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# CONTROL OF THE OF MAIN PESTS OF WINTER OILSEED RAPE IN THE CONDITIONS OF VINNYTSIA REGION

***NINA RUDSKA**, Candidate of AgriculturalSciences, senior theacher,*
***OLEKSII ZABARNYI**, candidate of Agricultural Sciences, Seeds marketing manager BASF T.O.V. LLC*
*Vinnytsia National Agrarian University*

*This article highlights the issue of improved and substantiated elements of the winter oilseed rape protection system against main pests in the Vinnitsa region, which is based on clarification of the species composition of phytophagy in winter oilseed rape, their harmfulness and limiting their numbers when applying seed treatment with insecticides and poisoners. spraying crops with drugs during the growing season of the crop.*

*The species composition of the harmful entomofauna of winter oilseed rape was clarified and 22 species of insects belonging to 6 orders and 16 families were identified. The largest species diversity is characterized by the number of Coleoptera, the share of species of which was 60,2% of the total. The effectiveness of modern insecticides of poisoners against pests of winter oilseed rape and optimized methods of their application were evaluated. It has been established that the highest technical efficiency of insecticide poisoners is noted in versions with poisoners with mixtures of Force 200 SC + Cruiser 350 FS, consumption rate of 1,0+2,0 l/t. and Cruiser 350 FS, w.s.c. at the full consumption rate of 4,0 l/t is a highly effective method of controlling the number of cruciferous fleas. Initial efficiency during the first three days after emergence was 92,0% and 90,5%.*

*During the growing season of winter rape during the testing of insecticides, the highest technical efficiency – 93,3% for spraying rape seedlings against cruciferous fleas was shown by Confidor 20%, w.s.c. Confidor, 20% of the national capital, it provided technical efficiency at the level of 95,3%. This ensured a yield of 3.46 t/ha, and the yield increase was conventionally 0,53 t/ha of the crop.*

***Key words:** winter oilseed rape, phytophagous, harmfulness, insecticides, efficiency, yield, Force 200 SC.*
***Table 6. Fig 1. Lit. 15.***

**Introduction.** Winter oilseed rape (WOSR) is a high-margin, export-oriented bioenergy crop that provides a sufficient level of profit if cultivation requirements are carefully followed. For Ukrainian producers, winter oilseed rape products provide an opportunity to take better positions in the global rapeseed market, as European countries are reducing rapeseed crops, while the demand for products does not remain at a high level.

In recent years, the situation on the world winter oilseed rape market shows a trend towards an increase in gross harvests. Over the past 10 years, the production of rapeseed on a global scale has increased by 45% and amounted to 73,09 million tons. According to the reports of the US Department of Agriculture, the main countries producing rapeseed are the EU countries with a gross harvest of 20,5 million tons, Canada – 19,6 million tons, China – 13,5 and India 7 million tons, respectively. The total level of world trade is 15,9 million tons, 70% of which is provided by Canadian production. Import demand by the production of China, Japan and EU countries is steadily growing [1].

On the world market, Ukraine occupies a worthy place among rapeseed producers. The results of activities for 2021/2022 show that our state supplied 1,2 million tons of rape to the world market. The countries of the European Union are the main export market for the Ukrainian oil industry, which accounts for 98% of its total volume, which confirms the high level of demand for rapeseed products.

Analyzing the balance of rapeseed oil in Ukraine in recent years, it is worth noting that its production varies from year to year. According to UCAB forecasts, the level of profitability of rapeseed production will decrease significantly and in 2022 will decrease to almost 200,000 hectares, amounting to 1.1 million hectares compared to 1.3 million hectares a year earlier (-15%). Dry weather conditions in a number of oblasts prevented the sowing of crops on the planned scale and the military situation in a number of oblasts at the optimal time.

Over the past ten years, the average yield of winter rape in Ukraine is within 1,70–2,79 t/ha. It was the highest in 2019 and amounted to 2,79 t/ha [2].

Along with this, Ukraine, which has been the main supplier of oilseed rape to the European Union in recent years, has itself reduced its production by about 0.5 million tons. The next ones who can take the first positions in the sale of rapeseed are Australia and Canada. Current estimates indicate that crop imports from Canada to the EU could be up to 1,9 million tones. However, there is some uncertainty and a number of factors that could affect this. For example, this includes the trade conflict between China and Canada, difficulties related to the status of genetically modified Canadian canola, and France's decision to ban the use of herbicide-resistant Clearfield canola varieties [1, 3].

Considering the value of winter oilseed rape and the low level of agricultural management in modern conditions, the issue of protecting this crop from harmful organisms is acute. In particular, if protective measures against the main phytophagous are not carried out in a timely manner, the yield of seeds decreases by 30–40%. Significant losses are caused by insects that damage seedlings and generative organs. Such in the forest-steppe zone, where the Vinnitsa region is located, is a complex of cruciferous fleas and a common pollen beetles.

The need to clarify the entomocomplex of the rape agrocenosis, the features of the ecology of the main types of pests, the improvement of methods and measures to protect the culture from them in the conditions of modern cultivation technology determined the priority of the research direction and their relevance.

**Analysis of recent research and publications.** Winter oilseed rape (*Brassica napus* L.) is an oil crop that belongs to the cabbage family (Brassicaceae), which includes a significant number of other cultivated plants. Dangerous pests of plants of this family include cruciferous fleas (Phyllotreta family), *Plutella maculipennis* Curt., *Brevicoryne brassicae* L., *Pieris brassicae* L., *Pieris rapae* L., *Synchloe daplidice* L., as well as *Meligethes aeneis* F. In some years, the harmfulness of bugs increases – *Eurydema oleracae* L., *Eurydema ornata* L., *Athalia colibri* Christ., *Phytometra gamma* L. [5].

Cabbage seed crops are actively colonized by the *Ceuthorrhynchus assimilis* Payk., the *Evergestis frumentalis* L., and the *Amara similata* Gyll. In general, the list of phytophagous insects found during the growing season includes more than 100 species. Since their range captures the places of cultivation of plants from the cabbage family, this threatens to obtain stable profits when growing these crops in many regions.

Canada is the world leader in winter oilseed rape cultivation. A widespread pest of cabbage crops in this country is the cabbage moth. Canadian scientists also emphasize the high adaptive abilities of this pest, which certainly affects its spread and harmfulness. Gooses, biting the «window» in the leaves, are able to reduce the potential yield of winter rapeseed plants by almost 2 times.

It is known that the rape agrocenoses of Central Europe are damaged by more than 20 specialized pests. Thus, the observations of polish researchers established that in the phase of budding, at the number of 12 *Meligethes aeneus* F. beetles per 100 buds, the loss of seed yield is 74%, and when one plant is inhabited by 5 cruciferous bugs – 49, 5%.

In the Republics of the Czech Republic and Slovakia, the most widespread pests of oilseed rape are considered to be *Ceuthorrhynchus assimilis* Payk., cabbage whitefly (*Pieris brassicae* L.) and cabbage scoop (*Mamestra brassicae* L.). However, the most dangerous among them was the *Meligethes aeneus*. Observations of the development of this phytophage on cabbage crops indicate that in the conditions of the specified countries this phytophagy has one generation. Although the development of the second generation is possible in warm weather. Beetles hibernate in the soil, in forest strips under fallen leaves, and after hibernation appear in April, when the soil temperature reaches +5°C. At first, they feed on pollen on the inflorescences of weeds and trees. With the appearance of buds on cabbage crops, they intensively populate them.

The records of insects on cabbage crops in Latvia revealed 94 species, and 15 pests of these crops were noted for the first time. In Romania, the vegetative organs of oilseed rape are damaged by a large number of pests, among which the *Phyllotreta nemorum* L. and black cruciform flea beetle (*Phyllotreta cruciferae* Goeze.), cabbage moth (*Plutella maculipennis* Curt.), cabbage borer (*Mamestra brassicae* L.). On the territory of this country, there are also other phytophages of the mentioned oil crops, primarily the *Entomiscelis adonidis* Pall. and *Colaphellus hofti* Men., *Ceuthorrhynchus assimilis* and *Meligethes aeneus* F.

In Germany, the *Ceuthorrhynchus assimilis* Payk. is widespread in oilseed rape crops, its females lay eggs on the petiole of a leaf, and the reborn larvae mine the stems. During the flowering period, the rapeseed gnat (*Contarinia nasturtii* Kieff.) appears on the crop and lays its eggs in the holes formed as a result of damage by the *Ceuthorrhynchus assimilis* Payk. This leads to premature cracking of pods and shedding of seeds, resulting in yield losses of up to 23%. A rather diverse entomocomplex on cabbage plants in China, which includes 58 species, of which 39 are phytophagous, and 19 are predatory insects.

In Ukraine, among 40 species that damage cabbage crops, a number of researchers single out cruciferous fleas, cabbage aphids, rape flower borer, mustard and rape whiteflies, cabbage borer and rape sawfly [4, 5].

Damage caused by cruciferous bugs in the rosette phase is dangerous, as plants can be weakened by cruciferous scales during this period. Their harmfulness depends significantly on weather conditions. In dry hot weather, the need to maintain the water balance of the insect's body increases, which in turn is achieved due to more frequent stings of the stem. Under such conditions, there is a possibility of complete death of crops, as the number of bedbugs in some years reaches 300–400 ekz./m$^2$ .

In some years, crops of cabbage crops are damaged by the cabbage moth, which is spread almost all over the world. Mass reproduction of the cabbage moth is periodically observed in the Southern regions of Ukraine. In some fields, in years the density of caterpillars was 750–2000 ekz./m$^2$, and even more. As a result, the crops had damage of a continuous nature [11].

The *Meligethes aeneus* eater was found singly on winter oilseed rape and had no economic significance. However, at the end of the 90s of the last century, as a result of the expansion of the area, a rapid increase in its number began. From 1999 to 2018, the average number of phytophagous was 18 ekz./m$^2$, and in 2020 it reached 4 ekz./plant.

In the course of observations of the seasonal dynamics of the harmful entomofauna of the rapeseed agrocenosis, it was established that the number of insects changes markedly according to the phytophagous of development. Colonization of crops by pests begins in the 2nd–3rd decade of April. The first to appear are cruciferous fleas (Eurydema spp.) on the stairs. Rapeseed leaf beetle (*Entomoscelis adonidis* Pall.) and painted bug appear (*Eurydema ventralis* Kol., *E. oleracea* L., *E. ornata* L.) on crops during the seedling period – rosettes, at the same time the summer of cabbage moth butterflies begins (*Plutella maculipennis* Curt.).

During the flowering period, the winged parthenogenetic females of the cabbage aphid appear (*Brevicoryne brassicae* L.) on the crops. The latter form colonies on inflorescences and young pods.

In addition to the fact that during the growing season, plants from the cabbage family (Brassicaceae) are inhabited by a whole complex of oligophages species, they are harmed by some polyphages, in particular wireworms, *Scotia segetum* Schiff. A significant threat to rape crops in this zone is the rape sawfly, the rape leaf eater, two species stand out among the most dangerous pests: – cruciferous fleas (Eurydema spp.) and common pollen beetles (*Meligethes aeneus* F.). Despite the annual, repeated treatment of rapeseed crops with insecticides, the number of these pests remains consistently high [5].

Generative organs of rape are damaged by the common pollen beetles (*Meligethes aeneus* F.). Flower-eating adults cause significant damage to buds and flowers. Regarding the harmfulness of cabbage crops on plants, there are two opposing opinions in the literature. Some consider the rape flower eater one of the most dangerous pests of cabbage, others – on the contrary, deny the harmfulness of this species. It was established that the larvae of the flower eater feed exclusively on pollen and only in the absence of food do they damage the petals of the bud.

However, in the Mykolayiv region, the most dangerous pest of rape seed crops is the common pollen beetles (*Meligethes aeneus* F.), as well as the rape sawfly (*Athalia rosae*). In modern conditions, the phytophagous plant threatens crops that are in the phase of budding or flowering. In this period, the population of crops by the pest can reach 94%, and the maximum number on one plant is 9 specimens. Rapeseed sawfly damages crops during the flowering phase – the formation of pods. At the same time, the population can be 40% with 3 false caterpillars per plant.

Aphids are dangerous insects that damage agricultural plants. In mass numbers, they significantly reduce the yield of crops, and under favorable conditions of development, they are able to completely destroy crops. In addition, they are carriers of viral plant diseases. Thus, cabbage aphids can carry the mosaic virus (TMV) on oilseed rape crops. Cabbage aphid (*Brevicoryne brassicae* L.) is widespread in the territory of the right-bank forest-steppe [6].

It was established that in the conditions of the right-bank forest-steppe of Ukraine, the development of the cabbage aphid occurs in the spring on wild cabbage plants. Under favorable conditions, they multiply quickly, as one female gives up to 2,500 individuals during the growing season, as a result of which the yield decreases by 30–40% [6].

However, the literature data regarding the species composition of winter oilseed rape pests are incomplete and refer to cabbage crop pests in general.

*Measures to protect winter oilseed rape crops from phytophagous.* Analysis of literary sources shows that the need to protect oilseed rape crops from pests arose at the beginning of the last century. A decisive role in the complex of measures to protect cultivated plants from pests was played by the chemical method, which was based on the use of typical poisonous substances of gastric action: sodium arsenic acid, calcium arsenic acid, calcium arsenate, paris greens, etc. [7].

In the middle of the last century, the search for methods that would allow not to destroy pests, but to prevent their mass appearance, began. Such methods were called preventive, and their improvement was further developed thanks to the works of other authors. First of all, measures aimed at comprehensive control of winter oilseed rape pests were developed. These should include the following preventive measures: pre-sowing treatment of seeds, since some dangerous phytophages can spread with seeds, especially thin and underdeveloped ones, pre-sowing treatment of marginal strips, as well as processing of marginal strips immediately after the full emergence of seedlings and processing of crops during the growing season [8].

Therefore, during this period, the protection of winter oilseed rape was mainly based on the chemical method, excluding almost all other techniques. Such a tendency was the carrier of the anti-ecological manifestation of the use of insecticides, creating prerequisites for the development of negative processes: the appearance of resistant populations in harmful organisms, a decrease in the effectiveness of drugs, environmental pollution. Such consequences of the «pesticide syndrome» call for the need to find an alternative strategy for plant protection based on the economic thresholds of harmfulness of the main plant phytophagous.

An important place in the integrated protection of winter oilseed rape from pests belongs to the chemical method, one of the technologies of which is pre-sowing seed treatment – the most rational way of using pesticides. Its essence lies in the ability of chemicals to penetrate through the seed coat and the root system of sprouts into plant tissue, due to which the seedlings of agricultural crops become toxic to harmful organisms.

The seeds were treated before sowing, which gave a positive result in some cases. Thus, during seed treatment with the gamma isomer of hexachloran, damage to plants did not exceed 8%. At the same time, it should be noted that the terms of processing seeds and their sowing are important. Thus, when treated one month before sowing, damage to plants by cruciferous fleas is observed 2,5–3,0 times less than when treated 3 days later. Processing of marginal strips was also carried out.

The constant damage of dominant phytophagous on rapeseed can be explained by the lack of effective entomophagy in these pests, which necessitates its protection. In the case when the number of pests exceeds the EPS, ground spraying with insecticides is carried out: 1st treatment of rape seedlings against pests of seedlings, 2nd in the phase of budding against pests of generative organs [14].

The technical efficiency of Vantex 60 with a rate of 0,04 l/ha against cruciferous fleas within five days was 89,5–100%. Spraying rape seedlings in the conditions of the Cherkasy region with the insecticide Sumi-alpha at a rate of 0,3 l/ha allowed to reduce the number of these phytophagous by 90,7% from 31 ekz./m$^2$ to 3 ekz./m$^2$ [11, 13].

In the Czech Republic, the effectiveness of controlling the number of *Meligethes aeneus* F. with the help of the pyrethroid drug Nerамethrin or its mixture with Aktelik after two days was 77,7–81%, which is significantly lower than the effectiveness of Fastak and Tsimbush. Observations were made on the activity and changes in the population density of oilseed rape beetles and stem borer beetles.

In Poland, the technical efficiency of Decis insecticide is 2,5% c.e. it is 89,1 against splendor, and 99% of the yield increase against sedum was up to 3,2 t/ha.

The timing of measures to protect crops from pests has a significant impact on the yield and quality of seeds. If protective measures against phytophagous are not carried out in a timely manner, crop losses can reach an average of 25–35%, especially from pests of seedlings and generative organs [8].

The most dangerous pests can be conditionally divided into three groups: those that feed during the seedling period, those that harm during the stemming period, and pests of generative organs. The first group includes cruciferous fleas (Eurydema spp.). In years of mass reproduction, their beetles completely destroy oilseed rape crops. During the growing season of the crop, the leaves are damaged by the canola sawfly (*Athalia rosae* L), and the stems are damaged by the larvae of the cabbage stem borer (*Ceuthorrhynchus pallidactylus*). Generative organs are damaged by the common pollen beetles (*Meligethes aeneus* F.), the cabbage midge (*Dasineura* *brassicae* Winn.), the hidden seed beetle (*Ceuthorrhynchus assimilis*), the cabbage aphid (*Brevicoryne brassicae* L.), and a number of bugs.

Currently, it is not possible to grow winter oilseed rape without active protection against pests, so attention should be paid to improving the chemical method of protection. The priority direction is the improvement of the protection system due to updating the range of insecticides.

**Materials and methods of research**. Study of the entomocomplex and features of its formation in the oilseed rape agrocenosis. Research on the species composition of arthropods was conducted using the basic methods adopted in entomological research [8, 12].

During the growing season of winter oilseed rape, the conducted research was aimed at studying the peculiarities of the formation of the entomocomplex, accounting for the number of harmful insects, observing the phenology of the most dangerous phytophagy, the structure of their population was determined at certain stages of plant organogenesis.

The material was collected once every 10 days in the period from April to August. The population count and taxonomic dependence were established using descriptions and identifiers [12].

During the study of the number of the most dangerous phytophagous on winter oilseed rape depending on the distance to the edge of the field, glue traps were used. They were made of sticky, yellow paper measuring 300x210 mm smeared with entomological glue «Pestifiks». Experiments were laid in four repetitions (4 traps). In order to determine the dependence of the number of attached individuals when flying from wintering places to winter oilseed rape crops, they were located according to the following scheme:

Placement of traps for recording cruciferous fleas (*Phyllotreta crusiferae):*

at a distance of 5, 10, 15, 20, 30, 40 m from the edge of the field.

Placement of traps for recording the common pollen beetles (*Meligethes aeneus* F.): at a distance of 10, 20, 30, 40 from the edge of the field.

The number of adhered objects was counted on the 5th and 10th day after the beginning of their appearance.

When studying the seasonal dynamics of the number of dominant pests, records were taken every 15 days.

Determination of the technical effectiveness of insecticides against the main phytophagy of winter rape. In the course of 2021–2022, in order to investigate the effect of modern insecticides on harmful organisms of the rape agrocenosis, we conducted experiments in the conditions of the Vinnytsia region according to generally accepted methods.

The rate of consumption of the drug was established according to the official «List of pesticides and agrochemicals approved for use in Ukraine», half the recommended rates were used in the study of mixtures. The consumption of the working solution during spraying is 300 l/ha, and during pre-sowing treatment of seeds – 10 l/t.

The area of the plots was 25 $m^2$ (10 m long with a row spacing of 15 cm), repeated 3 times. The seed sowing rate was 1,6 million seeds/ha. Oilseed rape of the Mercedes winter hybrid were used for sowing.

In order to determine the technical effectiveness of insecticides against seedling pests, pre-sowing seed treatment and seedling spraying were carried out. The seeds were treated by the semi-dry method a month before sowing.

The number of pests was counted after the emergence of seedlings, by analyzing 10–15 plants in each repetition (at least 50 inhabited plants).

The effect of insecticides was investigated for the treatment of winter oilseed rape, the scheme of the experiment for evaluating the effectiveness of which is given in Table 1.

*Table 1*

**The scheme of the experiment on the evaluation of the efficiency of poisoners for the treatment of winter oilseeds rape against seedlings pests**

| № p/p | Variant | Consumption rate, kg (l)/t |
|---|---|---|
| 1 | Control | Water |
| 2 | Force 200 CS, c.s. (tefluthrin) | 2,0 |
| 3 | Cruiser 350 FS, t.c.s. (thiamethoxam) | 4,0 |
| 4 | Force 200 SC c.s., (tefluthrin)+ Cruiser 350 FS, t.c.s., (thiamethoxam) | 2,0+2,0 |

*source: formed on the basis of own research*

During the growing season of winter rapeseed plants, the effectiveness of using insecticides was studied. The schemes of experiments for evaluating the effectiveness of which are given in Table 2.

*Table 2*

**The scheme of the experiment on the evaluation of the efficiency of preparations for spraying winter oilseeds rape crops against cruciferous fleas (*Phyllotreta crusiferae*) and common pollen beetles (*Meligethes aeneus* F.)**

| № p/p | Variant | Consumption rate, kg (l)/t |
|---|---|---|
| 1 | Control | Water |
| 2 | Fastak 10% c.e., (alpha-cypemitrin) | 1,0 |
| 3 | Confidor, w.s.c. (imidacloprid, 200 g/l) | 0,25 |
| 4 | Aktara 25 WG, w.s.c. (thiamethoxam) | 0,06 |
| 5 | Mospilan 20%, w. p. (acetamiprid) | 0,75 |

*source: formed on the basis of own research*

Studying the efficiency of modern insecticides was carried out by applying insecticides to crops in small drops. Spraying was carried out in the period of germination and budding with a knapsack sprayer at different drug consumption rates, according to the experiment scheme. The number of phytophages and their damage to vegetative and generative organs was recorded before treatment and 3, 7 and 14 days after spraying [9, 13, 15].

Determination of the technical efficiency of insecticides in field conditions by reducing the number of pests in the experimental version, compared to the control, was carried out according to formula 1:

$$Te = \frac{A - B}{A} \cdot 100, \qquad (1)$$

where Te – technical efficiency, %;

A – number of pests in control, ekz./m$^2$, ekz./plant;

B – number of pests in the experimental version, ekz./m$^2$, ekz./plant.

In case of death > 3% of insects in the control, the technical efficiency was calculated with a correction according to the Abbott formula 2:

$$P = \frac{M\partial - M\kappa}{100 - M\kappa} \cdot 100\%, \qquad (2)$$

where P is correction for death in control;

Md – the number of dead insects in the experimental version, ekz;

Mk – is the number of dead insects in the control version, ekz.

During the germination period, the number of undamaged, damaged and dead plants of winter rape was determined by cruciferous scales, in the phase of «cotyledon leaves – the formation of the first pair of true leaves» directly in the field.

To determine the mass of 1000 grains, two samples of 500 grains were taken and weighed to the nearest 0,01 g. If the difference between the masses of the samples was greater than 3%, the third sample was taken and weighed.

The average mass of 1000 grains was converted to mass with a moisture content of 14% according to formula 3:

$$M = \frac{m \cdot (100 - mf)}{100 - 14} \qquad (3)$$

where M is the mass of 1000 grains at a moisture content of 14%, g;

m – mass of 1000 grains at actual humidity, g;

mf – actual grain moisture at the time of analysis, %.

The seed yield was determined after the selection of test sheaves from one linear meter and threshing of the plants with further calculation per 1m² and per 1ha.

Statistical processing was carried out taking into account the number of pests on variants and repetitions, the obtained yield was calculated using the computer program Exel.

**Research results.** The main reason for the low yield of winter oilseed rape is non-compliance with agricultural techniques of cultivation together with losses from harmful organisms, including phytophagy. Crop failure from pests can reach more than 30%, and in years favorable for reproduction, they are able to completely destroy it.

In the conditions of the Forest Steppe of Ukraine, 211 species of phytophagy that damage cabbage crops, or 14% of all insects harmful to agricultural crops, have been registered, among which the number of specialized pests is 56 species. According to researchers, winter oilseed rape in Ukraine is damaged by 47 species of insects, among which representatives from a number of antopterans dominate [5].

As a result of research carried out with the help of research methods generally accepted in entomology in 2021–2022, 22 species of phytophagous belonging to 7 series and 14 families were found on winter oilseed rape crops. It was established that representatives of the order Coleoptera accounted for the largest share of the total number of species at 60,2%, followed by Hemiptera and Lepidoptera with a share of species of 12,8% and 14,8%, respectively. Homoptera 2,5% and Thysanoptera 1,0% made up the smallest share, respectively (Fig. 1).

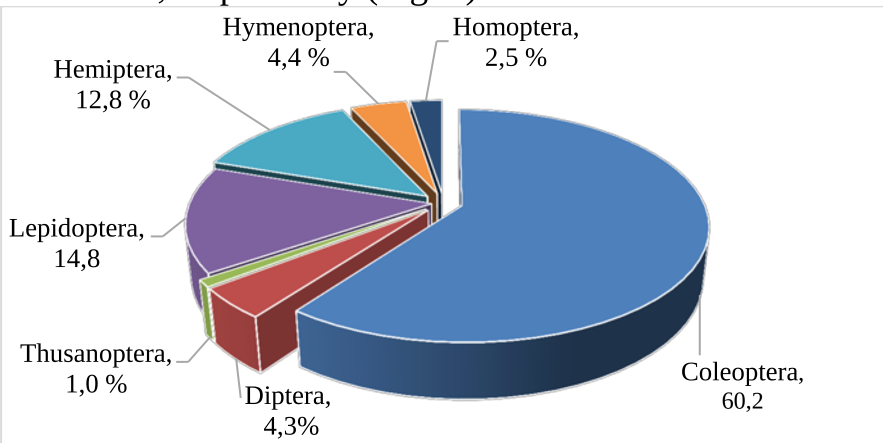


Fig. 1. Taxonomic structure of harmful entomocomplex of winter oilseed rape agrobiocenosis (2021–2022)

*source: formed on the basis of own research*

When studying the peculiarities of the formation of the species composition of phytophagy in winter oilseed rape crops, it was found that its structure depends on the phase of plant development and is formed due to species migrating from other biotopes, wintering in the fields where the crops were located, and polyvoltine species whose life cycle takes place in this and agrocenosis.

As a result of the analysis of the species composition of pests, it was established that, according to the quantitative ratio, phytophagy from the *Chrysomelidae* family dominate the rapeseed agrocenosis by 21,1% and *Nitidulidae* by 20,2%. The second most numerous are representatives of the families *Curculionidae* 10,2%, *Pieridae* – 9,8% and *Pentatomidae* – 8,1%. The least numerous at 0,4% are representatives of the families Miridae and Elateridae. In the conditions of the Vinnytsia region, the peculiarities of the formation of the entomocomplex of the rape field were investigated. According to the results of the conducted observations, it was established that winter oilseed rape crops were colonized by pests in three periods.

The first period – emergence – the formation of four true leaves (III decade of April – II decade of May).

Among phytophages, representatives of the family Chrysomelidae – cruciferous fleas (*Phyllotreta crusiferae)*. It was established that they dominated oilseed rape crops.

*Phyllotreta nigripes* F., as well as *Phyllotreta atra* F, dominated the complex of leaf-gnawing pests of seedlings. The share of blue cruciferous fleas in the total number of cruciferous fleas was 56,5%, the second densest population was the black flea population at 27,9%, the total number of striped fleas did not exceed 20%.

In the second period: stemming – budding (III decade of May – II decade of June), a complex of pests is formed, which belong to different families: in particular, these are representatives of the Curculionidae family – *Ceuthorrhynchus guadridens* Panz.; family Pentatomidae 13% – *Eurydema oleracea* L., *Eyrydema ornata* L., as well as *Eyrydema festiva* L. – the species spread massively. With insufficient protection, crop losses amount to more than 20%. During this period, entomophages with spring-summer activity – Carabidae, Stafilinidae, Nabidae, Coccinelidae – appear en masse on winter oilseed rape crops.

In the third period: flowering – the formation of pods (III decade of June – II decade of July), the species composition of insects is formed by representatives of the order Lepidoptera (12%), namely the families Nyponomeutidae – *Plutella maculipennis* Curt. and Pieridae – *Pieris brassicae* L., *Pieris rapae* L., Diptera order (5%) – *Dasyneum brassicae* L. Hymenoptera order (4%) – *Athalia colibri* L. These species were quite common; their harmfulness was 15%.

In addition, *Meligethes aeneus* F., the larvae of which feed in buds, and beetles gnaw anthers in flowers, should be singled out from the most dangerous oilseed rape pests in the third period of crop development. Crops of oilseed rape were inhabited by phytophagous adults during the formation of inflorescences, while eggs were laid in the buds that were formed.

So, winter oilseed rape crops in Vinnitsa region are inhabited by 22 types of pests belonging to 6 orders and 16 families. Among the total number of species, representatives of the order Coleoptera make up the largest share – 60,2%.

According to the degree of occurrence and harmfulness of oilseed rape phytophages can be conditionally divided into three groups: main and secondary pests, as well as associated species. Pests from the families Chrysomelidae – cruciferous fleas and Nitidulidae – rape flower eaters were of economic importance on oilseed rape crops, the total share of which from all species was 21,1% and 20,2%, respectively.

The formation of the entomocomplex of phytophagy in the winter oilseed rape agrocenosis took place in three periods: emergence – the formation of four true leaves (III decade of April – II decade of May), the second period – stemming – budding (III decade of May – II decade of June) and the third period – flowering – the formation of pods (III decade of June – II decade of July).

**Technical efficiency of modern insecticides for pre-sowing treatment of seeds against cruciferous fleas (*Phyllotreta cruciferae*).**

The destruction of pests before the onset of plant damage has been the main idea in the work of many researchers since the beginning of the chemical method. Its essence is to ensure reliable protection of plants in the most vulnerable period of their growth – seedlings, based on the properties of the drug and ecological features of the pest. For this purpose, the necessary amount of toxicant is created and maintained at the place of direct feeding of the phytophagous.

Modern insecticides, which have added to the list of drugs recommended against cruciferous fleas (*Phyllotreta cruciferae*) and other pests, are quite effective, while at the same time less dangerous for warm-blooded animals. Therefore, the development of modern techniques for the use of insecticides can ensure reliable protection of plants from pests while simultaneously increasing economic efficiency and improving the ecological situation.

When protecting seedlings of winter oilseed rape, an important circumstance that greatly complicates the fight against cruciferous fleas (*Phyllotreta cruciferae*) is that in cloudy and cool weather, up to 85% of pests are under the crust and clods of the soil, as a result, ground treatment does not work to its full extent. Therefore, such a technique as pre-sowing treatment of seeds with insecticides deserves special attention. This method is the most rational, since the drugs are localized only on the seed material, which makes it possible to significantly reduce the chemical load on the agrocenosis, environmental pollution, and protect the crop seedlings from harmful insects, increasing plant productivity.

The results of technical efficiency and the period of protective action of insecticide poisons are presented in Table 3.

*Table 3*

**Technical efficiency of insecticide poisons against cruciferous fleas (*Phyllotreta cruciferae*) (average for 2021–2022)**

| Variant | Consumption rates of the drug, l/t | Technical efficiency, % | | | |
|---|---|---|---|---|---|
| | | for... a day after the emergence of seedlings | | | The first pair of real leaves |
| | | 3 | 7 | 14 | |
| Control | - | 0 | 0 | 0 | - |
| Cruiser 350 FS, t.c.s. | 4,0 | 90,5 | 74,8 | 47,8 | 47,1 |
| Force 200 CS, c.s. | 2,0 | 82,0 | 68,8 | 58,0 | 35,9 |
| Force 20% c.s. +Cruiser 350 FS, t.c.s. | 2,0+2,0 | 92,0 | 76,8 | 62,5 | 49,0 |

*source: formed on the basis of own research*

The obtained data indicate that the efficiency and period of protective action of the drugs is different. The highest technical efficiency, recorded on the 3rd day of records, was noted in the combined drugs Force 20% c.s + Cruiser 350 FS t.c.s. (thiamethoxam) with a consumption rate of 2,0 +2,0 l/t – 92,0%. The drug Force 20% c.s was the least effective, its effectiveness for this period was 82,0%.

After 7 days, the toxic effect of the drugs decreased. So, the effectiveness of the mixtures of poisoners Force 20 c.s.+ Cruiser 350 FS, t.c.s. was 76,8%, Cruiser 350 FS, t.c.s., was close in terms of efficiency, on the variant with which the number of cruciferous fleas compared to the control decreased by 74,8%.

The longest duration of the protective action was recorded in the mixture of poisons Force 20% c.s. + Cruiser 35% with consumption rates of 2,0+2,0 l/t, respectively. The technical efficiency of this mixture on the 14th day of accounting was 62,5%, while the version with Force was 20%, microseconds – 58,0%. The drug

Cruiser 350 FS turned out to be the least effective, because with a drug consumption rate of 4,0 l/t, its efficiency for this period was 47,8%.

The efficiency of the drugs in the phase of the first pair of leaves on rapeseed plants decreased significantly. In particular, on variants with mixtures of Force 20% c.s. + Cruiser 35% with consumption rates of 2,0+2,0 l/t, the number of cruciferous fleas decreased compared to the control by 39,0%, and Cruiser 350 FS, t.c.s. by 37,1%. Although the area of the damaged leaf surface decreased due to the increase in the vegetative mass of the plants.

The obtained results indicate that the duration of the toxic effect and the technical efficiency of insecticide poisons are different. Mixtures of drugs Force 20% c.s. have a high initial efficiency. + Cruiser 35% with consumption rates of 2,0+2,0 l/t and Cruiser 350 FS, t.c.s. The reduction in the number of cruciferous fleas on the version with them was 92,0% and 90,5%, respectively. The longest duration of the toxic action was observed in the mixture of poisoners Force 20% c.s.+ Cruiser 350 FS, t.c.s., where after 2 weeks from the period of germination, its efficiency was 62,5%.

**Technical efficiency of modern insecticides for spraying crops against cruciferous fleas (*Phyllotreta cruciferae*).**

Hot and dry weather contribute to an increase in the harmfulness of cruciferous fleas. On the one hand, this is explained by the increased activity of the phytophagous plant to restore the water balance in the insect's body, and on the other hand, by the fact that plants are more susceptible to damage during a drought. For example, at an air temperature of 14°C, one beetle eats 43 mm$^2$ of the leaf surface, and at 20°C, 72 mm$^2$. In case of massive reproduction of fleas, they completely destroy the sprouts of cabbage crops.

The chemical method is an integral component of the integrated system of protection of winter oilseed rape against fleas. An effective method of regulating their number is continuous or marginal spraying of crops during the period of emergence. At the same time, the assortment of drugs for processing is constantly changing. Thus, organochlorine compounds, which were used earlier, were replaced by organophosphorus insecticides. Regardless of weather conditions, they have high toxicity and a longer duration of protective action. Also, the list of drugs recommended against cruciferous fleas was supplemented by synthetic pyrethroids, which have high initial effectiveness, but are not without certain disadvantages: short duration of protective action, dependence on ambient temperature. In recent years, the range of insecticides has been supplemented with drugs from the class of neonicatinoids [15].

To determine the effectiveness of modern insecticides against cruciferous fleas (*Phyllotreta cruciferae*), experiments were conducted during the period of mass colonization of crops by pests. When studying the technical efficiency of new insecticides, we came to the conclusion that the highest efficiency is in the version of Confidor, 20% of w.s.c. for consumption norms of 0,25 l/ha. When counted on the 3rd day after treatment, it was 93,3%. It was noted that this drug had the longest toxic effect against insects. Technical efficiency at day 14 after treatment was 62,7%, while Aktara 25 WG at a rate of 0,06 kg/ha had a technical efficiency of 58,5% for this period. Although high plant damage was observed on experimental variants, the degree of damage compared to the control decreased by 2 times (Table 4).

From the results of the calculations carried out on the 7th day after the experiments, a decrease in the efficiency of the drugs was noted, and the number of fleas on the experimental variants decreased by 4 times compared to the control variant. In the preparation Confidor 20% for this period, the technical efficiency was recorded at 75,9%.

On the 14th day after treatment, a further loss of the toxic effect of insecticides was noted. The highest efficiency in this period was Confidor, w.s.c. and Aktara 25 WG 62,7% and 58,5%, respectively, but the leaf surface area increased due to the appearance of true leaves, as a result, the plants compensated for the damage due to compensatory mechanisms.

*Table 4*

**Technical efficiency of insecticides when spraying winter oilseed rape seedlings against (*Phyllotreta cruciferae*) (average, 2021–2022)**

| Variant | Consumption norms of the drug kg, l/ha | Effectiveness for ... day after processing | | |
|---|---|---|---|---|
| | | 3 | 7 | 14 |
| Control | - | 0 | 0 | 0 |
| Fastak 10% k.e. | 0,1 | 80,5 | 54,7 | 47,9 |
| Confidor, w.s.c. | 0,25 | 93,3 | 75,9 | 62,7 |
| Mospilan 20% w. p. | 0,75 | 78,0 | 55,8 | 42,6 |
| Aktara 25 WG, w.s.c. | 0,06 | 83,5 | 68,2 | 58,5 |

*source: formed on the basis of own research*

Therefore, the most effective in the treatment of winter oilseed rape seedlings against cruciferous fleas among the studied preparations was Confidor, w.s.c., the technical efficiency of which, on the 3rd day after application, was 93,3%. On the variant with Confidor, 20% w.r.c. and Aktara recorded the longest duration of protective action, on the 14th day the reduction in the number of cruciferous fleas compared to the control, on these variants was 62,7% and 58,5%, respectively.

***Technical efficiency of modern insecticides for spraying crops against the common pollen beetles (Meligethes aeneus* F.*).***

The question of the future development of the cultivation and processing of oil crops in Ukraine is closely related to the further growth of the gross harvest of winter oilseed rape and its processing products. Among oil crops, it is one of the most valuable crops both in terms of oil content and possible yield. Winter oilseed rape is an important source of cheap vegetable oil, high-quality cake, meal, ecologically clean biodiesel fuel, lubricants, etc. Prices for seeds and products of their processing have increased significantly on the world market among oil crops.

Observance of all elements of cultivation technology, including protection from particularly dangerous pests of generative organs, helps to obtain increased yields of winter oilseed rape seeds. Among this group of phytophagy, the most common and harmful is the rape flower-eater, whose beetles and larvae feed on buds and flowers. In some years, the infestation of crops by the pest reaches 90–100% with an average number of 5–9 beetles per plant and 26–43% bud damage. Under such conditions, the seed yield is sharply reduced.

The results of the calculations indicate the need for treatment against pests of generative organs, as the number of canola flower-eating adults in the culture in the budding phase was 15–20 ekz./plant. During this period, small area experiments were laid. On the 3rd day after spraying, the technical efficiency of the drugs was within 85,5–95,3% (Table 5).

*Table 5*

**Technical efficiency of insecticides for spraying winter oilseed rape plants against the (*Meligethes aeneus* F.) (average, 2021–2022)**

| Variant | Consumption norms of the drug kg, l/ha | Effectiveness for ... day after processing | | |
|---|---|---|---|---|
| | | 3 | 7 | 14 |
| Control | - | 0 | 0 | 0 |
| Fastak 10% c.e. | 0,1 | 93,5 | 81,0 | 58,6 |
| Confidor, 20% w.s.c. | 0,25 | 95,3 | 84,1 | 71,2 |
| Mospilan 20% w. p. | 0,75 | 90,9 | 78,4 | 65,1 |
| Aktara 25 WG, w.s.c. | 0,06 | 92,1 | 75,4 | 64,9 |

*source: formed on the basis of own research*

Among the investigated insecticides, the highest technical efficiency in this period was recorded in the versions of Confidor, w.s.c. – 95,3% at consumption rates of 0,25 l/ha and Fastak 10% c.e. – 93,5% (0,1 l/ha). Under such conditions, the number of phytophagous beetles after treatments ranged from 1 to 2 beetles per plant, while in the control – 20 ekz. on the plant.

After 7 days, the toxic effect of the drugs weakened, but the greatest decrease in the number of the *Meligethes aeneus* F. compared to the control was recorded on the variants also treated with Confidor 20%, w.s.c. and Fastak 10% c.e. – 84,1% and 81,0%, respectively. The highest technical efficiency on the 14th day after treatment of the studied preparations was also found in the insecticide Confidor, w.s.c. – 71,2%, lower than Fastak's 10% c.e. – 58,6%.

Treatment of crops with Confidor 20% of annual income. had a positive effect on the biometric indicators of winter oilseed rape. On average, 68 pods with 19 seeds each were collected from one plant on this option, and due to this, 0,53 t/ha of seeds were saved. For comparison, there were 55 fewer pods and 15 seeds each in the control (Table 6). The most effective insecticide that provided protection of winter oilseed rape plants from the rape flower eater is Confidor, w.s.c. with a consumption rate of 0,25 l/ha. In terms of effectiveness, it exceeded all the studied drugs. During 14 days, it provided technical efficiency at the level of 71,2%, which allowed to save 0,53 t/ha of seeds.

*Table 6*

**Economic efficiency of insecticides for the protection of winter canola from major pests (average for 2021–2022)**

| Variant | Consumption rate kg, l/ha | Plant height, cm | Quantity, pcs | | Mass of 1000 seeds, g | Yield of grain | |
|---|---|---|---|---|---|---|---|
| | | | Pods on a plant, pcs | Seeds in pods, pcs | | t/ha | saved yield, t/ha |
| Control | - | 21,9 | 55 | 15 | 2,46 | 2,93 | |
| Confidor 20% w.r.c. | 0,25 | 24,4 | 68 | 19 | 2,68 | 3,46 | 0,53 |
| Aktara 25 WG w.s.c. | 1,5 | 23,3 | 64 | 18 | 2,56 | 3,30 | 0,37 |
| Fastak 10% c.e. | 0,1 | 21,1 | 68 | 17 | 2,54 | 3,31 | 0,38 |
| Mospilan 20% w. p. | 0,75 | 22,2 | 65 | 17 | 2,54 | 3,22 | 0,29 |
| $LSD_{05}$ | | | | | | 1,4 | |

*source: formed on the basis of own research*

It is assumed that the action of the insecticide on the plant is possible in two ways, conventionally called «direct» and «indirect». The direct effect of the toxicant is manifested as a result of its direct penetration into the plant and its influence on growth processes. Side effects are the result of more (less) active development of soil microflora under the influence of an insecticide involved in plant development.

It has been proven that the duration of the toxic effect and the technical efficiency of insecticide poisons are different. The drug Cruiser has a high initial efficiency, the reduction in the number of *Phyllotreta cruciferae* on these variants was 92,0%, respectively. The longest-lasting toxic effect was observed in the mixture of poisons Force 20% c.s. + Cruiser 35%, t.c.s. – after 2 weeks from the period of germination, its efficiency was 65,0%.

Confidor, w.s.c. was the most effective for spraying winter oilseed rape seedlings against cruciferous fleas among the studied preparations, the technical efficiency of which, on the 3rd day after application, was 93,3%. On the variant with Confidor, 20%, w.s.c. and Aktara 25 WG recorded the longest duration of protective action – on the 14th day, the reduction in the number of *Phyllotreta cruciferae* compared to the control on these variants was 62,7% and 58,5%, respectively.

The insecticide that provided the most effective protection of winter oilseed rape plants against the common pollen beetles turned out to be Confidor, 20%, w.s.c. with a consumption rate of 0,25 l/ha. During 14 days, they provided technical efficiency at the level of 71,2%, which allowed to save 0,53 t/ha of seeds.

**Conclusions.** In the agrobiocenosis of winter oilseed rape in the conditions of the Vinnytsia region of the right-bank forest-steppe of Ukraine, 22 species of pests belonging to 6 orders and 16 families were found. The largest species diversity is characterized by the number of Coleoptera, the share of species of which was 62,6% of the total.

Each species is adapted to a certain phenophase of the culture. Three periods of the development of rapeseed plants were identified, which are associated with certain complexes of phytophages: emergence – the formation of four true leaves *Phyllotreta cruciferae* ; stemming – budding (*Ceuthorrhynchus quadridens* Panz.), *Brevicoryne brassicae* L., *Eurydema oleracea* L, *Plutella maculipennis* Curt.); flowering – the formation of pods (*Ceuthorrhynchus assimilis* Payk., *Meligethes aeneus* F., *Dasyneura brassicae* Winn.).

Pre-sowing treatment of rapeseed with mixtures of Force 200 SC + Cruiser 350 FS, consumption rate 2,0+2,0 l/t. and Cruiser 350 FS, t.c.s. at the full consumption rate of 4,0 l/t is a highly effective method of controlling the number of cruciferous fleas. Initial efficiency during the first three days after emergence was 92,0% and 90,5%, respectively. The longest duration of the toxic action was observed in the mixture of poisoners Force 20% c.s. + Cruiser 35%, t.c.s. after 2 weeks from the period of germination, its efficiency was 62,5%.

The highest technical efficiency – 93,3% for spraying rape seedlings against cruciferous fleas was shown by Confidor 20, w.s.c. The variant with this drug and Aktara also recorded the longest duration of protective action, on the 14th day the reduction in the number of cruciferous fleas compared to the control was 62,7% and 58,5%, respectively.

The most effective insecticide that provided protection of winter oilseed rape plants from the rape flower-eater is Confidor, 20%, w.s.c. with a consumption rate of 0,25 l/ha. In terms of effectiveness, it exceeded all other studied drugs. During 14 days, technical efficiency was ensured at the level of 71,2%. That made it possible to save 0,53 t/ha of seeds.

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# *АНОТАЦІЯ*
# *КОНТРОЛЬ ЧИСЕЛЬНОСТІ ОСНОВНИХ ШКІДНИКІВ РІПАКУ ОЗИМОГО В УМОВАХ ВІННИЦЬКОЇ ОБЛАСТІ*

*У даній статті висвітлено проблематику, що полягає в удосконалені і обґрунтовані елементів системи захисту ріпаку озимого від основних шкідників в умовах Вінницької області., яка ґрунтується на уточнені видового складу фітофагів у посівах ріпаку озимого, їх шкідливості та обмеження чисельності при застосуванні обробки насіння інсектицидами протруйниками і обприскування посівів препаратами упродовж вегетації культури.*

*Уточнено видовий склад шкідливої ентомофауни ріпаку озимого та виділено 22 види комах які належать до 6 рядів та 16 родин. Найбільшим видовим різноманіттям характеризується ряд Coleoptera частка видів якого складала 60,2% від загалу. Щоб створити максимально ефективну систему інсектицидного захисту, необхідно добре знати фенологію шкідників, періоди появи їх шкодочинних стадій.*

*Оцінено ефективність сучасних інсектицидів протруйників проти шкідників ріпаку озимого та оптимізовані способи їх застосування. Встановлено, що найвища технічна ефективність інсектицидних протруйників відмічена у варіантах з протруйниками сумішами Форс 200 SC + Круїзер 350 FS, норма витрати 1,0+2,0 л/т. і Круїзером 350 FS, т.к.с. у повній нормі витрат 4,0 л/т є високоефективним прийомом контролю чисельності хрестоцвітих блішок. Початкова ефективність впродовж перших трьох діб після появи сходів становила 92,0% та 90,5%.*

*Упродовж вегетації ріпаку озимого при випробуванні інсектицидів найвищу технічну ефективність – 93,3% за обприскування сходів ріпаку проти хрестоцвітих блішок проявив Конфідор 20% в.р.к., а найбільш ефективним інсектицидом, що забезпечив захист рослин ріпаку озимого від ріпакового квіткоїда теж виявився Конфідор, 20% в.р.к., ним забезпечувалась технічна ефективність на рівні 95,3%. Що забезпечило отримання урожайності 3,46 т/га, а приріст урожаю умовно склав 0,53 т/га врожаю.*

***Ключові слова:*** *ріпак озимий, фітофаги, шкідливість, інсектициди, ефективність, урожай.*
***Табл. 6. Рис. 1. Літ. 15.***

## Інформація про авторів

**Рудська Ніна Олександрівна** – кандидат сільськогосподарських наук, старший викладач кафедри ботаніки, генетики та захисту рослин Вінницького національного аграрного університету (21008, м. Вінниця, вул. Сонячна, 3, e-mail: nina.rudska@gmail.com).

**Забарний Олексій Сергійович** – кандидат сільськогосподарських наук, менеджер з маркетингу насіння компанії BASF T.O.V. LLC (21007, Вінниця, Запорізька вул. 4, e-mail: zabarnyy@ukr.net).

**Rudska Nina Oleksandrivna** – Candidate of Agricultural Sciences, Senior Lecturer of the Department of Botany, Genetics and Plant Protection, Vinnytsia National Agrarian University (21008, Vinnytsia, Soniachna Str. 3, e-mail: nina.rudska@gmail.com).

**Zabarnyi Oleksii Serhiyovych** – Candidate of Agricultural Sciences, Seeds marketing manager BASF T.O.V. LLC (21007, Vinnytsia, Zaporizka St. 4, e-mail: zabarnyy@ukr.net).