

EFFECTIVENESS OF MODERN INSECTICIDES

in protection of apple planting from blood-red aphids

Goal. To investigate an efficacy of the insecticides Movento 100 SC (spirotetramate, 100 g/l), Sivanto Prime 200 SL (flupiradifuran, 200 g/l) and Transform WG (sulfoxaflor, 500 g/kg) on a reduction of a number and a harmfulness of blood-red aphid (*Eriosoma lanigerum* Hausm.), their impact on yields in commercial apple orchards.

Methods. A field method, in the commercial apple orchards under the conditions of educational production department of Uman National University of Horticulture of the Ministry of Education and Science of Ukraine. A type of apple trees was Golden Delicious. Planting scheme — 4.0 × 3.0 m. Year of planting — 1992. Crown shape — sparsely (improved) — tiered. Rootstock — MM-106. Phases of plant development at application timing — «after blooming, fruit size — up to 20 mm» (BBCH 72) and «development of fruit (fruits about 90% of the final size)» (BBCH 79). 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 to generally accepted methods in horticulture, plant protection and entomology. **Results.** The use of insecticides Movento 100 SC (spirotetramate, 100 g/l), Sivanto Prime 200 SL (flupiradifuran, 200 g/l) and Transform WG (sulfoxaflor, 500 g/kg) against blood-red aphids provided a reduction of this species in the number of 92.8–97.2%. It allowed to obtain a high — grade apple product with a yield of 1.7–1.9 times higher comparing to control. The outcome of non-standard products did

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not exceed 4.9% compare to 24.9% in the control (water treatment). An application of these insecticides allowed to increase the effectiveness of main biometric indicators of trees, namely: the average length of annual shoots, shoot thickness, leaf surface area by 52.4–76.9%, 1.1–1.2 times and 47.9–138.5%, accordingly, which is important for settlement of potential fruit buds and future yields. **Conclusions.** The use of insecticides Movento 100 SC (spirotetramat, 100 g/l), Sivanto Prime 200 SL (flupiradifuran, 200 g/l) Transform WG (sulfoxaflor, 500 g/kg) can reduce effectively the harmfulness of blood-red aphids in apple orchards and control its number during the growing period. A limitation of a number of the current sucking species in apple orchard by using the studied applications provided a yield increase and a marketable quality of the obtained fruit products and the effectiveness of basic biometric indicators of trees, namely: the average length of annual shoots, shoot thickness, leaf surface area, which is important for the potential yields in commercial apple orchards in the next years.

apple tree; planting; insect; blood-red or gray apple aphid; insecticide; technical efficiency; yield; marketability of fruits

According to the State Statistics Service of Ukraine, in 2019 the area of apple orchards was 101.5 thousand hectares, about 1.2 million tons of standard fruit products were harvested with an average yield of 11.8 t/ha [1]. In 2025, the total area of apple orchards will be 144.8 thousand, which will produce at least 2.5 million tons of high quality fruit annually [2].

In apple plantations of Ukraine there are more than 250 species of pests, mites and rodents that weaken the life of cultivated plants during the growing season, in case of absence or untimely protective measures against them, the yield of marketable products is reduced by 18–32% [3].

Injurious species of sucking arthropods, in particular aphids, cause significant damage to apple orchards [3–7]. Blood aphids (*Eriosoma lanigerum* Hausm.) are one of the worst. Currently in Ukraine there is an increase in the area of plantations inhabited by this species, which totals about 100 thousand hectares. The pest inhabits primarily young shoots at the base of buds, petioles of leaves, often — fruit stalks. As a result swellings occur, which then cause cracks and deep ulcers, where bacteria that cause rot settle; adult trees in two to three years suspend fruiting and die [7].

It is worth mention the peculiarities of the biology of this pest: aphid colonies for a long time are covered with waxy fluff (inflow), which complicates the action of the chemical contact method (it is washed away, reduces the duration of contact of insecticide with phytophagan) [5, 7].

It is known that to effectively reduce the number of this pest requires direct contact of the drug with the body of insects for at least 15–20 minutes [4].

Thus, the use of insecticides of contact or contact-intestinal action against this species will be ineffective. In addition, other reasons for the low effectiveness of chemicals from this dangerous object in the apple tree are long-term use of the same drugs, re-

sistance to certain groups of chemical compounds, violation of the technology of their use [3, 4, 7].

Currently, the chemical method of protection using modern insecticides based on new active substances and the mechanism of their action is dominant, and the issue of their rational use to ensure maximum effect with minimal consumption of plant protection products and environmental safety remains paramount. This determined the relevance of the research.

Objective. To study the effectiveness of the insecticides Movento 100 SC, KS (spirotetramat, 100 g/l), Sivanto Prime 200 SL, LCD (flupiradifuran, 200 g/l) and Transform, VG (sulfo-xaflor, 500 g/kg) to reduce the number and harmfulness blood aphid (*Eriosomalaniqerum* Hausm.) in the industrial apple orchards.

Methods. The research was conducted during 2015–2020 in the industrial apple orchards in the conditions of the educational and production department of the university.

The trees variety is Golden Delicious. The lanting scheme os 3.0×1.5 m. The planting year is 1992. Crown shape — sparsely (improved) — tiered. The rootstock is MM-106. The stages of plant development at the time of treatment — «after flowering, size fruit (up to 20 mm)» (BBCH 72) and «fruit development» («fruits have about half of the final size») (BBCH 79). The soil is shallow, low-humus dusty — loamy podzolic leached black soils: humus content — 1.3–2.5%; pH 4.8–5.2; mobile compounds P_2O_5 — 130–180 mg/kg and K_2O — 8.9–9.2 mg/kg (by Chirikov criterion). The measures for care of the experimental site — soil loosening in the stem strips during the growing period, application of organic and mineral fertilizers, pruning, mowing between the rows (row spacing), protection from pests and diseases.

Studies have shown the technical effectiveness of drugs against the blood aphid apple orchards. To do this, the experimental plots were sprayed with trees (in the stage of plant development at the time of treatment — «after flowering, fruit size — up to 20 mm» (BBCH 72) and «fruit development» (fruit about 90% of the final size») BBCH 79) by the insecticides Movento 100 SC, KS (spirotetramate, 100 g/l), Sivanto Prime 200 SL, RK (flupiradifuran,

200 g/l) and Transform, VG (sulfoxaflor, 500 g/kg) at different rates of consumption.

Our choice of these insecticides against blood aphids is explained by the fact that these drugs are primarily designed against latent pests: Movento 100 SC, KS, Sivanto Prime 200 SL, RK are characterized by high systemic action in the acropetal direction of the plant phloem, and Transform, VG in addition to high systemic and transmilar action also at contact can control their number.

Accounts were performed according to generally accepted methods in horticulture, plant protection and entomology [9, 10]. Location of plots is randomized. Tree — repetition. The density of the pest was carried out before treatment and on the tenth day after spraying according to the Henderson and Tilton formula. Biometric indices of trees during the growing season were conducted at the end of the third decade of August.

Research results. It was established that the blood aphid is permanent dominant species in the apple orchards cenosis and has evolved over 8 to 10 generations. Larvae that overwintered on the roots wake up in the spring and move further to the trunk and crown of trees, where with increasing air temperature (up to + 14–15°C) begin to feed intensively (sucking sap from trunks and tree branches). Ehen the new shoots occur (usually the middle — end of May) aphids settle on them (Fig. 1).

According to our research, the number of blood-red aphids during the growing season has two maximums: the first one — the end of May-mid-June (during the intensive growth of shoots in spring) (BBCH 72), the second one — the end of August-mid-September (during the secondary growth of shoots in the second half summer (BBCH 79).

It is important that during the period of protection against blood aphids there are often the extreme conditions for the use of insecticides: high prolonged air temperatures (above + 25°C) and frequent and

prolonged rains (up to 35 mm for 2–3 days), which significantly affects the effectiveness of insecticides [7]. In addition, taking into account the peculiarities of the biology of this pest, aphid colonies have long been covered with a waxy fluff (inflow), which complicates the action of the chemical by contact, the effectiveness of insecticides against phytophagan did not exceed 80%.

In this regard, one of the methods to increase the effectiveness of insecticides against this species, we proposed the use of adjuvant Silvet Gold (0.25 l/ha), which is added to their working solution to improve the effectiveness of pesticides, ensuring maximum wetting of both the upper and lower surfaces of leaves and hard-to-reach places with working solution, regardless of the thickness of the wax layer and hairiness of the plant, the effectiveness of drugs reached 90.5%, which significantly affected fruit quality and yield of apple trees [7].

Application of insecticides Movento 100 SC, KS (2.0–2.25 l/ha), Sivanto Prime 200 SL, RK (0.75–1.0 l/ha) and Transform, VG (0.075–0.1 kg/ha) reduced by 91.4–95.9% the number of blood aphids, which provided an increase in yield and marketable quality of the obtained fruit products (Table 1, Table 2). With the use of new modern insecticides Movento 100 SC, KS, Sivanto Prime 200 SL, RK and Transform,



Fig. Blood-red aphid colonies in industrial apple orchards

VG the high-quality apple products with a yield of 1.7–1.9 times higher than the control were obtained. The yield of non-standard products did not exceed 5.6% against 24.9% in the control (water treatment). With the effective use of these insecticides compared to the control (water treatment), the average length of shoots increases by 52.4–76.9%, the thickness of shoots increases by 1.1–1.2 times, the leaf surface area — by 47.9–138.5%, respectively, which has a positive effect on yields in future years.

CONCLUSIONS

The experimental data show that the use of modern insecticides Movento 100 SC, KS (2.0–2.25 l/ha), Sivanto Prime 200 SL, LCD (0.75–1.0 l/ha) and Transform, VG (0.075–0.1 kg/ha) reduced by 91.4–95.9% the number of blood aphids and provided the increase of yield in 1.7–1.9 times compared to the control of with high marketable quality of fruit products. With the effective use of these insecticides compared to the control (water treatment), the average length of shoots increases by 52.4–76.9%, the thickness of shoots — 1.1–1.2 times, the leaf surface area — by 47.9–138.5%, respectively, which has a positive effect on yields in future years. The results of studies on the effectiveness of Movento 100 SC, KS, Sivanto Prime 200 SL, RK and Transform, VG made it possible to recommend

1. Effectiveness of insecticides against blood aphids in industrial apple orchards (Experimental plot of Uman National University of Horticulture, Golden Delicious variety, (BBCH 72), average 2015–2020)

Nº	Option (drug, rate of consumption per hectare)	Technical efficiency, %
1.	Control (water treatment)	0.0
2.	Bi — 58 new, ie 2.0 l (standard)	77.3
3.	Calypso 480 SC, KS, 0.25 l (standard)	80.4
4.	Bi — 58 new, k.e., 2.0 l + Silvet Gold, 0.25 l (standard)	89.2
5.	Calypso 480 SC, KS, 0.25 l + Silvet Gold, 0.25 l (standard)	90.3
6.	Movento 100 SC, KS, 2.0 l	91.6
7.	Movento 100 SC, KS, 2.25 l	92.5
8.	Sivanto Prime 200 SL, LCD, 0.75 liters	91.2
9.	Sivanto Prime 200 SL, LCD, 1.0 l	92.9
10.	Transform, VG, 0.075 kg	94.7
11.	Transform, VG, 0.1 kg	95.9
	NIP ₀₅	1.5

their inclusion in the current national «List of pesticides and agrochemicals approved for use in Ukraine».

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URL: <http://zakon.rada.gov.ua/>; <http://www.ukrstat.gov.ua/> (in Ukrainian).

2. Concept and sectoral program for horticultural development in Ukraine until 2025 /Ministry of Agrarian Policy. Ukrainian Academy of Agrarian Sciences (order № 444/743 from 21.07.2008) [Electronic resource]. URL: http://www.uaz-akon.com/documents/date_cu/pg_gbwlsl/index.htm (in Ukrainian).

3. Matvievskiy O.S. (Ed.). (1990). Dovidnyk iz zakhystu roslyn i hvorob. [Directory on plant protection and diseases]. Kyiv: Urozhai.256 p. (in Ukrainian).

4. Lisoviy M.P. (Ed.). (1999). Dovidnyk iz zakhystu roslyn. [Directory on plant protection]. Kyiv: Urozhai.744 p. (in Ukrainian).

5. Lapa O.M., Drozda V.F., Shvez M.V. (2004). Zakhyst zernyatkovykh sadiv. [Orchards protection]. Kyiv: Svit, 78 p. (in Ukrainian).

6. Yanovskiy Y.P., Kravets I.S., Krykunov I.V., et al. (2015). Integrovanyi zakhyst plodovykh kultur. Navchalnyi posibnyk. [Integrated protec-

REFERENCE

1. Statystychna informatsiia. Derzhstat Ukrainy, 1998-2020. [Statistical information. State Statistics Service of Ukraine]. 1998-2020.

2. Effectiveness of insecticides against blood aphids in industrial apple orchards (Experimental plot of Uman National University of Horticulture, Golden Delicious variety, (BBCH 79), average 2015–2020)

Variant (drug, rate of consumption per hectare)	Technical efficiency, %	Biometric indices of annual shoots		Surface area of one leaf, cm ²	Yield, t/ha	Product grade, %		
		Average length of shoots, cm	Average thickness of shoots, mm			First grade	Second grade	u/g
Control (water treatment)	0.0	14.3	4.1	11.7	33.2	24.3	50.8	24.9
Bi — 58 new, i.e. 2.0 l (standard)	76.9	15.8	4.3	13.9	40.3	35.6	44.8	19.6
Calypso 480 SC, KS, 0.25 l (standard)	80.1	16.9	4.5	14.4	42.1	36.9	45.7	17.4
Bi — 58 new, k.e., 2.0 l + Silvet Gold, 0.25 l (standard)	86.3	17.4	4.6	15.5	46.7	40.9	42.8	16.3
Calypso 480 SC, KS, 0.25 l + Silvet Gold, 0.25 l (standard)	88.8	20.3	4.6	16.8	50.1	42.1	45.9	12.0
Movento 100 SC, KS, 2.0 l	91.4	21.8	4.7	17.3	56.4	52.3	42.1	5.6
Movento 100 SC, KS, 2.25 l	92.1	22.2	4.8	18.5	59.7	52.9	42.9	4.2
Sivanto Prime 200 SL, LCD, 0.75 liters	91.6	23.7	4.8	21.1	60.3	53.8	43.5	2.7
Sivanto Prime 200 SL, LCD, 1.0 l	93.3	24.1	4.8	24.7	61.1	54.2	43.9	1.9
Transform, VG, 0.075 kg	94.1	24.5	4.8	25.6	60.7	54.1	43.7	2.2
Transform, VG, 0.1 kg	94.9	25.3	4.9	27.9	61.9	54.6	44.2	1.2
HIP ₀₅	1.4	1.7	0.2	1.1	2.2	—	—	—

tion of fruit crops. Tutorial]. Kyiv: Fenix. 648 p. (in Ukrainian).

7. Yanovskyi Y.P. (2016). Uwaga, krovyana popelytsya! Krovyana popelytsya ta zahody obmegennya ii chyselnosti v plodovyyh nasadgenyakh Ukrainy. [Attention, blood-red aphids! Blood-red aphid and measures to limit its number in fruit plants in Ukraine]. *Karantyn i zahyst roslyn*. № 7. 12-14 p. (in Ukrainian).

8. Yanovskyi Y.P. (2019). Dovidnyk iz zakhystu plodovyykh kultur. Navchalnyi posibnyk. [Directory on fruit crops protection]. Kyiv: Fenix. 472 p. (in Ukrainian).

9. Moiseichenko V.F. (1988). Metodika polevogo opytnogo dela v plodovodstve i ovochevodstve. [The method of field trial work in fruit and vegetable growing.]. Kyiv: Vystcha shkola. 73-88 p. (in Ukrainian).

10. Trybel S.O., Siharova D.D., Sekun M.P. et al. (Trybel S.O. Ed.). (2001). Metodyky vyprovuvannia i zastosuvannia pestytsydiv. [Methods of testing and application of pesticides]. Kyiv: Svit. 448 p. (in Ukrainian).

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Ефективність сучасних інсектицидів у захисті яблуневих насаджень від кров'яної попелиці

Мета. Дослідити ефективність дії інсектицидів Мовенто 100 SC, КС (спіротетрамат, 100 г/л), Сіванто Прайм 200 SL, РК (флупірадіфуран, 200 г/л) і Трансформ, ВГ (сульфоксафлор, 500 г/кг) на зниження чисельності і шкідливості кров'яної попелиці (*Eriosoma lanigerum* Haust.), їх вплив на показники продуктивності яблуні в промислових насадженнях. **Методи.** Польові, в умовах промислових садів яблуні навчально-виробничого відділу Уманського національного університету садівництва МОН України. Дерева сорту Голден Делішес. Схема садіння — 4,0 × 3,0 м. Рік садіння — 1992. Форма крони — розріджено(покращено)-ярусна. Підщеп — ММ-106. Фази розвитку рослин в момент обробок: після цвітіння, розмір плоду — до 20 мм (ВВСН 72); розвиток плоду (плоти приблизно 90% кінцевого розміру) (ВВСН 79). Грунт — неглибокий, малогумусний пілувато-суглинистий опідзолено-вильужений 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). Догляд 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 інсектицидів у різних нормах витрат проти кров'яної попелиці та вплив на показники продуктивності яблуні в промислових насадженнях. Обліки проводили за загальноприйнятими в плодівництві, захисті рослин і ентомології методиками. **Результати.** Використання препаратів Мовенто 100 SC, КС, Сіванто Прайм 200 SL, РК і Трансформ, ВГ проти кров'яної попелиці забезпечило зменшення чисельності популяції на 91,4—95,9%. Це дало змогу отримати високосортну продукцію яблук з урожайністю в 1,7—1,9 раза вищою ніж у контролі. Вихід нестандартної продукції не перевищив 5,6% (24,9% у контролі, обробка водою). Застосування інсектицидів сприяло поліпшенню основних біометричних показників дерев, зокрема середньої довжини однорічних пагонів — на 52,4—76,9%; товщини пагонів — в 1,1—1,2 раза; площі поверхні листка — на 47,9—138,5%, що важливо для закладання потенційних плодів бруньок та майбутніх врожаїв. **Висновки.** Використання інсектицидів Мовенто 100 SC, КС, Сіванто Прайм 200 SL, РК і Трансформ, ВГ дає змогу ефективно знизити шкідливість кров'яної попелиці в насадженнях яблуні та контролювати її чисельність упродовж вегетаційного періоду. Обмеження чисельності цього сисного виду в яблуневому саду за використання досліджуваних препаратів забезпечило підвищення врожайності, товарної якості отриманої плодової продукції та результативності основних біометричних показників дерев (середньої довжини однорічних пагонів, товщини пагонів, площі поверхні листка), що важливо для отримання потенційної врожайності промислових насаджень яблуні в наступні роки.

яблуня; насадження; комаха; кров'яна попелиця; інсектициди; технічна ефективність; біометричні показники; врожайність; товарність плодів

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Ефективність сучасних інсектицидів в захисті яблуневих насаджень від кров'яної тли

Цель. Исследовать эффективность действия инсектицидов Мовенто 100 SC, КС (спиротетрамат, 100 г/л), Сиванто Прайм 200 SL, РК (флупирадифуран, 200 г/л) и Трансформ, ВГ (сульфоксафлор, 500 г/кг) на снижение численности и вредоносности кровяной тли (*Eriosoma lanigerum* Haust.) в промышленных насаждениях яблони. **Методы.** Полевые, в промышленных садах

яблони в условиях учебно-производственного отдела Уманского национального университета садоводства МОН Украины. Деревья сорта Голден Делішес. Схема посадки — 4,0 × 3,0 м. Год посадки — 1992. Форма кроны — разреженно(улучшено)-ярусная. Подвой — ММ-106. Фазы развития растений в момент обработки — после цветения, размер плода — до 20 мм (ВВСН 72) и развитие плода (плоды имеют приблизительно 90% остаточного размера) (ВВСН 79). Почва — неглубокий, малогумусный пыле-суглинистый оподзолено-вильуженный чернозем: содержание гумуса — 1,3—2,5%; рН — 4,8—5,2; содержание соединений P₂O₅ — 130—180 мг/кг и K₂O — 8,9—9,2 мг/кг (по методу Чирікова). Мероприятия по уходу за опытным участком — рыхление почвы в пристовольных полосах на протяжении всего вегетационного периода, внесение органических и минеральных удобрений, обрезка, скашивание травы в междурядьях (задержание междурадий), защита от вредителей и болезней. Определяли техническую эффективность препаратов в разных нормах расхода против кровяной тли в насаждениях яблони. Учеты проводили в общепринятых в плодородстве, защите растений и энтомологии методиках. **Результаты.** Применение инсектицидов Мовенто 100 SC, КС, Сиванто Прайм 200 SL, РК и Трансформ, ВГ против кровяной тли обеспечивало снижение численности вида на 91,4—95,96%. Это позволило получить высокосортную продукцию яблук с урожайностью в 1,7—1,9 раза выше чем в контроле. Выход нестандартной продукции не превышал 5,6% (24,9% — в контроле, обработка водой). Применение инсектицидов позволило повысить результативность основных биометрических показателей деревьев, а именно: средней длины однолетних побегов — на 52,4—76,9%; толщины побегов — в 1,1—1,2 раза; площади поверхности листа — на 47,9—138,5%, что важно для закладки потенциальных плодовых почек и будущих урожаев. **Выводы.** Применение инсектицидов Мовенто 100 SC, КС, Сиванто Прайм 200 SL, РК и Трансформ, ВГ позволяет эффективно снизить вредоносность кровяной тли в насаждениях яблони и контролировать ее численность на протяжении всего вегетационного периода. Ограничение численности этого сосущего вида в яблонном саду при применении испытываемых препаратов обеспечило повышение урожайности, товарного качества полученной плодовой продукции и результативность основных биометрических показателей деревьев (средней длины однолетних побегов, толщины побегов, площади поверхности листа), что важно для закладки потенциальной урожайности промышленных насаждений яблони в последующие года.

яблоня; насаждения; насекомое; кровяная тля; инсектициды; техническая эффективность; биометрические показатели; урожайность; товарность плодов

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