SCIENTIFIC HORIZONS

Journal homepage: https://sciencehorizon.com.ua

Scientific Horizons, 24(1), 61-67

UDC 632.7:634.25(477.7)
DOI: 10.48077/scihor.24(1).2021.61-67

SPECIES COMPOSITION OF HARMFUL ENTOMOCOMPLEX IN PEACH ORCHARDS OF SOUTHERN UKRAINE

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Article's History:
Received: 02.12.2020
Revised: 27.01.2021
Accepted: 15.03.2021

Suggested Citation:
Yudytska, I., & Klechkovskyi, Yu. (2021). Species composition of harmful entomocomplex in peach orchards of Southern Ukraine. *Scientific Horizons*, 24(1), 61-67.

Abstract. Studies of the dynamics of changes in the species composition of pests in fruit orchards in the context of climate change became especially relevant. Monitoring of phytophagous insects in gardens with the isolation of dominant species is a key component for building an effective system of protection of perennial plantings. The study was conducted in 2018-2020 on the basis of the Melitopol Experimental Station of Horticulture named after M.F. Sidorenko IS NAAS. The purpose of the study was to establish the species composition of phytophages and the level of their colonisation of peach orchards to optimise measures to protect this crop from pest damage. Conducting route and detailed surveys in different phases of tree development (swelling of buds, pink bud, flowering, end of flowering, forming, growth and ripening of fruits) showed that the entomocenosis of peach orchards consisted of 15 species of phytophagous insects belonging to 4 orders, 10 families, and 2 species of mites. The species composition and level of pest colonisation of peach orchards changed under the influence of weather conditions and protection measures. *Lepidoptera* insects were represented by 7 species of pests, among which the main carpophages were *Grapholitha molesta* Busck., to a lesser extent *Anarsia lineatella*. The attack density of these pests each year was at a high and medium level, respectively. Throughout all the years of study most harmful of insects from the order Coleoptera was polyphagous *Epicometis hirta*. The main *Homoptera* pest in 2018 was *Quadraspidiotus perniciosus* Comst., while the prevalence of other catfacing insects was weak. During the vegetation periods of 2019-2020 the development of insects such as aphids and increase in the colonisation of leaves by mites, *Thrips fuscipennis* Haliche and *Typhlocyba rosae* L. was recorded in peach orchards

Keywords: pest colonisation, monitoring, peach orchards, phytophages

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INTRODUCTION

Horticulture is an important branch of the agro-industrial complex of Ukraine, which meets the needs of the population in fruits that contain a complex of important macro- and microelements, as well as vitamins [1]. The range of crops and their varieties depends on the climatic conditions of the region and local agricultural traditions [2]. In the structure of orchards in the South of Ukraine, stone fruit crops dominate. Among them, one of the early fruiting is the peach. This plant is characterised by high taste and its fruits contain approximately 13% of various vitamins and 10.7% of acids [3]. According to statistics in the southern regions, the area of peach orchards as of 2018 was more than 2.9 thousand hectares, but compared to 2000, it decreased almost twice [4].

Species and quantitative composition of pests in orchards is not stable and depends on the age of the gardens, species, and varietal composition [5]. The development of the entomocomplex of perennial plantings begins from the moment the garden is laid and continues throughout the entire period of its cultivation under the influence of biotic and abiotic factors introduced with the planting material and by migration from nearby territories [6]. Significant changes in the biodiversity of entomoacarifauna also occur under the action of pesticides [7; 8]. Analysis of the species composition of pests in the fruit crop agrocenoses indicates the presence of both polyphagous and specialised species. In some phytophages there are periodic increase their numbers and such species such as *Laspeyresia* are constantly harming plantings [9; 10].

A number of authors [11; 12] have determined that the main part of the biomass of phytophagous insects in orchards is from order *Lepidoptera*. Among them, the *Grapholitha molesta* is the most harmful in peach orchards [13-15]. The spread of pests such as *Anarsia lineatella* is observed in outbreaks mostly in older plantings [7; 15]. However, in some countries this phytophagous is the dominant species, as compared with other members of this order [16-19]. According to the observations of N.M. Karpun and O.V. Mikhailova [20] in peach orchards in the humid subtropics of Russia there are about 18 species of pests, while more than 43.7% of harmful species are polyphagous.

The studies by S.P. Iovleva [15] found that in the foothills of the Crimea in peach orchards of different ages there are 30 species of pests and 1 species of mites. In plantings of 3-4 years of age the species diversity is three times smaller. Dominant representatives of a number of isopods are species of the family *Aphididae*, in particular green and striped peach aphids (*Myzodes persicae* and *Brachycaudus persicae*). A number of beetles include 13 species, of which 9 belong to the family *Curculionidae*. The authors noted the strong colonisation of peach orchards by lepidopteran pests, namely the *Grapholitha molesta* and *Anarsia lineatella*. During 2015-2017, it was found that in the territory of the Crimea the peach orchards were dominated by 3 species of aphids, as well as *Grapholitha molesta*, *Anarsia lineatella*, and *Epicometis hirta* [21].

According to a number of authors [14], in the South of Ukraine during 2012-2013, the constant species in the peach agrocenoses were *Grapholitha molesta*, *Anarsia lineatella*, *Myzodes persicae*, and *Tetranychus crataegi* Hirst. The colonisation of trees with *Epicometis hirta*, *Sciaphobus squalidus* and other phytophagous species is observed not every year. According to the study in 2018-2019, it was found that the main pests of peach were *Grapholitha molesta* and *Quadraspidiotus pemiciosus* [22].

R. Andreev and P. Vasilev note that in Bulgaria the most common pests on peaches are the *Grapholitha molesta* and *Anarsia lineatella*. In addition to these phytophages, 8 species of aphids have been recorded, while only 3 of them are dominant and of economic importance [23]. In peach orchards in Brazil, the most common pests are fruit flies of the family *Tephritidae*, the larvae of which will cause large yield losses [24].

Changes in the main meteorological parameters of the climate in today's conditions lead to changes in the structure of the complex of pests [25; 26]. In this regard, the constant monitoring of fruit plantings to obtain information on the species composition of pests, their distribution, levels of damage with the release of dominant phytophages is the basis for making decisions on the applicability of protective measures. Extermination of all pests without exception is always incomparably more expensive than just keeping their numbers below the level of the economic threshold of harm [12].

In view of the above, the purpose of the study was to establish the species composition of phytophagous insects and the level of pest colonisation of peach orchards to optimise measures to protect this crop from pest damage.

MATERIALS AND METHODS

Field and laboratory studies on the species composition of peach pests were conducted in 2018-2020 at the "Naukova" Melitopol Experimental Station of Horticulture named after M.F.Sidorenko IS NAAS. Peach orchards of 2004-2007 years of planting were represented by varieties: Iiyunskyi rannii, Melitopolskyi iasnyi, Charivnyk, Zlatodar, Vireneia, Redhaven, Spokusa, Zolotystyi, Mriya, Yuvileynyi Sidorenka. The scheme of planting trees – 5x4 m, stock – rootstock 1. The soil of the experimental site – heavy loam southern chernozem, soil retention system – black fallow.

Detection of peach pests was carried out by conducting routine and detailed surveys of peach plantatings in accordance with the phases of the host plant: swelling of buds, pink bud, flowering, end of flowering, forming, growth and ripening of fruits. The

number of sample trees was at least 8 of each variety. Determination of the species composition and pest colonisation of peach plantations was carried out using various methods, in particular: visual estimation of pests or damage to leaves, shoots, shaking, the use of pheromone traps. Thus, the estimation of the pest colonisation of peach plantings by weevils started during the bud bursting phase. It was carried out by shaking different sides of the crown of the four branches of each sample tree. *Diaspididae* and *Lecaniidae* were counted during a thorough examination of bark on the trunks, main branches, and shoots. For this, shoots 10 cm long and small parts of the bark with colonies of scale insects (if present on main branches) 3 cm long and 2 cm wide were cut off. The presence of *Tortricidae* was determined by examining 100 inflorescences and leaves on trees. The species composition of mites and the level of their presence were recorded on the leaves of trees, plucking them from all tiers of the tree in the amount of 10 pcs. The colonisation of trees with catfacing insects (aphids, leafhoppers) was carried out by inspecting the leaves and shoots 0.5 m long (two shoots on each side of the crown) [27]. Pheromone traps at the rate of 1 trap per 0.5 ha were used to record lepidopteran pests [28].

The collected material was analysed in the laboratory using MBS-10 binocular microscope. Insect species were established using atlases and identifiers of pests based on plant damage [29; 30]. According to the data on the number of pests, the level of pest colonisation of plantings was determined for each sample.

Weather conditions during the study differed in temperature and moisture content. However, a common feature for weather conditions were increased air temperatures compared with long-term averages. In 2018, the average monthly air temperature during the growing season (April-September) was in the range of +13.4^{0}C...+25.9^{0}C; in 2019 it was +11.4^{0}C +25.3^{0}C; in 2020 +9.4^{0}C...+24.9^{0}C, which is 0.5-4.8^{0}C higher than long-term values. During the spring and summer months, there was 227.2-270.4 mm of precipitation. The uneven distribution of rainfall was observed, which led to a significant deficit of moisture and a decrease in the relative humidity below 50%.

RESULTS AND DISCUSSION

Phytosanitary monitoring conducted in peach orchards during 2018-2020 revealed that the species composition of the entomocomplex is dominated by representatives of the class *Insecta*. The share of which in 2018 and 2020 was 91.7 and 93.3%, from the class *Arachnida* – 8.3 and 6.7%, respectively. In 2019, the share of phytophagous insects decreased slightly to 87.5%, while the share of mites increased to 12.5%.

Throughout the study, the order *Lepidoptera* was widespread and the most numerous in terms of species diversity, which in 2018 accounted for 63.6% of the total number of insect pests (Fig. 1). In 2019-2020, the share of representatives of this order decreased and amounted to 46.7%, which is due to the expansion of the species composition of phytophages in other orders. The orders *Coleoptera* and *Homoptera* in 2018 had 2 species of insects each with a total share of 18.2%. In 2019 and 2020 – 3 and 4 species, which amounted to 20.0% and 26.7 % of the total detected phytophages. In addition, in 2019-2020 the taxonomic structure of the harmful entomocomplex of peach included one species from the order Thysanoptera with a share of 6.6%.

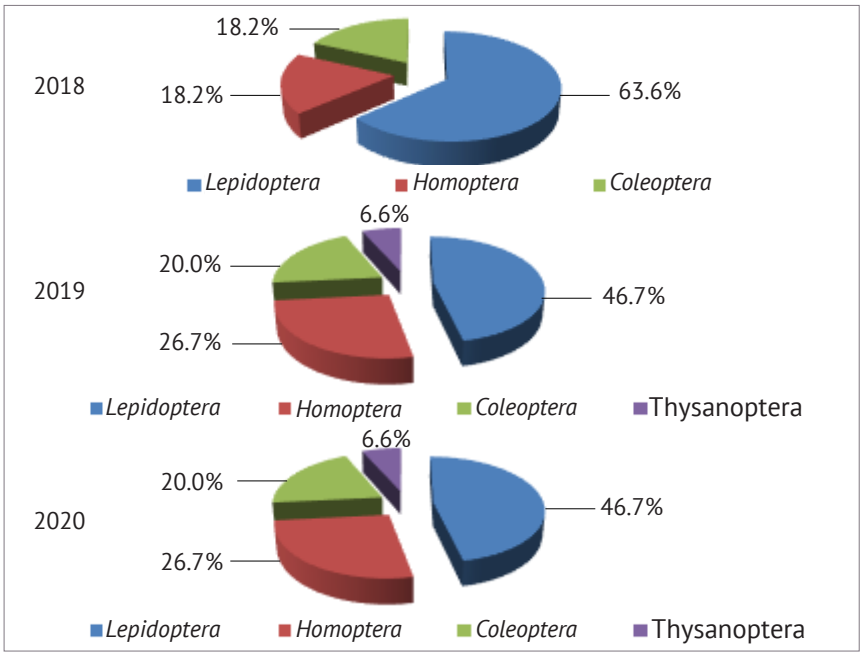

Figure 1. *Taxonomic structure of the harmful entomocomplex of peach plantings (Naukova Experimental Station, 2018-2020)*

In the conditions of the Southern Steppe of Ukraine in the peach agrocenoses, 15 insect pests belonging to 4 orders, 10 families, and 2 species of mites were recorded (Table 1).

***Table 1**. Species composition of the harmful entomocomplex in peach plantings in the South of Ukraine (Naukova Experimental Station, 2018-2020)*

Phytophage	Pest colonisation		
	2018	2019	2020
Class *Insecta*			
Order *Lepidoptera*			
Family *Tortricidae*			
Archips rosana L.	+	+	+
Archips podana Scop.	+	+	+
Grapholitha molesta Busck.	+++	+++	+++
Laspeyresia pomonella L.	+	+	+
Grapholitha funebrana Tr.	+	+	+
Family *Gelechiidae*			
Anarsia lineatella Zell.	++	++	++
Family *Lithocolletidae*			
Lithocolletis cerasicolella H.S.	+	–	–
Order *Homoptera*			
Suborder *Aphidinea*			
Family *Aphididae*			
Myzodes persicae Sulz.	–	++	++
Hyaloplerus pruni Geoffr.	–	+	++
Suborder *Coccoidea*			
Family *Diaspididae*			
Quadraspidiotus perniciosus Comst.	++	++	++
Suborder *Auchenorrhyncha*			
Family *Cicadellidae*			
Typhlocyba rosae L.	+	++	++
Order *Coleoptera*			
Family *Scarabaeidae*			
Epicometis hirta Poda.	+	++	++
Family *Curculionidae*			
Sciaphobus squalidus Gyll.	+	+	+
Family *Buprestidae*			
Capnodis cariosa Pall.	–	+	+
Order *Thysanoptera*			
Family *Tripidae*			
Thrips fuscipennis Haliche	–	++	++
Class *Arachnida*			
Order *Acarina*			
Tetranychus viennensis Zacher.	+	++	–
Tetranychus urticae Koch.	–	++	++

***Note**: + – low pest colonisation; ++ – average pest colonisation; +++ – strong pest colonisation; – species is absent*

It was found that in peach plantings the species composition of pests changed over the years under the influence of weather conditions, varietal characteristics of the crop, protection measures.

The complex of pests from the order *Coleoptera* included 3 species from three families *Scarabaeidae, Curculionidae, Buprestidae*. Among them, the greatest damage was caused by the polyphagous *Epicometis hirta,* the imago of which feeds intensively on flowers during the flowering of fruit trees and leads to significant crop losses [12]. During the flowering of peach trees in 2018 (15-17.04-24.04) under dry weather conditions and average daily air temperature +10.6ºC … +15.8^{0}C, a weak population of pest beetles was established. In 2019, during the flowering of peach trees (17–18.04-26-27.04), the average daily air temperature was +7.4^{0}C…+18.1^{0}C (maximum – +25.6^{0}C), while the density of *Epicometis hirta* was higher than 2018. The level of pest infestation in the flowering phase of trees in 2020 (09-10.04-21-22.04) was lower than in 2019, due to the freezing of reproductive buds and low intensity of flowering trees. In addition to *Epicometis hirta* in the early spring period, a weak colonisation of trees with *Sciaphobus squalidus* was recorded, during the summer – with *Chrysobothris affinis*.

Among the pests of the order *Homoptera* there is a dangerous quarantine phytophage – *Quadraspidiotus pemiciosus*. The degree pest colonisation during the three years of study was at the average level. In the South of Ukraine, the pest colonisation of peach orchards with *Quadraspidiotus pemiciosus* fluctuates significantly [18]. It was found that peach plantings were dominated by two species of aphids, the intensive reproduction of which is observed from late May to mid-summer. At the same time, in 2018, the development of catfacing phytophages from the suborder Aphidinea was not recorded on any of the studied varieties. However, in 2019 the pest colonisation of gardens with *Anarsia lineatella* was at an average level, *Tetranychus urticae* Koch. – at a weak level, in 2020 – at an average level of both species.

In the peach agrocenoses, *Typhlocyba rosae* L. was a permanent species belonging to the order *Homoptera*. Reproduction of this pest in 2018 was observed during August at a weak level, which was due to the high average daily air temperature +23.0^{0}C…+28.9^{0}C and a significant deficit of moisture. In the following 2019 and 2020, the appearance of *Typhlocyba rosae* L. was recorded in peach plantations in late May-June and August, with the average degree of pest colonisation.

During the summer period, the development of representatives of the class *Arachnida*, including two species of mites, was observed. It was found that during 2018 and 2019, on different varieties of peach, respectively, a weak and medium contamination of leaves with motile stages of mite (*Tetranychus viennensis Zacher*) was recorded. The reproduction of the common spider mite was detected in 2019 and 2020 at an average level.

In 2019 and 2020, in addition to the above species of catfacing insects, the average pest colonisation of peach leaves with *Thysanoptera* was recorded. It was found that in the peach agrocenoses, 7 pests from the order *Lepidoptera* were recorded, belonging to 3 families, the most numerous of which is the family *Tortricidae*. During the years of study there was a low degree of colonisation of peach orchards by two types of tortrix (*Archips rosana* L. and *Archips podana* Scop.). In 2018, there was a weak colonisation of trees by a member of the family *Lithocolletidae* – *Lithocolletis cerasicolella* H.S. In subsequent years, observations of peach leaves damaged by the insects were not observed.

Males of 4 species of lepidopterous phytophages were caught on pheromone traps in peach orchards. The most common and most dangerous of these insects was *Grapholitha molesta*. Depending on weather conditions, the flight of insects lasted from mid-April to late September. The four peaks of phytophagous flight corresponds to the development of four generations. At the same time, the colonisation of peach orchards by *Grapholitha molesta* was at a high level in all years of study. In the conditions of the South of Ukraine in peach orchards the *Grapholitha molesta* belonging to the family *Gelechiidae* also has indirect distribution [12]. The development of two complete generations and partially the third has been established. During the years of observation, the flight of Grapholitha molesta began in the 10th-20th day of May and lasted until the 20th-30th day of September. At the same time the pest colonisation of the species was at the average level.

CONCLUSIONS

In the peach agrocenoses, the species composition of insect pests in the Southern Steppe of Ukraine includes 15 phytophagous insects belonging to 4 orders, 10 families, as well as 2 species of mites. The level of pest infestation changed during the years of observations under the influence of weather and climatic conditions, and protective measures. The most numerous species in terms of species diversity was *Lepidoptera* Lepidoptera – 46.7–63.6% of the total composition of phytophagous insects. Among which the constant and most harmful fruit-damaging species was *Grapholitha molesta* Busck., to a lesser extent – *Anarsia lineatella*. In the spring, *Epicometis hirta* was the most dangerous among insects from other orders. During the summer, there was a low and medium colonisation of peach plantations by catfacing insects (*Quadraspidiotus perniciosus, Myzodes persicae, Hyaloplerus pruni, Tetranychus viennensis* and *Tetranychus urticae, Typhlocyba rosae*), the total harmfulness of which was reflected in the weakening of trees productivity due to damage to vegetative organs.

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ВИДОВИЙ СКЛАД ШКІДЛИВОГО ЕНТОМОКОМПЛЕКСУ У НАСАДЖЕННЯХ ПЕРСИКА ПІВДНЯ УКРАЇНИ

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Анотація. Дослідження динаміки змін видового складу шкідників у плодових насадженнях в умовах змін клімату набувають особливої актуальності. Моніторинг фітофагів у садах з виокремленням домінуючих видів є основною складовою для побудови ефективної системи захисту багаторічних насаджень. Метою досліджень, що проводились протягом 2018–2020 рр. на базі Мелітопольської дослідної станції садівництва імені М.Ф. Сидоренка ІС НААН, було встановлення видового складу фітофагів і рівня заселеності ними у насадженнях персика для оптимізації заходів захисту даної культури від пошкодження шкідниками. Проведення маршрутних і детальних обстежень у різні фази розвитку дерев (набрякання бруньок, рожевий бутон, цвітіння, кінець цвітіння, формування, ріст і дозрівання плодів) дало змогу визначити, що ентомоакароценоз персикових насаджень складався з 15 видів комах-фітофагів, що належать до 4 рядів і 10 родин та 2 видів кліщів. Видовий склад і рівень заселеності насаджень персика шкідниками змінювався під впливом погодних умов, проведених заходів із захисту. Ряд лускокрилих був представлений 7 видами шкідників, серед яких основними карпофагами є східна плодожерка, меншою мірою фруктова смугаста міль. Інтенсивність заселення насаджень персика даними шкідниками кожного року знаходилась на високому та середньому рівні відповідно. Протягом усіх років досліджень з ряду твердокрилих найбільшу шкідливість завдавав багатоїдний фітофаг оленка волохата. Основним шкідником з ряду рівнокрилих у 2018 р. виявилася каліфорнійська щитівка, а заселеність іншими сисними фітофагами була на слабкому рівні. Протягом вегетаційних періодів 2019 та 2020 рр. у насадженнях персика зафіксовано розвиток сисних фітофагів з підряду попелиць і підвищення рівня заселення листків персика кліщами, трипсом розановим і цикадкою розановою

Ключові слова: заселеність, моніторинг, насадження персика, фітофаги