UDC 632.7:632.951.1(2):633.34
DOI: 10.37128/2707-5826-2022-1-9

SPECIES COMPOSITION OF SOY AGROCENOSE PESTS AND CONTROL OF THEIR NUMBER IN THE RIGHT BANK FOREST STEPPE

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The article presents the results of research to clarify the species composition of the harmful entomocomplex of soybean agrocenosis in the Right Bank Forest-Steppe. It was found that the most harmful phytophagous were Etiella zinckenella Tr., Tetranychus urticae Koch. and bedbugs (Miridae). Six periods of development of soybean plants have been identified, which are associated with certain phytophagous complexes, three of which are critical when active protection measures are needed. Depending on the damage to various plant organs, soybean phytophages are conventionally divided into the following groups of pests: nodules, root system, leaves and stems and generative organs. The application of methods and effectiveness of modern chemical and biological drugs and their mixtures against the most dangerous species of arthropods are substantiated.

According to the results of our research, we found that spraying soybean crops in the period of the beginning of the formation of beans against acacia fire is the most effective: Dragun, k.e. (1,2 l/ha), Decis f-Lux, 10% m.e. (0,25 l/ha) and a mixture of Dragoon, k.e. with Aktofit, k.e. (0,6 + 1,0 l/ha), the technical efficiency of which was 95,3 and 98,7% (above the standard Zolon, k.e. – 94,5%). At the same time, seed damage decreased by 4,2–5,6 times, and the preserved yield averaged 0,59–0,63 t/ha. Aktofit, k.e., was somewhat inferior in efficiency. (89,4%).

When spraying soybean crops against common spider mites, the most effective were Dragun, k.e. (1,2 l/ha), Syntax (0,2 g/l) and a mixture of Syntax, g/l with Aktofit, k.e. Their technical efficiency was 95,2 and 99,7%, respectively (Zolon, k.e. – 87,9%). The saved yield was 0,55 and 0,66 t/ha.

Key words: *soybeans, pests, entomocomplex, harmfulness, insecticides, efficiency, yield*
Table 2. Fig 1. Lit. 13.

Introduction. Soybeans are one of the leading crops in world agriculture. It occupies an important place in the structure of crops, grain, fodder and food balances. The growth rate of crops and production volumes are unmatched. Soybeans play an important role in improving agricultural crops, soil nitrogen balance, crop structure and food resources. It is deservedly popular among other crops as the most profitable, is the cheapest producer of protein. It is a strategic culture in solving the global food problem, so it is grown on all continents in the main agricultural regions of the planet [6].

In the world ranking of soybean producers, Ukraine ranks first in Europe and eighth-tenth in the world. Due to the formation of soybean processing in Ukraine since the beginning of the XXI century, the industrial soybean complex is rapidly forming, which has great prospects and consequences for the economy of agriculture and the state as a whole. It is projected to increase soybean acreage as a strategic crop for Ukrainian agriculture to 4 million hectares and increase seed production to 8–10 million tons, which will also provide more than 450–600 thousand tons of biological nitrogen. In the medium term (by 2030) soybean seed production is projected to increase to 7,5–8,0 million tons. Given the growing demand for seeds in the domestic and foreign markets, soybean acreage in Ukraine has grown rapidly in recent years and as of 2020 year amounted to 1 million 409 thousand hectares. with an average yield of 2,07 t/ha and a gross harvest of 2,75 million tons [1, 3].

In addition, it should be noted that obtaining high stable soybean yields is limited by numerous pests, grain losses from which can reach up to 90% while reducing its quality. In recent years, the saturation of field crop rotations has increased, the range of varieties and hybrids has expanded, the general technology of its cultivation has changed, which has significantly affected the entomocomplex of soybean agrobiocenosis. These issues are especially relevant in the context of global and local climate change. Therefore, clarifying the species composition of phytophagous, studying the peculiarities of their biology and harmfulness taking into account current conditions, improving measures to limit their numbers on the basis of environmental and economic approach determine the priority of research and their relevance [6].

Analysis of recent research and publications. As other legumes, soybeans are damaged by many pests, resulting in reduced yields and poor quality. The entomocomplex of soybean agrocenosis is formed under the influence of anthropic, abiotic and biotic factors. World experience shows that new forms of land use, specialization and intensification of soybean cultivation significantly affect the reproduction and harmfulness of phytophagous. This is facilitated by the violation of crop rotations and the deterioration of the quality of cultivation technology.

According to literature sources, the differences in the species composition of soybean arthropods in different countries have been studied. Yes, W.V. Balduf began research on the species composition of the entomofauna of the soybean field and identified 209 species of insects and mites. According to other authors, US soybean crops include more than 1,500 species of insects and mites, 20 of which are particularly dangerous. [7].

In Japan, a number of authors note that soybean pests are 220 species, 30 species are quite dangerous and 16 of which are new, in China there are more than 30 harmful species of insects, in India up to 100 different species, 46 of which are the most harmful. In Nigeria, 135 species have been identified, of which 120 are phytophagous [8].

More than 96 species of phytophagous that damage soybean crops have been registered in the Far East. Researchers have found that in the North Caucasus, Moldova, and Central Asia, 40 to 60 species of soybeans have been recorded.

In Ukraine, the harmful fauna of the soybean field is characterized by a significant diversity of species composition. 136 years after the first soybean sowing in the Kherson research field, the number of pests on crops increased from 51 to 114 species. At this time, harmful fauna on soybeans has not yet fully formed, as evidenced by the emergence of new species adapted to current conditions. Over the last 5 years, the species composition of the entomofauna of the soybean field has changed greatly as a result of the expansion of crops in the context of global and local climate change. The most complete faunal description of soybean phytophagous is given in the works of O.A. Grikuna. According to the author, 72 species belonging to 10 genera and 39 families have been identified in Ukraine. As of 2009, it was already 114 species of arthropods. The bulk of soybean phytophagous species are insects – 96,5%. The share of snails and mites is 2–6% and 0–9%, respectively. The most dangerous polyphagous include spider mite (*Tetranychus urticae* Koch.), The most dangerous oligophages – acacia (*Etiella zinckenella* Tr.) [4].

Analysis of soybean-registered insect species has shown that they are cosmopolitan in prevalence. There are species that inhabit almost all continents: Europe, Asia and North America.

The increase in soybean grain production depends on the effectiveness of the crop protection system against damage by phytophagous, which significantly reduces the yield and its quality. The development of rational measures to protect soybeans from pests in the current period is carried out in many countries: Bulgaria, Hungary, India, China, Romania, Russia, USA, Japan and others.

Crop protection systems against phytophagous are developed taking into account the species composition and soil and climatic conditions. Such a system includes accounting for the number of pests, the development of economic thresholds of harmfulness and the timely use of insecticides in the minimum consumption rates. The most important elements of soybean protection are the accounting of the number and its comparison with the economic thresholds of harm (EPS), which allows to minimize the use of pesticides – drugs that are highly effective but dangerous to the environment. Determining the economic thresholds of harmfulness of phytophagous soybeans is complicated by the presence of a diverse complex of pests. For example, in the United States, economic thresholds and recommendations for the protection of soybean crops from leaf-eating pests are based primarily on indicators of the total degree of damage to the leaves of several species, as well as indicators of the total number of phytophagous per unit of account. The modern system of protection should be based not on the complete destruction of harmful species, but on regulating their numbers to economically intangible and environmentally safe levels [5].

Currently, the chemical method of protecting plants from phytophagous remains the main. In world agricultural production, there is a tendency to increase the use of pesticides. Of the total purchase of 24,6 billion dollars, 7,1% are drugs needed for soybean cultivation [2].

According to researchers, protective measures against seed pests are appropriate when settling more than 7–10% of beans, their effectiveness depends on systemic insecticides. Marginal and tape spraying is carried out from the germination phase to the appearance of the third true leaf (stalk phase), against a complex or individual pests that migrate from perennial grasses, one of the insecticides: Carbophos, k.e. (500 g/l) 0,6–1,0 l/ha, Sumicidin, k.e. (200 g/l) 0,5 l/ha, Fozalon, k.e. (350 g/l) 1,5–3,0 l/ha, or preparations based on cypermethrin (Arrivo, Tsitkor, Almetrin, Tsiraks, Tsipi, k.e.) (25 g/l) – 0,32 l/ha [9].

Against the caterpillar of leaf-eating moths are recommended for use Forte – 3,0 l/ha, Arrivo – 0,3 l/ha, Almetrine – 0,3 l/ha, Viper – 0,3 l/ha; against aphids, leafhoppers, scoops and meadow butterfly Fufanon – 0,6–1,0 l/ha; against bean fire, soybean fruit eater Sharpai – 0,3 l/ha; against spider mite is used Omayt – 1,3 l/ha, Karate – 0,4 l/ha, Mauritius – 0,5 l/ha and Karate zeon – 0,4 l/ha [5].

Mortality 100% of larvae, nymphs and adults of *Tetranychus urticae* Koch. achieved by using Hexithiazox at a concentration of 0,0125 g/l. Acaricides Morocid (0,1%) and Keltan (0,2%) on the third day after application cause the death of 95–97% of mobile stages and 96–98% of its eggs. High protective effect against *Tetranychus urticae* Koch. on soybeans provides application of BI–58, 40% k.e., Fozalon, 35% k.e., Omayt, 30% z.p. – on the 7th day after treatment, there is a decrease in the number of pests by 91,2–99,7%. Neoron, 50% k.e. at the rate of 1 l/ha against this phytophagous increases the efficiency at the level of 94–99% [9, 12].

The use of insecticides and acaricides has three main results on insect and tick populations: population change, resistance development, and genetic destabilization. The latter develops as a result of the stress response of the population to the action of highly toxic insecticides. At the same time, population variability increases significantly. Since only a small proportion of individuals in the population receive a lethal dose, the use of any insecticide always stimulates the acceleration of microevolution processes aimed at the development of resistance [6].

So, the analysis of literature sources shows that the species composition of phytophages of this culture is extensive, as soybeans are grown in different countries. In Ukraine, soybeans feed on polyphages and oligophages. A number of authors noted that *Etiella zinckenella* Tr. and *Tetranychus urticae* Koch. are one of the most dangerous pests of soybeans. The number of pest species increases every year, due to the adaptation to soybean-fed numerous phytophages from local biocenoses, which is caused by the expansion of sown areas under this crop. Therefore, clarification of the biology of the main species of soybean pests and improvement of the system of crop protection in today's conditions determine the priority of research [10].

The purpose. Improving the system of protection of soybeans from the complex of pests taking into account the peculiarities of the biology of dominant species of phytophagous and modern technology of growing crops in the Vinnytsia region.

Analysis of recent research and publications.

Soybeans are among the crops for which the protection of crops from pests through the use of insecticides is one of the key elements in the technology of their cultivation. However, the stagnation of insecticides requires a comprehensive environmental and economic justification [11]. Therefore, there is a need to find ways to optimize the chemical method of pest control in soybean crops. Important in improving the biologization of the effectiveness of the method of pest control is the use of insecticides in combination with biological products. The question of studying the peculiarities of the formation of the harmful entomocomplex of soybean crops and increasing the efficiency of methods of controlling phytophagous in soybean crops was dealt with by the following domestic scientists, OA Grikun [4], B. B. Bepesovska-Bpigac [10], M.P. Sekun [5], S.V. Stankevich [8]. Numerous studies have clarified the species composition and harmfulness of the most dominant pest species in soybean crops, which needs constant updating because the number of pest species increases every year, due to the adaptation to soybean-fed numerous phytophagous from local biocenoses, which is caused by. It is also noted that insecticides of different classes of chemical compounds and the mechanism of action in different ways affect the effectiveness.

Materials and methods of research. In 2020–2021, during the soybean growing season, entomological assessment of crops, accounting for the number of harmful insect species, observation of the phenology of the most dangerous phytophages, and the structure of their populations at certain stages of plant organogenesis were performed. The species composition of entomofauna was studied according to generally accepted and special methods [13].

The research was performed to study the effect of modern insecticides against the most harmful phytophagous soybean agrocenosis. We have established experiments in the research field of on the basis of SRF «Agronomichne», which is in the village of Agronomichne, Vinnytsia region according to generally accepted methods adopted in entomology.

Insecticides of different classes of chemical compounds and mechanism of action were used in the experiments. Organophosphorus compounds – Zolon (phosalone), k.e. (standard), Dragun (chlorpyrifos), k.e. Pyrethroids – Decis f Lux (deltamethrin), k.e.

Avermectins – Syntax, hp (hexithiazox, 204 g/l + abamectin, 36 g/l) – 0,2 l/ha;

Biologicals – Aktofit (aversectin), k.e. In studies of insecticide mixtures used half the recommended rates. Consumption of working liquid at spraying – 300 l/h. The area of plots was 50,2 m^2, repeated 3 times.

Spraying was carried out in the phase of forming beans with a knapsack sprayer at different rates of consumption of drugs, according to the experimental scheme. The number of phytophagous was counted before treatment and 3, 7 and 14 days after spraying [13].

To evaluate the effectiveness of the drug against *Etiella zinckenella* Tr. on 50 plants (5 plants in 10 places) each repetition counted the total number of beans and their damage at dissection.

The technical effectiveness of insecticides was determined by reducing the number of pests in the experimental version compared to the control.

$$Te = \frac{A - B}{A} \cdot 100,$$

where Te – technical efficiency, %;

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

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

Damaged beans were opened and the number of healthy and damaged seeds was counted in them. After summarizing the data, the population (damage) of beans to *Etiella zinckenella* Tr. was determined by the formula:

$$P = \frac{100 \cdot n}{N},$$

where n is the number of damaged beans, pcs;

N – the total number of beans in the sample, pcs.

Harvesting was carried out in the phase of full ripeness of grain by direct combining with a combine, and harvest accounting – by weighing grain from the accounting area, followed by recalculation of 14% moisture and 100% purity. Data from accounting and yield were subjected to mathematical processing by analysis of variance.

The object of*:* soybean, *Etiella zinckenella* Tr., *Tetranychus urticae* Koch., bedbugs-Miridae, modern insecticides, biopreparaty.

Subject of research – improvement of the system of protection of soybean crops from the complex of phytophagous.

Research methods: field, laboratory, mathematical-statistical, computational.

Research results. Increasing the level of soybean seed production is impossible without improving the system of protection of crops from pest complex, based on the biocoenotic principle. This is, first of all, possible with a thorough study of the species composition of pests of soybean agrocenosis, their ratio, population dynamics, ecological and biological features, biocoenotic relationships in this agroecosystem, which allows to rationally address the optimal stabilization of phytosanitary crops.

Harmful soybean entomofauna has not yet fully formed. However, its agrobiocenosis, as an annual crop, is unstable and depends on the composition of ecosystems and other factors. The entomofauna of the culture, despite the short existence of the agrobiocenosis (70–120 days) in comparison with other agricultural crops, is characterized by a significant diversity of species composition. As a result of monitoring the entomocenosis in Vinnytsia region, 46 species of pests from 16 families and one species of mites that can damage soybeans to one degree or another were identified on soybean crops.

Analysis of the species composition of pests shows that in systematic terms, the largest number of harmful species belongs to a number of Hemiptera and Coleoptera – 39% and 32%, respectively, of the total number of phytophagous insects. The third largest group of species includes (Lepidoptera) – 15%. Less numerous are representatives of a number of Homoptera – 5% and fringed or Thysanoptera – 5% (fig. 1).

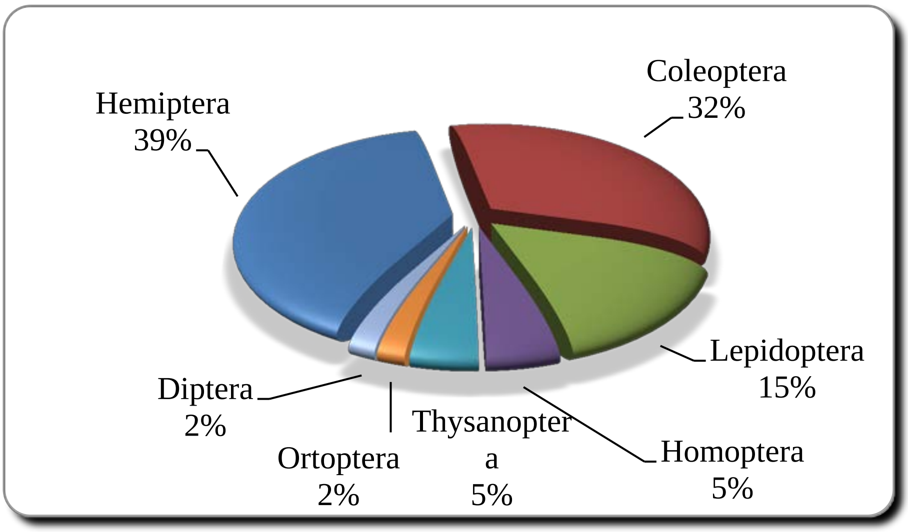

Fig.1. Taxonomic structure of harmful soy entomocomplex in the conditions of Vinnytsia region (average for 2020–2021)

The differences in the biology of these species, the variety of factors that affect their numbers and harmfulness require the use of diverse but interrelated methods of crop protection.

According to the degree of harmfulness of phytophages can be divided into three groups:

- the most numerous and harmful, which pose the greatest threat to crops: *Etiella zinckenella* Tr., *Tetranychus urticae* Koch., bedbugs-Miridae.

- less numerous and harmful, outbreaks of the population is observed only in some years: Curculionidae, Acrididae, Noctuidae, Tortricidae.

- few in number and not particularly harmful: Elateridae, *Delia platura*, bedbugs-Pentatomidae.

Given this grouping of phytophagous, it should be noted that the pests of the first group should always be introduced precautions to protect soybean crops, the second – to constantly monitor the dynamics of their numbers and only in excess of EPS to apply active pesticides.

On annual crops, including soybean plants, 12 qualitatively different stages of organogenesis have been established, and a certain element of plant productivity is formed on each of them. Each such stage of yield formation is associated with a certain complex of harmful species of arthropods, which to some extent affects the yield and its quality [10].

Analysis of the total dynamics of insect numbers and observation of the phenology of soybean plants in the Vinnitsa region allowed to identify a set of pest species associated with certain stages of crop organogenesis. During the growing season, according to the change in the number of phytophages, five periods in the development of soybeans were established, with which a certain complex of phytophagous insects is combined. In the germination phase – 2–3 true leaves, it was found that the germinating seeds in the soil and seedlings are damaged by the larvae of the sprout fly and wireworms. The first specimens of tuberous weevils appeared belonging to the family Sitona. In some individuals, caterpillars of the winter moth (*Agrotis segetum* Schiff.) and larvae of the May beetle (*Melolontha melolontha* L.), imagoes of bedbugs and locusts were observed. There were a small number of thrips (0,9 ekz./50 e.m.n.), which were concentrated mainly in the axils of the primordial leaves.

During the budding-flowering phase, an increase in the number of blind bugs (8,2 ekz./50 e.m.n.) was observed. There are 3 types of leaf-eating moths in the crops: *Autographa gamma*, *Amathes C-nigrum* and *Heliothis viriplaca*.

. Further reproduction of Tetranychus urticae Koch was observed on single plants. (16,2 ekz./triple letter) and *Etiella zinckenella* Tr. (1,8 ekz./plant.). Shield bugs, locusts and thrips were found in solitary individuals.

During the formation of beans and the filling of seeds, the maximum population of crops during the growing season was noted with acacia firefly and bedbugs (including meadow, grass and alfalfa), the EPS of which exceeded 1,5–2,0 times. Shield bugs, thrips and cicadas were found in smaller numbers. Isolated individuals of scoops and locusts were found.

The results of the research made it possible to establish that the formation of the species composition of pests on soybean crops is gradual throughout the growing season of plants. The structure of the composition at different periods of plant development is due to species that migrate from other habitats, species that overwinter in fields where crops are located and polyvoltic species, most of the life cycle of which takes place in the same cenosis.

However, among them there are two critical periods, which are associated with a certain complex of phytophagous, which necessitates active measures to protect crops (flowering phase – the formation of beans). Among the main and most dangerous pests that cause significant damage in the are *Etiella zinckenella* Tr., *Tetranychus urticae* Koch. and a complex of bedbugs – *Lygus pratensis* L, *Lygus rugulipennis* Popp., *Adelphocoris lineolatus* L.

According to our research, Miridae – 41,3% and Curculionidae – 40,3% of the total harmful entomocomplex were the most common in the flowering phase of soybean plants during the years of observations on crops in Vinnytsia region. Also numerous in all these years was the family Thripidae – 5,9%, Phycitidae – 3,6%, Cicadellidae – 2,7 and Elateridae – 2,1%. However, none of the species of phytophagous exceeded the economic level of harm. The families Noctuidae, Pentatomidae, Tettigoniidae, Pyraustidae, Tortricidae, Scarabaeidae were quite small in the study area – 1,7–0,1%.

During the formation of beans dominated and continue to increase the number of the family Miridae – 52,1% and Curculionidae – 27,6%. Other species remained less numerous and did not pose a significant threat to soybean cultivation during the years of research.

Given the fact that a certain proportion of harmful soybean field entomocomplex is insufficiently controlled by agricultural techniques and bioagents, and modern culture technology creates additional conditions for reproduction and harmfulness of many species of phytophagous, it becomes almost inevitable widespread use of chemical methods. Until now, one of the urgent problems is its improvement by finding effective insecticides from new classes of chemical compounds, biologicals, formulations, technologies for their use in the system of protection of soybeans from pests.

The timing of insecticide application to plant phenology, taking into account the nature and degree of crop population, is one of the important economically justified measures in terms of combining chemical protection of soybeans from a complex of dominant pests.

Recently, the production of domestic and some foreign insecticides of various formulations is carried out not on the basis of the active substance of its own synthesis, but through the formulation. In addition to the active substance, they contain various surfactants – emulsifiers, stabilizers and other fillers. They help to improve the physical properties of the working fluids: they improve the coverage and retention of droplets on the surface to be treated, increase its viscosity and reduce surface tension. Depending on the fillers to a large extent depend on the toxicological properties of the drugs themselves. In order to reduce the pesticide load on soybean crops, a combination of chemical and biological drugs is possible [2].

This system of measures to protect soybeans is based on monitoring the dynamics of the number of dominant species at certain stages of plant organogenesis and the rational use of modern insecticides and biological products in the optimal timing of their use.

As noted earlier, in the area of our research on soybean crops, *Etiella zinckenella* Tr. and *Tetranychus urticae* Koch. In 2020–2021, the greatest harmfulness of the caterpillar *Etiella zinckenella* Tr., *Tetranychus urticae* Koch. was detected. and a complex of bedbugs – blind bugs (Miridae) in the late flowering phase – poured grain. As their number was close to or exceeded the EPS, there was a need to treat soybean crops with chemical and biological drugs and mixtures thereof. The technical effectiveness of the drugs was determined by the number of dead individuals for a certain period after spraying.

The obtained results indicate that the duration of toxic action and technical efficacy of drugs against the caterpillar *Etiella zinckenella* Tr. was different (table 1).

Table 1

Technical efficiency of the main pests of soybeans (average for 2020–2021)

Variant	Consumption rate, l / ha	The effectiveness of ... days after spraying, %								
		Etiella zinckenella Tr.			*Tetranychus urticae* Koch.			*Bedbugs*-Miridae		
		3	7	14	3	7	14	3	7	14
Control (without insecticides)	-	3,1*	4,7*	5,4*	23,3	27,3	32,2	39,4	45,7	53,6
Zolon, 35% k.e. (standard)	3,0	94,5	89,3	83,3	87,9	82,0	75,2	98,2	94,2	88,4
Decis f-Lux, 10% m.e.	0,25	95,3	93,5	90,8	85,6	77,3	73,4	94,2	90,3	83,3
Dragun, k.e.	1,2	98,7	96,8	93,7	99,7	97,4	94,6	99,0	93,4	89,1
Syntax, g/l	0,2	77,9	74,2	68,0	98,4	88,5	81,9	76,2	71,6	64,9
Aktofit, k.e.	2,0	89,4	84,7	77,6	89,4	83,2	77,6	91,1	87,7	81,9
Dragun + Aktofit	0,6 + 1,0	98,2	93,7	89,6	94,7	90,4	87,2	89,2	83,8	80,7
Syntax + Aktofit	0,1 + 1,0	74,5	71,6	70,2	95,2	87,7	80,8	82,4	78,7	75,5

***** *In the control (without insecticides) indicates the average number of pests, ekz./m^2, ekz./plant, ekz./50 e.m.n.*

3 days after spraying Zolon, k.e. (3,0 l/ha) provided pest mortality at the level of 94,5%, which on the 7th day decreased to 89,3% and on the 14th day – to 83,3%. Had almost the same efficiency indicators, Decis f-Lux, 10% m.e. (0,25 l/ha) and Dragun, k.e. (1,2 l/ha), which provided a significant initial mortality: 95,3% and 98,7%, respectively. After 7 days, the percentage decreased slightly to 93,5 and 96,8. After 14 days, the insect mortality rate varied between 90,8 and 93,7% in both cases.

It is worth noting the toxic effect of the biological product Aktofit, k.e. (2,0 l/ha), which reduced the number of acacia fire at the level of chemicals – 89,4% after 3 days, 84,7% after 7 days and 77,6% after 14 days.

In order to reduce the pesticide load, the effectiveness of mixtures of chemicals and biologicals at half the consumption rate was studied. It was established that the mixture of Dragun with Aktofit already on the 3rd day of spraying provided 98,2% of the death of the pest. The insecticidal effect of the mixture Syntax with Aktofit was slightly lower: 74,5% after 3 days, 71,6 after 7 days and 70,2% after 14 days.

When studying the features of the protective effect of insecticides against the common *Tetranychus urticae* Koch., it was found that 3 days after spraying Zolon provided pest mortality at 87,9%, which on day 7 decreased to 82,0% and on day 14 decreased to 75, 2% (table 1.). The positive effect of Syntax was noted, the efficiency of which was 98,4%, after 3 days, 88,5% after 7 and 81,9%. in 14 days.

Decis f-Lux and Dragun had almost the same toxicity and provided a significant mortality rate: 85,6% and 99,7%. After 7 days, it dropped to 77,3 and 97,4. After 14 days, 73,4% mortality was observed in the variant with Decis f-Lux and 94,6% in the treatment with Dragun.

The biological product Aktofit had a significantly higher effect, although mortality after treatment gradually decreased and amounted to 83,2% after a week and 77,6% after 14 days. The mixture of Sintaku with Aktofit reduced the number of pests by 95,2% (3 days), 87,7% (7 days) and 80,8% (14 days). The effect of the mixture of Dragun with Aktofit was slightly weaker: 90,4% after 7 days and 87,2% after 14 days.

Among the studied insecticides, the highest effectiveness against bedbugs – blind bugs was observed in the version with Dragun, k.e. (table 1). 3 days after spraying, the mortality of phytophages reached 99,0% and gradually decreased to 89,1% after 14 days. Syntax ensured pest mortality at 76,2%, which remained at 64,9% on day 14. The protective effect of Decis f-Lux was noted, which provided a significant mortality rate – 94,2%. After 14 days, 83,3% of mortality was noted. Zolon's efficiency reached 98,2% and remained almost constant – 88,4% on the 14th day.

High efficiency was provided by the biological product Aktofit, where the mortality rate of bedbugs reached 91,1%. As against other pests, the mixture of Dragun with Aktofit even 7 days after spraying provided 83,8% death of bedbugs and on day 14 reached 80,7%. The effect of the mixture of Syntax with Aktofit was slightly weaker – 78,7%.

Therefore, it was found that a single application of Decis f-Lux, 10% m.e. (0,25 l/ha) and Dragun (1,2 l/ha) provided 95,3–98,7% of the death of acacia firefly (*Etiella zinckenella* Tr.) and Dragun (1,2 l/ha) and Sintak (0,2 l/ha) 99,7 and 98,4% – spider mite (*Tetranychus urticae* Koch.). At the same time, the amount of damage to soybean seeds decreased by 4,2–5,8 times compared to the control, and the preserved yield averaged 0,63 t/ha. The use of the biological product Aktofit, 0,2% k.e. contributed to the death of phytophages at the level of 89,4%, reduction of seed damage by 4,2 times and preservation of the yield at the level of 0,60 t/ha. The efficiency of mixtures of Dragun and Sintak with Aktofit in half the consumption norms exceeded the efficiency of Aktofit, but was lower than that of Dragun, which were used in full norms. This makes it possible to reduce the pesticides load of chemicals on the agrocenosis.

The significant influence of insecticides and biological products against phytophages on crop productivity was revealed. It should be noted that the harvest from the variants of the experiment significantly exceeds the control. High technical efficiency of crop treatment provided the highest value of the preserved yield – 0,66 t/ha when using Dragun and 0,63 t/ha – a mixture of Dragun and Aktofit (table 2).

Table 2

Economic efficiency of insecticides on soybean crops against the main pest species (average for 2020−2021)

Variant	Consumption rate, l/ha	Seed damage, %	Weight of 1000 seeds, g	Yield, t/ha	
				actual	saved
Control (without insecticides)	-	4,3	126	2,02	-
Zolon, 35% k.e. (standard)	3,0	2,6	136	2,49	0,47
Decis f-Lux, 10% m.e.	0,25	1,1	141	2,61	0,59
Dragun, k.e.	1,2	0,8	145	2,68	0,66
Syntax, g/l	0,2	2,9	133	2,57	0,55
Aktofit, k.e.	2,0	1,1	140	2,62	0,60
Dragun + Aktofit	0,6+1,0	1,5	139	2,65	0,63
Syntax+ Aktofit	0,1 + 1,0	1,9	136	2,60	0,58

The damage of seeds to the caterpillar of acacia firefly (*Etiella zinckenella* Tr.) varied in the range of 0,8–1,6%. Spraying of crops with a mixture of Syntax with Aktofit ensured the preservation of the yield at the level of 0,58 t/ha, slightly higher was observed in the variant of Dragun with Aktofit – 0,63 t/ha. Decis f-Lux, 10% mk.e provided 0,59 t/ha of additional yield with seed damage of 1,1%. Aktofit was more effective than Decis f-Lux, 10% m.e., because with a similar damage, this figure reached 0,60 t/ha.

According to the results of research, spraying of soybean crops with insecticides and biological products helped to reduce plant damage by phytophagous in all variants of the experiment by 5,7–1,4 times compared with the control and increase the value of the preserved crop yield in the range of 0,47–0,66 t/ha.

Conclusions. As a result of the conducted researches in the Vinnytsia region the species composition of the entomocomplex of soybean agrocenosis, features of biology of dominant species of phytophagous are specified, efficiency of biological and chemical methods of protection of culture against pests is studied.

In the forest-steppe conditions of the right bank, 46 species of harmful insect species from 7 orders and 16 families and one species of herbivorous mites were found on soybean crops. The largest species diversity was characterized by a number of Hemiptera, the share of species in the structure of the harmful entomocomplex was 39% of the total.

There are three critical periods of plant development, which are associated with the most dangerous species of phytophagous: seedlings, flowering and the formation of beans. In the harmful entomoacaricomplex of soybean agrocenosis the most dangerous are: *Etiella zinckenella* Tr., *Tetranychus urticae* Koch. and a complex of bedbugs – *Lygus pratensis* L., *Lygus rugulipennis* Popp., *Adelphocoris lineolatus*, whose population density annually reaches or exceeds the indicators of EPS.

When spraying soybean crops in the period of the beginning of the formation of beans against acacia fire (*Etiella zinckenella* Tr.), the most effective: Dragun, k.e. (1,2 l/ha), Decis f-Lux, 10% m.e. (0,25 l/ha) and a mixture of Dragun, k.e. with Aktofit, k.e. (0,6 + 1,0 l/ha), the technical efficiency of which was 95,3 and 98,7% (above the standard Zolon, k.e. – 94,5%). At the same time, seed damage decreased by 4,2–5,6 times, and the preserved yield averaged 0,59–0,63 t/ha. Aktofit, k.e., was somewhat inferior in efficiency. (89,4%).

When spraying soybean crops against the common spider mite (*Tetranychus urticae* Koch.), the most effective were Dragun, k.e. (1,2 l/ha), Syntax (0,2 g/l) and a mixture of Syntax, g/l with Aktofit, k.e. Their technical efficiency was 95,2 and 99,7%, respectively (Zolona, k.e. – 87,9%). The saved yield was 0,55 and 0,66 t/ha.

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АНОТАЦІЯ

ВИДОВИЙ СКЛАД ШКІДНИКІВ АГРОЦЕНОЗУ СОЇ ТА КОНТРОЛЬ ЇХ ЧИСЕЛЬНОСТІ У ПРАВОБЕРЕЖНОМУ ЛІСОСТЕПУ

У статті представлені результати досліджень з уточнення видового складу шкідливого ентомокомплексу соєвого агроценозу в умовах правобережного Лісостепу.

Встановлено, що найбільш шкідливими фітофагами виявились акацієва вогнівка (Etiella zinckenella Tr.), павутинний кліщ (Tetranychus urticae Koch.) та клопи-сліпняки, що належать до родини Miridae. Виявлено, шість періодів розвитку рослин сої, з якими пов'язані певні комплекси фітофагів, з яких три – критичні, коли необхідно проводити активні заходи захисту. В залежності від пошкоджень різних органів рослин, фітофаги сої умовно діляться на такі групи шкідників: бульбочок, кореневої системи, листя і стебел та генеративних органів. Обґрунтовано застосування прийомів та ефективність сучасних хімічних і біологічних препаратів та їх сумішей проти найбільш небезпечних видів членистоногих.

Згідно результатів наших досліджень нами встановлено, що обприскування посівів сої в період початку формування бобів проти акацієвої вогнівки найбільш ефективні: Драгун, к.е. (1,2 л/га), Децис f-Люкс, 10% мк.е. (0,25 л/га) та суміш Драгуна, к.е. з Актофітом, к.е. (0,6+1,0 л/га), технічна ефективність яких складала 95,3 та 98,7 % (вище еталону Золон, к.е. – 94,5%). При цьому пошкодженість насіння зменшилась в 4,2–5,6 рази, а збережений врожай становив в середньому 0,59–0,63 т/га. Дещо за ефективністю поступались Актофіт, к.е. (89,4 %).

За обприскування посівів сої проти звичайного павутинного кліща *найефективнішими виявились Драгун, к.е. (1,2 л/га), Сінтак (0,2 г/л) і суміш Сінтак, г/л з Актофітом, к.е. Технічна ефективність їх складала 95,2 та 99,7 % відповідно (Золону, к.е. – 87,9 %). Збережений врожай при цьому становив 0,55 та 0,66 т/га.*

Ключові слова: *соя, шкідники, ентомокомплекс, інсектициди, ефективність, урожайність*

Табл. 2. Рис. 1. Літ. 13.

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