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MAIN SUNFLOWER PESTS AND CONTROL OF THEIR NUMBER

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This article highlights the issues of improving and justifying the elements of the sunflower protection system against major pests in the Vinnytsa region. As a result of the conducted entomological monitoring, the most harmful species of phytophagy were found, among which the larvae of blacksmith beetles (true wireworms) and the meadow butterfly were the most numerous. It was noted that in a systematic sense, among the detected larvae, the largest number was observed in the larvae of the Agriotes obscurus L. – 46,3%, a somewhat smaller number was observed in the larvae of Agriotes lineatus L. – 22,1%. The number of the Selatosomus latus F. and the Agriotes sputator L. 12,7% and 12,2%, respectively. The share of other species in the structure was 6,5%.

It was found that when growing sunflower, it was possible to reduce the number of wireworms for the period of full emergence of seedlings by 84% when using the drug Gaucho plus 466 FS, TH (10,5 l/t), 88% when using the drug Semafor 20 ST, t.c.s. (2,5 l/t). The best among the studied insecticides was the drug Cruizer 350 FS, t.c.s. with a drug consumption rate of 10 l/t of seeds, the effectiveness of the drug was 92%. Thanks to seed treatment, the highest yield was obtained when using the drug Cruizer 350 FS, t.c.s. (10 l/t), which allowed to obtain the highest sunflower yield of 2,8 and 3,4 t/ha in 2023 and 2024, while the average yield was 3,1 t/ha.

It was noted that the larvae of the meadow butterfly inhabited the sunflower crop during the growing season. The number of phytophagous caterpillars in sunflower crops before processing in the experimental variants was 7,7–8,1 ekz./m^2, and exceeded the ETH (8–10 ekz./m^2). It was found that the highest technical efficiency (96%) was observed when using the drug Coragen 20 CS, c.s. at a consumption rate of 0,15 l/ha. Effective control of the larvae of the meadow butterfly was observed on all versions of the researched preparations, which contributed to obtaining a higher yield, which was 2,5 t/ha in the control. The variant using the drug Koragen 20, CS at a rate of 0,2 l/ha, provided the highest yield – 3,6 t/ha, which is 1,1 t/ha more compared to the control.

***Key words:** sunflower, major pests, seed poisoning, insecticides, efficiency, yield.*
Table 6. Fig 1. Lit. 15.

Introduction. Sunflower is one of the most important oilseed crops both in Ukraine and in the world. In terms of its distribution, versatility of use and high energy value, it occupies a leading place among other crops. Sunflower provides the highest oil yield per unit area, which makes it extremely effective in cultivation. The production of this crop is profitable in all agro-climatic zones of Ukraine, which further emphasizes its importance for the country's agricultural sector. According to Ukrainian statistics, in 2022, the world production of sunflower seeds amounted to 46.3 million tons, in Ukraine more than 12 million tons, which is 26% of world production. Thus, Ukraine is the world leader in the production of sunflower oil – 4,9-5,5 million tons, with the latter's needs for the domestic market about 0.5 million tons [1].

Sunflower plays a key role in Ukraine's agricultural production, especially as an oilseed crop, but excessive increase in its sown area does have a number of environmental and agronomic risks, Soil depletion, Accumulation of phytophages and diseases, monoculture. Therefore, increasing yields through the use of innovative growing technologies and effective pest protection is a key way to increase profitability without harming the environment.

Technological solutions, such as the use of modern plant protection products, the correct use of fertilizers, monitoring the condition of the soil and observing crop rotation, can significantly increase yields [4].

Sunflower really plays a key role in the agricultural sector of Ukraine. Here are some reasons why this crop is so important: high profitability, adaptability to climate. However, its performance is often limited by the effects of phytophages, such as click beetles and the meadow butterfly. These pests not only reduce yields, but also significantly worsen the quality of seeds, which is reflected in their commercial and sowing characteristics. Crop losses can reach 30%, and in some cases – up to 50% and more [3, 4].

An urgent task of modern agriculture is the improvement of existing methods of pest control and the development of new effective measures to reduce their number. This will not only preserve the harvest, but also increase its quality and the economic efficiency of sunflower production.

Analysis of recent research and publications. The increase in temperature in Ukraine is indeed having a significant impact on agriculture, especially due to the increase in the number of pests. Warmer climatic conditions contribute to the expansion of the distribution range of many pests that previously could not survive in certain regions due to the lack of heat. This, in turn, leads to the fact that insects begin to become more active earlier than usual and damage plants that have not yet had time to get stronger. As a result, crop losses increase [2].

In Ukraine, sunflowers are damaged by almost 90 species of insects, but about 20 of them are of economic importance. Their number and harmfulness fluctuates from year to year and depends on the crop growing zone, soil cultivation method, varieties, hybrids, sowing dates, seed embedding depth, fertilizer application, and meteorological conditions [11].

The most dangerous harmful insects in the early stages of corn development include woodpecker larvae click beetles (family Elateridae, order Coleoptera).

There are about 1,130 species of woodlice (Elateridae) in the world fauna. In Ukraine, researchers have noted 171 species of this family, and their distribution in the natural zones of the country varies. There are 129 species in the Carpathians and Transcarpathia, 82 in the Forest-Steppe, 60 in Polesie, 51 in the Steppe. Among all these species, about 40 are found on arable lands, and 23 species are pests of agricultural crops. It is the click beetles (especially their larvae, known as «wireworms») that are widespread and cause significant damage to cultivated plants. They often damage the root system of plants, which leads to their death [5].

Studies show that the distribution of click beetles on arable lands is closely related to the type of subsoil and vegetation. Wireworms are pests that can cause significant damage to agricultural crops. They overwinter in the soil at a depth of 25–35 to 70–90 cm and emerge to the surface in the spring, when the soil becomes suitable for cultivation. The larvae grow in the upper layer of the substrate (1–8 cm) and begin to actively feed on swollen seeds, young plant shoots, roots and underground. The period is critical, most larvae can cause significant damage to young plants, which can lead to their death.

For the normal development of wireworms, constant humidity of the environment is necessary, without which they die. During the growing season, woodlice larvae make vertical and horizontal movements – migrations associated with the temperature regime and humidity of the soil. At low humidity (12–15 %), the upper layers reasonably move to the lower layers. On black soil, with a decrease in humidity, phytophages do not descend below 30 cm [11].

Phytophagous beetles overwinter in pupal cradles, where after the larval stage they transform into pupae. Pupation occurs in the summer, and the pupal stage lasts approximately 2–2,5 weeks. After this, the young beetles remain in the ground for the winter and emerge. If you have a specific question about this process or about a specific species [6].

The damage that can be caused to cultivated plants by the larvae of pests such as wireworms or the larvae of other insects. They affect the growth and development of plants by damaging underground parts such as roots, stems and diseases.

Sowing becomes less effective, after which they make holes in the seeds, gnaw through the sprouts and damage the root system, which can lead to yellowing, death of young plants or their significant suppression, which ultimately reduces the yield. To combat such pests, a complex of measures is often used: pest treatment before sowing, the use of insecticides, crop rotation and agrotechnical methods that reduce the number of pests at the base [10].

The most common click beetles in Ukraine include: *Agriotes sputator* L., *Agriotes obscurus* L., *Agriotes gurgistamus* Fald., *Agriotes pige* L. and *Selatosomus latus* F.).

The meadow butterfly (*Margaritia sticticalis* L.) belongs to the family Pyraustidae, order Lepidoptera. Cyclic outbreaks of mass reproduction of the meadow butterfly are an interesting object for research in entomology. Systematic data began to appear from the mid-1950s.

According to researchers, 13 outbreaks of reproduction were recorded over 135 years of observations, which indicates a period of approximately 10,5 years. This cyclist coincides with the 11-year cycle of solar activity, which may indicate a connection between fluctuations in solar activity.

Scientists are investigating various factors that can influence the mass reproduction of phytophagous insects, including climatic conditions, changes in ecosystems and the influence of natural enemies. The study of such cycles is important for understanding the dynamics of pest populations and developing effective measures to limit their numbers [7].

Caterpillars feed on aerial parts of plants. At younger ages, they eat the pulp of the leaves, later they roughly skeletonize the leaves, leaving only the veins, gnaw the stems, bite into the middle of the onion leaves, into the baskets of sunflowers, the heads of root crops of beets and carrots, and eat the wrappers and grain in the cobs on corn. The butterfly hibernates in the caterpillar stage of the last instar in cocoons in the soil. Caterpillars in the cocoon can withstand cold temperatures down to -30 ℃, but in the spring during pupation, as well as the pupae themselves, they can die even at slight frosts (less than -1 ℃) [9].

The flight of butterflies in the steppe zone is observed in the first, in the forest-steppe zone – in the second half of May. It usually occurs at a temperature above +15 ℃ and the sum of effective temperatures (more than 10 ℃) about 80 ℃. Mass flight takes place at an average daily temperature above +17 ℃, when the SET is 150-200 ℃. Under adverse weather conditions (periodic cooling, drought) the SET before the start of mass flight can be 350 ℃ [8].

One female can lay from 20 to 600 eggs, and on average – 100-200, their laying usually lasts 7-15 days, and at a temperature below +20 ℃, it is significantly extended. The development of caterpillars depends on temperature and lasts 13-18 days. During this time, they molt 4 times. The optimal temperature for the development of first-instar caterpillars is +25 ℃. High temperatures during the development of caterpillars may not cause noticeable changes in their development, but lead to a decrease in the fertility of females and even to their infertility. Having completed development, the caterpillars crawl into the soil, where they weave cocoons in the earthen cave they have made and after 2-11 days, depending on the temperature, pupate. The pupal stage lasts from 10 to 21 days. The optimal temperatures for pupae are +24-32 ℃ and 75% humidity [7, 9].

During the growing season, the meadow butterfly develops in 1-2 generations, and in the south in warm years there may be a third generation. It is characterized by periodic mass reproduction. The decisive factor in the mass reproduction of this pest is the fecundity of butterflies, which is determined by weather conditions, food quality and other conditions. Migration is also important

The meadow butterfly has two types of migrations: active flight of butterflies (up to 20–25 km) – in search of optimal conditions for offspring; passive settlement – with warm air currents, butterflies are transported over considerable distances (up to 1000 km) [13].

Caterpillars do the most damage during periods of increase in numbers and mass reproduction (with a cycle of 10-12 years). Losses from the settlement of sunflower crops range from 60 to 100% plant death.

The caterpillars live for 14-30 days. In the younger (I-II) age, they feed on the underside of leaves, wrapping them in a thin web, in the older age – openly on plants, eating them whole. Having finished feeding, the caterpillars burrow into the

surface layer of the soil, arrange vertical cocoons there, in which they pupate. The second generation butterflies fly in late June – in July [12].

Materials and methods of research. The research was conducted in the natural and climatic conditions of Vinnytsia district during 2023–2024. The purpose of the research was to study the species composition of the main sunflower pests and assess the effectiveness of measures to control their numbers. Field research was carried out using generally accepted methods adopted in entomological practice. The number of pests was recorded at different phases of crop development, taking into account the bioecological characteristics of harmful objects. [12, 13, 14].

Observations and records. Pests found in sunflower crops were labeled and identified using generally accepted methods using atlases and identifiers. To establish the timing of the appearance and development of pests, insects were collected using various means: glue and pheromone traps, Barber traps, soil excavations, registration sites, as well as the method of mowing with an entomological net.

To determine the species composition of click beetles larvae, they were selected according to the method and determined by external signs. The number of wireworms was determined before sowing sunflower, after the appearance of full shoots and after harvesting, according to the method. For this, 8 counting pits measuring 50x50 and 25 cm deep were dug in each plot (the area of the first pit was 0,25 m^2). The species composition of woodpecker larvae was determined in laboratory conditions using markers.

In addition to counting the number, the damage to the sown seeds and plants was also determined after the emergence of full seedlings. To do this, 5 seedlings were dug up per 20 m of row (1 m in 20 places) and the number of damaged seeds and plants was visually determined.

Soil excavations to detect pests were carried out in the fall after crop harvest (second half of September – October), as well as in the spring before sowing crops.

The number of butterflies is counted during their flight at least once every three days. Walking along the diagonal of the field, the butterflies that rise in front of the counter are counted. Steps and butterflies are counted in 10–15 places of the field at equal intervals (50, 100 steps). If more than 5 butterflies fly away at each step, then the flight should be considered massive, and the counts are not carried out. The average number of butterflies in the field was calculated for ten steps. The intensity of the butterfly flight determined the degree of threat and the feasibility of carrying out protective measures. The presence of caterpillars is determined on 100 plants (5 plants in 20 samples). If caterpillars are detected, their number on the plant per 1 m^2 is determined.

Field experiments were conducted in the Vinnytsa region, during 2023–2024 the species composition of the main sunflower pests and the control of their numbers were studied, which was established according to generally accepted methods adopted in entomology.

Determination of the technical efficiency of insecticides and fungicides for seed treatment and spraying of sunflower crops was carried out in field experiments. Agricultural technology for growing sunflower was generally accepted. Seed treatment with insecticides was carried out the day before sowing. The norms and terms of application of the preparations were determined based on the purpose and objectives of the research, as well as using the «List of pesticides and agrochemicals...» [15].

For seed treatment against woodlice larvae (true wireworms), the following insecticides were used: Cruiser 350 FS, t.c.s. (thiamethoxam, 350 g/l), Gaucho Plus 466 FS, TN (imidacloprid 233 g/l, clothianidin 233 g/l), Semaphor 20 ST, t.c.s. (bifenthrin, 200 g/l) (Table 1).

Records were made from the emergence of seedlings, by the method of soil excavation and plant inspection

Table 1

Scheme of the experiment to evaluate the effectiveness of pesticides for treating sunflower seeds against wireworms on average in 2023–2024

№ p/p	Variant	Consumption rate, kg (l)/t
1.	Control	-
2.	Cruiser 350 FS, t.c.s. (thiamethoxam, 350 g/l)	10,5
3.	Semaphore 20 ST, t.c.s. (bifenthrin, 200 g/l)	2,5
4.	Gaucho plus 466 FS,TH (imidacloprid 233 g/l, clothianidin 233 g/l)	10

source: formed on the basis of own research

The effectiveness of the action of poisoners in reducing the number of pests compared to their number before treatment was calculated according to the formula:

$$Ed = 100 \times (A - B) / A \qquad (2.1)$$

where Ed – reduction in pest density after treatment, %;
A – insect density before treatment, ekz./m^2;
B – insect density after treatment, ekz./m^2.

The size of the plots during field experiments to determine the effectiveness of chemical preparations was 25 m^2, the placement of the plots was randomized, the repetition was 4-fold. The method of applying the preparations was continuous spraying of plants. During the growing season of sunflower plants, the effectiveness of using chemical insecticides for spraying crops against the meadow moth was studied. The treatment was carried out during the period of mass flight of the butterfly.

The consumption norms of insecticides were established in accordance with the «List of pesticides and agrochemicals approved for use in Ukraine» [15]. The working fluid consumption was 300 l/ha (Table 2).

The number of adults after spraying was counted on the 3rd, 7th and 14th day. Observations of the dynamics of emergence of seedlings and analysis of plants for damage by woodlice larvae were carried out in the experimental plots. The effect of treating sunflower seeds with insecticides-protozoa on the density of the wireworm population in the soil was studied. The counts were carried out from the emergence of seedlings to the phase of 2 true leaves of the crop, using the soil excavation method.

Table 2

Scheme of the experiment on the evaluation of chemical efficiency drugs for spraying sunflower crops against the meadow butterfly

№ p/p	Variant	Consumption rate, l/ha
1.	Control	-
2.	Coragen sc20 CS, c.s. (chlorantraniliprole, 200 g/l)	0,15
3.	Decis f-Lux 25 CS (deltamethrin, 25 g/l)	0,3
4.	Engeo 247 SC, CS (lambda-cyhalothrin, 106 g/l thiamethoxam, 141 g/l)	0,18

source: formed on the basis of own research

The effectiveness of insecticides in reducing the number of pests compared to their number before treatment was calculated using the formula:

$$Ed = 100 \times (A – B)/ A \qquad (2.2)$$

where Ed – reduction in pest density after treatment, %;

A – insect density before treatment, ekz./m^2, ekz. /plant;

B – insect density after treatment, ekz./m^2, ekz./plant.

The determination of indicators of economic efficiency of insecticide use was carried out according to the method of S.O. Tribel (2001) [14].

Yield was determined on a 10 m² plot with subsequent conversion to 1 ha.

The data obtained were processed using standard statistical methods using MS Excel software.

Research results. As a result of entomological monitoring conducted in 2023–2024 in the Vinnytsa region, it was found that among the woodlice found in sunflower crops during soil excavations, the following species are most common: *Agriotes obscurus* L., *Agriotes lineatus* L., *Agriotes sputator* L., *Selatosomus latus* F. The analysis of the species composition shows that in a systematic sense, among the detected larvae, the largest number was that of the *Agriotes obscurus* L. – 46,3%, the number of the sow warbler *Agriotes lineatus* L. – 22,1%. The number of the *Selatosomus latus* F.12,2% and the *Agriotes sputator* L. was 12,7% and 12,2%, respectively. The share of other species in the structure was 6,5% (Fig. 1.).

It should be noted that over the years of research, among the identified woodpecker larvae, the majority (93,2%) were *Agriotes obscurus* L., *Agriotes lineatus* L., *A. sputator* L., and *Selatosomus latus*.

Considering the high degree of crop damage by the above-mentioned species, there is a need to use a reliable sunflower protection system against the larvae of click beetles, which should ensure high efficiency. And precisely due to chemical preparations, there is an opportunity to significantly level the difference between the harmfulness of phytophages and obtaining sustainable sunflower crops. Technical effectiveness of insecticides and seed treatments against wireworms. Obtaining high sunflower yields, with significant population of soil-dwelling phytophages, encourages the use of seed poisoning to limit the number of these phytophages. However, in today's conditions, taking into account the environmental situation, there

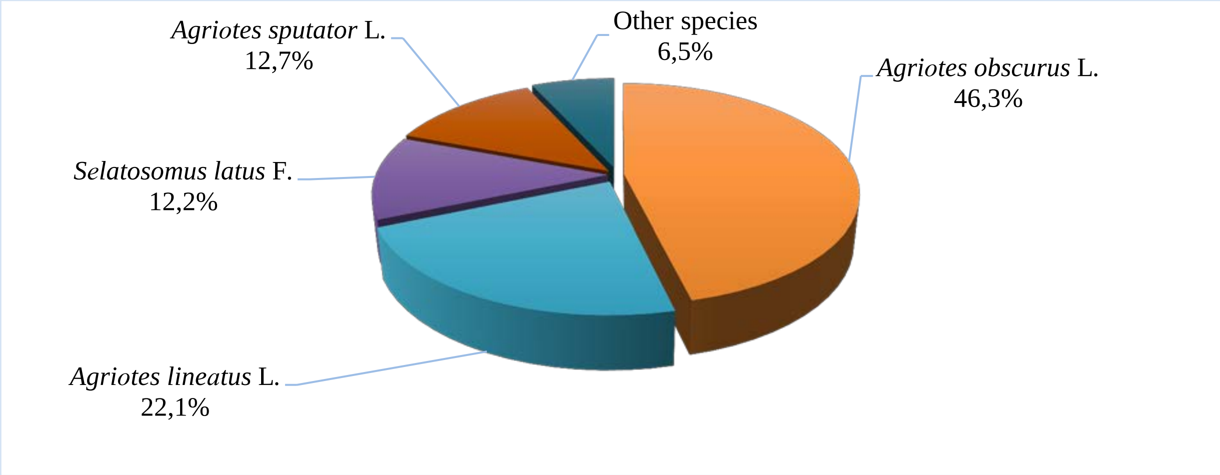

Fig. 1. Species composition of click beetles larvae (wireworms) in sunflower crops (in the conditions of Vinnytsa region, during 2023–2024).

source: formed on the basis of own research

is a need to use drugs that are safe for the environment and have a high long-term effect and safety during use. Therefore, in order to improve the sunflower protection system, it is necessary to use modern long-acting preparations for seed poisoning. The following insecticidal treatments were used in the studies: Gaucho plus 466 FS., Cruizer 350 FS, t.c.s., Semaphor 20 ST, t.c.s. with different active ingredients and mechanisms.

As a result of the research, it was established that during the surveys, soil excavations were carried out to determine the monitoring of the number of soil-dwelling pests in the «2 true leaf» phase, since true wireworms cause the main tangible damage to seeds sown in the soil, seedlings, and young plants.

As a result, it was found that before sowing, the number of pests in various variants was 10–16 ekz./m^2. This necessitated the mandatory treatment of sunflower seeds with insecticides, since the ETH for click beetles larvae is 3–5 ekz./m^2 in Table 3.

It was found that during the period of full emergence of seedlings in the soil of the control variant, the number of wireworms increased – up to 19 ekz./m^2. In variants with the use of insecticidal seed poisoning, the number of woodlice larvae decreased during the same period. When used for pre-sowing treatment of seeds with the pesticide Gaucho plus 466 FS., c.c (10,5 kg/t), only 2,7 ekz./m^2 of the phytophagous pest were detected. When using Semaphor 20 ST, t.c.s. (2,5 l/ha) larvae remained in the soil at 2,2% of ekz./m^2, and when using Cruiser 350 FS, t.c.s. (10 l/t) – 1,5 ekz./m^2. Therefore, the effectiveness of the tested preparations against woodpecker larvae in sunflower crops when applied with insecticidal insecticides was 84, 88, and 92%, respectively, which is explained by the mechanisms of deterrence of the number of phytophages by insecticides. When counting during the harvest period, the number of larvae in the soil increased. Thus, in the soil of the control variant, there were 28 ekz./m^2. In the soil of the variants with the use of pesticides, the number of larvae for the same period was 5–8 ekz./m^2.

Table 3

The number of larvae of click beetles in sunflower crops, average for 2023-2024

Variant	Drug consump tion rate, kg/t, l/t	The number of the pest, ekz./m^2			Effectiveness of insecticide action of poisoners for the period of emergence of full seedlings, %
		until sowing	after full shoots appear	after the harvest	
Control	–	16	19	28	–
Gaucho plus 466 FS, TH	10,5	10	2,7	5,9	84
Semaphore 20 ST, t.c.s.	2,5	14	2,2	8,2	88
Cruiser 350 FS, t.c.s.	10	13	1,5	6,4	92

source: formed on the basis of own research

Thus, it was found that a slight increase in the number of phytophagous larvae during the harvest period on the variants where pesticides were used is explained by the fact that the studied preparations have a long-term effect. The increase in the number of pests after harvest is due to the revival of larvae from the eggs of this year's generation, and in the control – also due to the migrations of click beetles larvae.

Thus, the use of insecticides seed poisoning in the cultivation of sunflower allowed to reduce the number of wireworms during the period of full emergence of seedlings by 84% when using the drug Gaucho, c.c. (10,5 l/t), 88% when using the drug Semafor 20 ST, t.c.s. (2,5 l/t). The best among the studied insecticides was the drug Cruiser 350 FS, t.c.s. with a drug consumption rate of 10 l/t of seeds, the effectiveness of the drug was 92%. It should be noted that the use of insecticides-poisoners had a positive effect on the increase in sunflower seed yield.

When determining the economic efficiency of using insecticides seed poisoning against wireworms, the yield of sunflower was determined on variants with the use of insecticides in relation to the control. The results of these studies are given in Table 4.

As a result of the research, it was found that when growing sunflower without the use of insecticidal pesticides with such a high population of wireworms, on average, 2,5 t/ha of sunflower was obtained over the years of research (2023–2024).

Table 4

Economic effectiveness of using insecticidal poisons on sunflower, for 2023–2024

Variant	Consumption rate, l/t, kg/t	Yield, t/ha			Yield increase t/ha
		2023 p.	2024 p.	Average	
Control	–	2,5	2,0	2,5	-
Gaucho plus 466 FS,TH	10,5	3,0	2,5	2,7	0,2
Semaphore 20 ST, t.c.s.	2,5	3,2	2,6	2,9	0,4
Cruiser 350 FS, t.c.s.	10	3,4	2,8	3,1	0,6
$LSD_{0,5}$		1,1	0,8		

source: formed on the basis of own research

So, thanks to the treatment of seeds with the Gaucho plus 466 FS. TH, c.c. (10,5 kg/t), it was possible to obtain 3,0 and 2,5 t/ha of sunflower seeds in 2023 and 2024 respectively, the average yield of this option reached 2,7 t/ha. When using the drug Semafor 20 ST, t.c.s. (2,5 l/ha), the sunflower yield was higher and amounted to 3,2 and 2.6 t/ha, respectively, with an average over the years of research of 2,9 t/ha. The highest yield was obtained when using the drug Cruiser 350 FS, t.c.s. (10 l/t), which allowed obtaining the highest sunflower yield of 3,4 and 2,8 t/ha in 2023 and 2024, with an average yield of 3,1 t/ha.

Therefore, in order to obtain high sunflower yields when the areas are populated by wireworm larvae, with their number exceeding the EPR by 2,5–5,0 times, the mandatory method is the use of pesticides. With the use of poisoners, the average yield of sunflower during the years of research was 2,5 t/ha. The use of preparations Gaucho plus 466 FS. TH, c.c., (10,5 kg/t), Semafor 20 ST, t.c.s. (2,5 l/ha), Cruiser 350 FS, t.c.s. (10 l/t) for seed treatment allowed to ensure an increase in yield within 0,2–0,6 t/ha.

Control of the number of the meadow butterfly by spraying sunflower plants.

When conducting the accounting, it was established that the sunflower crops were inhabited by the meadow butterfly throughout the growing season, which had a significant negative impact on obtaining sustainable crops. Therefore, the research provided for the use of sunflower crop treatment against this phytophagous insect.

Spraying of sunflower plants with insecticides against the meadow butterfly was carried out based on the data of monitoring the number of pests (route surveys, use of troughs) and phenological observations.

Spraying sunflower crops with insecticides was carried out during the emergence or mass appearance of caterpillars, which was from mid-June to the end of July-August (usually 2-3 weeks after the start of the butterflies' flight). That is why the use of drugs during this period showed maximum effectiveness.

During the development of the sunflower protection system against the meadow butterfly in 2023-2024 chemical preparations were used: Decis f-Lux 25 ES, CE (deltamethrin, 25 g/l) with a consumption rate of the drug of 0,3 l/ha and 0,5 l/ha; Engeo 247 SC, CS (lambda-cyhalothrin, 106 g/l + thiamethoxam, 141 g/l) with a consumption rate of 0,18 l/ha and 0,20 l/ha; Coragen 20, CS (chlorantraniliprole, 200 g/l) with a drug consumption rate of 0,15 l/ha and 0,2 l/ha.

As a result of the records, it was found that in 2023–2024, the number of meadow butterfly caterpillars in sunflower crops before treatment in the experimental variants was 7,7–8,1 ekz./m^2, and exceeded the ETH (8–10 ekz./m^2). After treatment on the 3rd day in the control variant, the number of meadow butterfly caterpillars was at the level of 8,8 ekz./m^2, while in areas where insecticides were used, the number of phytophagous insects decreased to 0,3–0,6 ekz./m^2 (Table 5). It was found that the highest technical efficiency (96%) was observed when using the drug Coragen 20 CS, c.s. at a consumption rate of 0.15 l/ha. Slightly lower efficiency was provided by the drug Engeo 247 SC, CS, c.s. 0,18 l/ha was 95%, the efficiency of the Decis f-Lux 25 ES, KE, c.e. (0,3 l/ha) was at the level of and 93%, respectively.

Table 5

Technical efficiency of insecticides against caterpillars of the meadow butterfly (*Margaritia sticticalis* L.) in sunflower crops (average, 2023-2024)

Variant	Rate, g, l/ha	before spraying, copies/100 plants	… days after spraying, ekz./m^2			technical effectiveness on ... day after spraying, %		
			3	7	14	3	7	14
Control	-	8,1	8,8	12,8	16,8	0	0	0
Coragen 20 CS, c.s.	0,15	7,7	0,3	1,7	4,5	96	87	73
Decis f-Lux 25 ES, c.e.	0,3	8,0	0,6	2,3	5,2	93	82	69
Engeo 247 SC, c.s.	0,18	7,9	0,4	1,9	4,7	95	85	72

source: formed on the basis of own research

In all variants, the studied drugs effectively restrained the larvae of the meadow butterfly.

When conducting records on the 7th day after spraying, it was found that the number of phytophagous larvae increased (in the control 12,8 ekz./m^2), reducing the technical efficiency of the preparations in all variants of the experiment. The most effective in restraining the larvae of the meadow butterfly (87,0%) was the use of the drug Coragen 20 CS, c.s. at a rate of 0,15 l/ha. Slightly lower technical efficiency (85,0%) was provided by the drug Engeo 247 SC, CS, c.s. at a rate of 0,18 l/ha, when using the drug Decis f-Lux 25 ES, KE, c.e. with a consumption rate of 0,3 l/ha, the efficiency was at the level of 82%.

Records conducted on the 14th day after spraying revealed that the highest level of pest control was provided by the drug Coragen 20 CS, c.s. at a consumption rate of 0,15 l/ha, the technical efficiency of which was at the level of 73,0%. The drug Engeo 247 SC, CS, c.s. at a rate of 0,18 l/ha was somewhat inferior to it – 72,0%. The lowest technical efficiency of controlling meadow moth caterpillars (69,0%) was found when using the drugs the Decis f-Lux 25 ES, KE, c.e. with a consumption rate of 0,3 l/ha. So, it should be noted that the use of insecticides that were studied showed high efficiency in controlling caterpillars of the meadow butterfly. The most effective was the use of the studied drug Coragen 20 CS, c.s. at a consumption rate of 0,15 l/ha, where the efficiency was at the level of 96–73%. The drug Engeo 247 SC, CS, c.s. at a rate of 0,18 l/ha was 95–72%. Somewhat less efficient was the variants where the drug Decis f-Lux 25 ES, KE, c.e. was used. with a consumption rate of 0,3 l/ha – 93–69%, however, it should be noted that the studied drugs provided a high level of control of phytophagous larvae throughout the entire period of crop cultivation.

It should be noted that spraying sunflower crops from meadow moth caterpillars with insecticides had a positive effect on the indicators of individual plant productivity. In all variants, when using all insecticides, the mass of seeds from 1 basket increased by 11,4–14,6 g and the mass of 1000 seeds by 2,5–4,0 g compared with the control variant (Table 6). It was also noted that over the years of research, spraying sunflower crops with the research preparations had a positive effect, which contributed to obtaining a higher yield, which in the control was 2,5 t/ha.

Table 6

Yield of sunflower seeds depending on options for crop protection (average for 2023–2024)

Variant	Weight of seeds from 1 basket, g	Weight of 1000 seeds, g	Yield		Oil yield, t/ha
			t/ha	Growth compared to control, %	
Control	65,8	55,0	2,5	-	1,19
Coragen 20 CS, c.s.	80,4	58,4	3,6	1,1	1,62
Decis f-Lux 25 ES, KE, c.e.	77,2	57,5	3,3	0,8	1,55
Engeo 247 SC, CS, c.s.	79,7	59,0	3,5	1,0	1,60
$LSD_{0,5}$		0,10			

source: formed on the basis of own research

The highest yield was recorded in the variant using the drug Coragen 20 CS, c.s. at a rate of 0,2 l/ha, which ensured obtaining a yield of 3,6 t/ha, which exceeded the yield in the control by 1,1 t/ha.

After analyzing the effectiveness of the studied measures, it was found that the oil yield from the options where sunflower crops were treated against the meadow butterfly was 1,55–1,62 t/ha, which is 0,36–0,43 t/ha higher than the similar indicator of the plot without insecticidal protection.

The best option was the one with the use of Coragen 20 CS, c.s. (0,2 l/ha), the oil yield was 1,62 t/ha. The protection of sunflower crops contributed to the best growth and development of the culture, obtaining a high yield of seeds with a high oil content.

Conclusions. As a result of the research carried out in Vinnytsa region, the species composition of pests was clarified, the most harmful species (larvae of click beetles, the meadow butterfly) in sunflower agrobiocenosis were identified, and the effectiveness of chemical protection of sunflower from pests was studied.

It was found that when growing sunflower, it was possible to reduce the number of wireworms for the period of full emergence of seedlings by 84% when using the drug Gaucho plus 466 FS, TH (10,5 l/t), 88% when using the drug Semafor 20 ST, t.c.s. (2,5 l/t). The drug Cruiser 350 FS turned out to be the best among the studied seed poisoning with a drug consumption rate of 10 l/t of seeds, the drug efficiency was at the level of 92%. Due to seed poisoning, the highest yield rate was obtained when using the drug Cruiser 350 FS, t.c.s. (10 l/t), which allowed obtaining the highest sunflower yield of 2,8 and 3.4 t/ha in 2023 and 2024, with the average yield being 3,1 t/ha.

It was found that during the growing season of the crop, sunflower crops were inhabited by the larva of the meadow butterfly. The number of caterpillars of the phytophagous moth in sunflower crops before treatment in the experimental variants was 7,7–8,1 ekz./m^2, and exceeded the ETH (8–10 ekz./m^2).

It was established that the highest technical (96%) was observed when using the drug Coragen 20 CS, c.s. at a consumption rate of 0,15 l/ha. In all variants of the study, the drugs effectively restrained the larvae of the meadow butterfly, which contributed to obtaining a higher yield, which in the control was 2,5 t/ha. The highest yield was recorded in the variant using the drug Coragen 20 CS, c.s. at a rate of 0,2 l/ha, which ensured a yield of 3,6 t/ha, which exceeded the yield in the control by 1,1 t/ha.

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АНОТАЦІЯ

ОСНОВНІ ШКІДНИКИ СОНЯШНИКУ ТА КОНТРОЛЬ ЇХ ЧИСЕЛЬНОСТІ

В даній статті висвітлено проблематику що полягає в удосконалені і обґрунтовані елементів системи захисту соняшника від основних шкідників в умовах Вінницької області. У результаті проведеного ентомологічного моніторингу виявлено найбільш шкодочинні види фітофагів, серед яких найбільш численними були личинки коваликів (справжні дротяники) та лучний метелик. Відмічено, що в систематичному відношенні серед виявлених личинок найбільша кількість спостерігалась личинок ковалика темного – 46,3 %, дещо менша чисельність була у личинок ковалика посівного –22,1%. Чисельність ковалика смугастого та ковалика широкого становила12,7% та 12,2 %, відповідно. Частка інших видів становила в структурі 6,5%.

Встановлено, що при вирощуванні соняшнику дозволило знизити чисельність *дротяників на період повної появи сходів на 84% при застосуванні препарату Гаучо, з.п. (10,5 л/т), 88% при застосуванні препарату Семафор 20 ST, т.к.с. (2,5 л/т). Найкращим серед досліджуваних протруйників виявився препарат Круізер 350 FS, т.к.с. з нормою витрати препарату 10 л/т насіння ефективність препарату була на рівні 92%. Завдяки протруєнню насіння найвищий показник врожайності було отримано при застосуванні препарату Круізер 350 FS, т.к.с. (10 л/т), що дозволило отримати найвищий врожай соняшнику 2,8 та 3,4 т/га у 2023 р. та 2024 р., при цьому середня врожайність становила – 3,1 т/га.*

Виявлено, що упродовж вегетації культури посіви соняшнику заселяла личинка лучного метелика. Чисельність гусениць фітофага в посівах соняшника до обробки у дослідних варіантах становила 7,7–8,1 екз./м^2, і перевищувала ЕПШ (8–10 екз./м^2,). Встановлено, що найбільшу технічну (96 %) було відмічено при застосуванні препарату Кораген 20 к.с. за норми витрати 0,15 л/га. На усіх варіантах досліджуючих препаратів спостерігалось ефективне стримування личинок лучного метелика, шо сприяло отриманню вищої урожайності, яка на контролі становила 2,5 т/га. Варіант із застосуванням препарату Кораген 20, КС у нормі 0,2 л/га забезпечив найвищу урожайність — 3,6 т/га, що на 1,1 т/га більше порівняно з контролем.

***Ключові слова**: соняшник, основні шкідники, протруєння насіння, інсектициди, ефективність, урожайність.*

Табл. 6. Рис. 1. Літ. 15.

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