B6, C, E, H and PP, macro- and microelements (potassium, calcium, magnesium, zinc, copper, manganese, iron, iodine, phosphorus), many sugars (fructose, glucose), several organic acids, including malic, fiber, carotenoids, pectins and a large amount





of anthocyanins (substances from the group of flavonoids) [1].

According to the State Statistics Service of Ukraine, in 2021, the area of industrial cherry and sweet cherry orchards amounted to 20.4 and 10.8 thousand hectares, and the yield was 8.9 and 6.7 t/ha, respectively [2].

There are more than 30 species of harmful insects, mites and rodents in the cherry and sweet cherry plantations of Ukraine, which weaken the vitality of cultivated plants during the growing season. The yield of commercial products decreases by 22–30% in the absence or untimely implementation of protective measures against them [3–6].

An important role in reducing the harmful effects of phytophages, weeds and pathogens in the agrobiocenosis of the garden belongs to chemical measures [3–5].

Harmful species of arthropods cause significant damage to cherry orchards [3–6]. *Rhagoletis cerasi* L. (cherry fly) takes the leading place in terms of harmfulness. Fruits damaged by fly larvae lose their luster, fruits become inedible, pulp rots, and part of them falls off. In some years, this species damages up to 80% of fruits [3], which is also confirmed by research materials of foreign scientists [7–8].

It is worth reminding about the peculiarities of the pest biology: the pupae hibernate in a false cocoon in the soil at a depth of up to 5 cm. The fly can be found from mid-May to mid-June. Females lay eggs under the skin of fruits that are beginning to ripen. After 7–10 days, the larvae appear and move towards the stone, damaging the pulp. Larvae develop for 20–30 days directly inside the fruits, which makes it extremely difficult to carry out protective measures to reduce their harmfulness, reduces the effect of preparations, in particular, by the contact method (it is washed away, the duration of contact of the insecticide with the phytophagous, etc. is reduced) [3, 9].

Long-term use of the same preparations, manifestation of resistance to some groups of chemical compounds, violations of protection technology are among other reasons

of the low effectiveness of chemical preparations against this dangerous object on sweet cherry and cherry [9].

It is important to remind that a new strategy for controlling this phytophagous — «attract and kill» is being actively developed in Europe and the USA. Bait is used and not eggs and larvae, but adults in the flight phase (flies) are destroyed. Protein-rich liquid bait «Combi-Protec», which is mixed with the preparations of Mospilan, Calypso, Spintor, is used. Spraying of trees is carried out at a consumption rate of 20 l/ha [10–11]. This method allows you to effectively reduce the number and harmfulness of the phytophagous, remarkably minimize the use of insecticides and their working solutions, and significantly improve the state of the natural environment.

In Ukraine, a chemical method and exclusively against the pest larvae is currently dominated in protection of sweet cherry and cherry plantations against cherry fly [4–6]. Therefore, plantations protection from this pest using modern preparations based on new active substances and the mechanism of their action is an extremely important issue today. Issues on the rational use of plant protection products in order to obtain the maximum effect at the minimum cost and ecological safety for the natural environment, and the possibility of using biological preparations remain the main ones.

To investigate the efficacy of the impact of insecticides (Aktelik 500 EC, KE (pyrimyphos-methyl, 500 g/l), Calypso 480 SC, KS (thiacloprid, 480 g/l), Proclaim 50 SG, RG (emamectyn benzoate, 50 g/kg), Movento 100 SC, KS (spirotetramate, 100 g/l), Exirel, CE (cyantraniliprole, 100 g/l)) and insecticidal bio products Actofit, KE (aversektyn C, 0.2%), Bitoxybacilyn — BTU, r. (cells of *Bacillus thuringiensis* var. Kurstaki bacterium, endospores, endotoxin)) on a reduction of a number and harmfulness of cherry fruit fly (*Rhagoletis cerasi* L.) in industrial plantations.

Methods. The research was carried out during 2020–2022 in industrial plantations of sweet cherry

and cherry in the conditions of the Educational and Production Department of Uman National University of Horticulture (EPD UNUH). Sweet cherry trees are of Regina variety and cherry trees are of Alfa variety. Planting scheme — 4 × 5 m. Planting year — 1996.

Crown shape was sparsely (improved) — tiered. Rootstock was strong-growth (*Prunus mahaleb*). Phases of plant development at application timing — «fruits development» (fruits have about 90% of the final size — beginning of fruits coloration), (BBCH 81) and «fruits ripening» (fruits coloration continues) (BBCH 85). Soil — shallow, low-humus dusty-loamy podzolic leached black soils: humus content — 1.3–2.5%; pH 4.8–5.2; mobile compounds P₂O₅ — 130–180 mg/kg and K₂O — 8.9–9.2 mg/kg (by Chirikov method). Measures of treatment of the experimental site: loosening the soil in the near-stemmed strips during the growing period, application of organic and mineral fertilizers, pruning, grass mowing in row spacing (sowing of special ground cover grasses) and protection from pests and diseases.

Sweet cherry and cherry trees were sprayed in the experiment (in the phase of plant development at the time of treatments — «fruits development» (fruits have about 90% of the final size — beginning of fruits coloration) (BBCH 81)) and «fruits ripening (fruits coloration continues)» (BBCH 85) with preparation of Aktelik 500 EC, KE; Calypso 480 SC, KS; Movento 100 SC, KS; Proclaim 50 SG, RG; Exirel, CE; Actofit, KE; Bitoxybacilyn — BTU, r. (insecticide) and Lepidocide — BTU, r. (insecticide) at different rates in order to determine the technical effectiveness of insecticides against cherry fly and the effect on productivity indicators.

The choice of these insecticides against cherry fly is explained by the fact that they are included in the current national «List of pesticides and agrochemicals approved for use in Ukraine» [12], have a contact-intestinal effect (Aktelik 500 EC, KE; Calypso 480 SC, KS;

Proclaim 50 SG, RG; Exirel, CE) or high acropetal systemic effect (Movento 100 SC, KS), the duration of their action is 15–20 days [9]. The greatest effect from the use of Aktelik 500 EC, KE; Calypso 480 SC, KS; Proclaim 50 SG, RG; Movento 100 SC, KS against the pest is achieved by using the preparation during the period when the pest is in the phase of «beginning of larval regeneration — larvae of younger ages». Taking into account the latest toxicological requirements for obtaining sweet cherries and cherries, which are primarily a product of dietary and baby food, and the expected increase in the volume of export sales of products to EU countries, the use of insecticides based on the active substance pirimiphos-methyl, 500 g/l (0.8–1.2 l/ha), thiacloprid, 480 g/l (0.2–0.3 l/ha) will be banned in the near future.

The preparation of Exirel, CE (cyantraniliprole, 100 g/l), which recently appeared at the market of Ukraine, has a contact-intestinal effect, the duration its action is two weeks. The active substance of this insecticide is the second representative from the group of anthralinamides (after chlorantraniliprole, which is contained in the insecticide of Coragen 20, KS) and the first active substance from this group with a wide spectrum of action against a complex of sucking, leaf-chewing, and fruit pests [9, 13].

We made a decision to study (clarify) the technical effectiveness of the use of modern biological preparations of Actofit, KE, Bitoxybacillin-BTU, r. and Lepidocid-BTU, r. specifically against cherry fly, since such information on their registration on cherry and sweet cherry in the current national «List...» is absent [12], and there are often positive reviews about the high effectiveness against this hidden-living harmful species in the domestic horticultural literature.

Recordings were carried out according to generally accepted methods in fruit growing, plant protection and entomology [14–15]. Location of plots was randomized. A tree — repetition. The yield of plantations on the experimental

plots was determined on the day of harvesting (the second decade of July), at the same time an analysis of damage of sweet cherry and cherry fruits by cherry fly was conducted. 200 fruits from each recording tree dividing them into damaged and undamaged by this phytophage were analyzed.

Results and discussion. It was established that cherry fly is a permanent harmful species in the coenoses of sweet cherry and cherry plantations. Pupae overwinter in puparia at a depth of up to 5 cm. The emergence of individuals is observed from mid-May («ovary formation and growth, fruit falling after flowering» (BBCH 71) and continues until mid-June («fruits are approximately 60% of final size») (BBCH 76). The beginning of mass egg laying occurs in the phase of «fruits development» (fruits have about 90% of the final size — beginning of fruits coloration») (BBCH 81) at the sum of effective air temperatures of 66°C, starting from the beginning of fly flight (or after 10 — 12 days after the first individuals of the pest are fixed on yellow glue traps) (Fig. 1). After 7–10 days, white legless larvae appear moving to the stone of the fruits and damaging the pulp. Their development continues for

20–30 days. Damaged fruits rotted, part of them (up to 10%) fell.

It was important that during the period of protective measures against cherry fly, settlement and damage of the tree leaves by cherry aphid and the Caliroa cerasi was observed, which required additional protective measures against them. Taking into account the mechanisms of action of the used insecticides of chemical origin, this problem was solved already after the first spraying with Aktelik 500 EC, KE; Calypso 480 SC, KS; Exirel, CE, and two weeks later, the plantations were re-treated with solutions of the following preparations: Calypso 480 SC, KS; Exirel, CE; Proclaim 50 SG, RG; Movento 100 SC, KS. Trees were treated with biological preparations against cherry fly four times during the month, every seven days. A week before treatment with biological preparations, plantations were sprayed against cherry aphids and Caliroa cerasi with the insecticide of Aktelik 500 EC, KE.

Research results indicated that the use of insecticides of Aktelik 500 EC, KE (1.2 l/ha), Calypso 480 SC, KS (0.25 l/ha), Proclaim 50 SG, RG (0.35 kg/ha), Exirel, CE (0.75 l/ha), Movento 100 SC,



Fig. 1. Glue trap for determining the time of flying-out of cherry fruit fly

KS (0.75 l/ha) against cherry fly provided a reduction in the number of the pest in sweet cherry and cherry plantations by 91.4–98.9% — 93.7–97.6%, respectively. This made it possible to obtain high-quality products of sweet cherry and cherry fruits with yields of 1.7–1.9 and 1.4–2.1 times higher, respectively, compared to the control. The output of non-standard products did not exceed 0.4–0.6% against 34.9–44.3% in the control (water treatment). The effectiveness of biological preparations in plantations of these crops did not exceed 32.9–40.4%, which indicated their low effectiveness against cherry fly (Tables 1, 2). High-quality products of sweet cherry and cherry with yields of 1.8–1.9 and 2.0–2.1 times higher, respectively, compared to the control while using modern insecticides of Calypso 480 SC, KS; Exirel, CE; Proclaim 50 SG, RG; Movento 100 SC, KS were obtained.

CONCLUSIONS

Experimental data indicated that the use of insecticides of Aktelik 500 EC, KE (1.2 l/ha), Calypso 480 SC, KS (0.25 l/ha), Movento 100 SC, KS (0.75 l/ha), Proclaim 50 SG, RG (0.35 kg/ha), Exirel, CE (0.75 l/ha) reduced the number of cherry fly in sweet cherry and cherry plantations by 91.4–98.9% — 93.7–97.6%, respectively; and ensured obtaining of high-quality production of sweet cherry and cherry fruits with yields of 1.7–1.9 and 1.4–2.1 times higher, respectively, compared to the control.

The effectiveness of biological preparations in plantations of these crops did not exceed 32.9–40.4%,

1. Effectiveness of preparations against cherry fruit fly in the commercial sweet cherry plantations (EPD UNUH, Regina variety, average of 2020–2022)

Variant	Technical efficacy, %	Yield, t/ha	Fruits marketability, %	
			varietal, %	n/v, %
Control (water treatment)	0.0	3.7	55.7	44.3
I treatment: Aktelik 500 EC, KE, 1.2 l/ha II treatment: Calypso 480 SC, KS, 0.25 l/ha	95.6	5.2	99.3	0.7
I treatment: Aktelik 500 EC, KE, 1.2 l/ha II treatment: Proclaim 50 SG, RG, 0.35 kg/ha	93.7	6.7	99.3	0.7
I treatment: Aktelik 500 EC, KE, 1.2 l/ha II treatment: Movento 100 SC, KS, 0.75 l/ha	94.2	6.9	99.1	0.9
I treatment: Calypso 480 SC, KS, 0.25 l/ha II treatment: Proclaim 50 SG, RG, 0.35 kg/ha	95.9	7.4	99.2	0.8
I treatment: Exirel, CE, 0.75 l/ha II treatment: Exirel, CE, 0.75 l/ha	97.6	7.7	99.4	0.6
Actofit, KE, 6.0 l/ha (IV treatment)	40.4	3.8	86.3	13.7
Bitoxybacilyn-BTU, r., (insecticide), 15 l/ha (IV treatment)	34.3	4.1	84.5	15.5
Lepidocyd-BTU, r., (insecticide), 3 l/ha (IV treatment)	36.9	4.5	84.3	15.7
LSD ₀₅	0.6	0.2	—	—

2. Effectiveness of preparations against cherry fruit fly in the commercial cherry plantations (EPD UNUH, Alfa variety, average of 2020–2022)

Variant	Technical efficacy, %	Yield, t/ha	Fruits marketability, %	
			varietal, %	n/v, %
Control (water treatment)	0.0	3.7	55.7	44.3
I treatment: Aktelik 500 EC, KE, 1.2 l/ha II treatment: Calypso 480 SC, KS, 0.25 l/ha	95.6	5.2	99.3	0.7
I treatment: Aktelik 500 EC, KE, 1.2 l/ha II treatment: Proclaim 50 SG, RG, 0.35 kg/ha	93.7	6.7	99.3	0.7
I treatment: Aktelik 500 EC, KE, 1.2 l/ha II treatment: Movento 100 SC, KS, 0.75 l/ha	94.2	6.9	99.1	0.9
I treatment: Calypso 480 SC, KS, 0.25 l/ha II treatment: Proclaim 50 SG, RG, 0.35 kg/ha	95.9	7.4	99.2	0.8
I treatment: Exirel, CE, 0.75 l/ha II treatment: Exirel, CE, 0.75 l/ha	97.6	7.7	99.4	0.6
Actofit, KE, 6.0 l/ha (IV treatment)	40.4	3.8	86.3	13.7
Bitoxybacilyn-BTU, r., (insecticide), 15 l/ha (IV treatment)	34.3	4.1	84.5	15.5
Lepidocyd-BTU, r., (insecticide), 3 l/ha (IV treatment)	36.9	4.5	84.3	15.7
LSD ₀₅	0.6	0.2	—	—



Damages made by cherry fruit fly

which indicated low effectiveness against cherry fruit fly.

The results of research on the effectiveness of the use of insecticides of Proclaim 50 SG, RG (0.35 kg/ha), Movento 100 SC, KS (0.75 l/ha) and Exirel, CE (0.75 l/ha) against cherry fruit fly give reasons to recommend to the Ministry of Energy and Environmental Protection of Ukraine further registration of these preparations on the cherry with the specified rates and their inclusion in the current national «List of pesticides and agrochemicals permitted for use in Ukraine».

Financing: The research was carried out at the expense of the budgetary topic of the Department of Plant Protection and Quarantine of UNUH (program «0101U004495» Optimal use of natural and resource potential of agro-ecosystems of the Right-Bank Forest-Steppe of Ukraine).

Conflict of interest: the authors declare no conflict of interest.

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Ефективність сучасних інсектицидів у захисті вишнево-черешневих промислових насаджень від вишневої мухи

Мета. Дослідити ефективність дії інсектицидів Актеллік 500 ЕС, КЕ (піриміфос-метил, 500 г/л), Каліпсо 480 SC, КС (тіаклопрід, 480 г/л), Проклейм 50 SG, РГ (емаектину бензоат, 50 г/кг), Мовенто 100 SC, КС (спіротетрамат, 100 г/л), Ексірель, СЕ (циантраніліпрол, 100 г/л) та біопрепаратів Актофит, КЕ (аверсектин С, 0,2%), Бітоксубацілін-БТУ, р., (клітини бактерії *Bacillus thuringiensis*. ендоспори, ендотоксин, екзотоксин), Ленідоцид-БТУ, р., (клітини бактерії *Bacillus thuringiensis* var. *Kurstaki*, ендоспори, ендотоксин) на зниження чисельності та шкідливості вишневої мухи (*Rhagoletis cerasi* L.), показ-

ники продуктивності черешні та вишні в промислових насадженнях. **Методи.** Польові, в промисловому саду черешні та вишні в умовах навчально-виробничого відділу університету. Дерева черешні сорту Регіна та вишні Альфа. Схема садіння — 4 × 5 м. Рік садіння — 1996. Форма крони — розріджено (покращено)-ярусна. Підщепна — сильноросла (антипка звичайна). Фази розвитку рослин в момент обробок — «розвиток плодів (плоди мають приблизно 90% кінцевого розміру — початок забарвлення плодів)» (ВВСН 81) та «достигання плодів (забарвлення плодів триває)» (ВВСН 85). Грунт — неглибокий, малогумусний пилувато-суглинистий опідзолено вилужений чорнозем: вміст гумусу — 1,3–2,5%; рН — 4,8–5,2; рухомих сполук P₂O₅ — 130–180 мг/кг і K₂O — 8,9–9,2 мг/кг (за методом Чирікова). Заходи з догляду за дослідною ділянкою — рихлення ґрунту в пристовбурних смугах упродовж вегетаційного періоду, внесення органічних і мінеральних добрив, обрізування, скошування трави в міжряддях (задерніння міжрядь), захист від шкідників і хвороб. Визначали технічну ефективність препаратів у різних нормах витрат проти вишневої мухи та їх вплив на показники продуктивності черешні та вишні в промислових насадженнях. Обліки проводили за загальноприйнятими в плодівництві, захисті рослин і ентомології методиками. **Результати.** Використання препаратів Актеллік 500 ЕС, КЕ; Каліпсо 480 SC, КС; Проклейм 50 SG, РГ; Мовенто 100 SC, КС; Ексірель, СЕ проти вишневої мухи забезпечило зниження чисельності цього виду в насадженнях черешні та вишні на 91,4–98,9% та 93,7–97,6% відповідно. Це дозволило отримати високосортну продукцію плодів черешні та вишні з урожайністю в 1,7–1,9 і 1,4–2,1 раза відповідно вищою порівняно з контролем. Вихід нестандартної продукції становив 0,4–0,6% проти 34,9–44,3% на контролі (обробка водою). Ефективність біопрепаратів у насадженнях цих культур становила 32,9–40,4%, що свідчить про низьку їхню ефективність проти даного шкідника. **Висновки.** Використання інсектицидів Актеллік 500 ЕС, КЕ; Каліпсо 480 SC, КС; Проклейм 50 SG, РГ; Мовенто 100 SC, КС; Ексірель, СЕ дає змогу ефективно знизити шкідливість вишневої мухи в насадженнях черешні та вишні і контролювати її чисельність упродовж місяця (тривалість розвитку личинок). Обмеження чисельності шкідника в промислових черешнево-вишневих садах за використання інсектицидів забезпечило підвищення врожайності та товарної якості отриманої плодової продукції.

черешня; вишня; насадження; комаха; вишнева муха; інсектициди; біопрепарати; технічна ефективність; врожайність; товарність плодів

Received on 10.02.2023

Accepted for publication: 16.02.2023

Printed and published online:

March 2023