Ukrainian Journal of Ecology

Ukrainian Journal of Ecology, 2020, 10(1), 277-288, doi: 10.15421/2020_44

ORIGINAL ARTICLE *UDC [632.768.12Ц:634.11]:632.951*

Ukrainian and international experience of integrated protection of apple-tree from apple-blossom weevil (*Anthonomus pomorum* Linnaeus, 1758)

I. V. Zabrodina, M. D. Yevtushenko, S. V. Stankevych*, O. A. Molchanova, H. V. Baidyk, I. P. Lezhenina, M. O. Filatov, L. Ya. Sirous, D. D. Yushchuk, V. O. Melenti, O. V. Romanov, T. A. Romanova, O. M. Bragin

V.V. Dokuchaev Kharkiv National Agrarian University, v. Dokuchaevske, Kharkiv Region, 62483, Ukraine

**Corresponding author E-mail: sergejstankevich1986@gmail.com*

Received: 20.01.2020. Accepted 26.02.2020

In the course of critical analysis of the literature, the authors paid special attention to the elements of the integrated protection of apple plantations from apple-blossom weevil. The protective measures were considered in such directions as agro-technical, physical and mechanical, chemical, biological, biotechnical and selective and genetic ones. Each of them is noteworthy and has both a number of disadvantages and indisputable advantages in comparison with other methods. At the pre-imago stages of development the main factors in the death of the apple-blossom weevil are the infestation of larvae and pupae with the parasitoids, larvae disease, cannibalism, destruction by predators and leafworms feeding on the same buttons, and rapid opening or underdevelopment of the button. First of all the essence of pest control in the garden is the timely and careful destruction of the hibernating stock. First and foremost the old bark should be carefully removed from the trunks of fruit trees and skeletal branches. The apple-blossom weevil spends most of its development in the buttons. Therefore it is necessary to control the beetles that came out of the hibernating places. Chemical protection measures should be applied only during the years of the mass appearance of the pest. The oriented criteria for the use of the extermination measures in fruit plantations are 40–50 beetles per a middle-aged tree. The insecticide treatment of fruit plantations is recommended to carry out in terms that would allow preserving the entomophages. One of the alternatives to use the chemical pest control method is the biological method, especially it is recommended to use it in the old gardens. This fact is based on the analysis of the trophocenotic consortium connections of the phytophages of the apple garden, in which the majority of the dendrophilous species should be considered as the feeders that cause the preservation of the parasitic species populations during the years of the garden pest depressions. Another condition for the preservation of the parasitic species in the gardens is to create a forage reserve for the imago nutrition. Trophic bonds can be retained as dominant only in the absence of garden pesticides treatments or with minor treatments. The use of the chemical method of protection leads to the significant changes in the consortium formula.

Key words: Apple-blossom weevil; Harmfulness; Economic threshold of harmfulness; Integrated protection

Introduction

An important task of modern systems of plant protection, including fruit crops, is to develop and implement the integrated measures that preserve the crops from harmful organisms while being the safest for the environment, animals and humans. The transition to such integrated systems involves the application of the biological method of pest control, reducing the number of pesticide treatments, the ability to use the preparations of selective action together with the entomophages, etc. An important reserve in this program is the activation and use of natural resources of the beneficial insects – parasitoids and predators which limit the number of harmful insect-phytophages (Yevtushenko, 2004; Tkachev, 1992; Triapitsin et al., 1982; Zerova et al., 1992; Hull et al., 1985).

According to M.A. Filippov (1990) the biological method of pest control is a necessary component of the integrated protection, but the high agricultural technology for growing crops, the use of resistant varieties and other methods must be the preconditions.

Considering the current direction of the plantation protection strategy, that is biologization and ecologically friendly environment, it is important to develop the programs that encompass separate techniques which would take into account the natural regulatory role of useful fauna. The deeper researches are connected with determining the role of plants themselves and their varieties as factors that form the ecological environment for the life of the entomocomplex, especially the entomophages (Filippov, 1990).

Vegetative features of any variety determine not only the feeding regime of the phytophage, but also create the specific conditions for both the host plant and its entomophages. The change in the ecological situation connected with the plant variety may have a positive or negative influence on both partners or on one of them depending on the biological characteristics of the phytophage and entomophage. Another situation is perennial, different in varietal composition fruit plantations. And if the species compositions of the entomocomplex and its biotic potential have been investigated thoroughly, the researchers paid little attention to the features and nature of the interaction of the entomocomplex with the fruit trees of different varieties. This is especially true for the study of the variety response to the efficiency of the natural entomophages and to the ratio of phytophage – entomophage when seasonal colonization of the entomophages is used.

Developing a modern strategy for the protection of fruit plantations, especially under the conditions of industrial fruit production, has proved to be the most difficult one. Some progress has been made in creating the optimum phytosanitary condition on the private plots and in the collective gardens. The extensive application of viral, bacterial and fungal biopreparations, protection and use of local entomophages, and rational application of chemical measures (taking into account the economic thresholds of the phytophages harmfulness and the criteria of the parasitoids, predators and pathogens number) became here especially important.

The role of blossoming plants for attracting the beneficial insects, increasing their life expectancy and the efficiency is well known. Extra feeding is especially needed for those entomophages which flight does not always coincide with the populating of a particular pest stage in nature.

In practice it is recommended to create the areas of concentration and extra feeding of the entomophages near the fruit plantations by sowing cultivated and wild nectariferous plants (Krykunov, 2002; Chernii, 2007).

Due to the increase of the trophic chain in the cenoses of the old gardens, the number of many species inclined to mass reproduction is smoothing over. The increase in the species diversity causes the stability of the garden cenosis and by most properties brings it nearer to natural forest biocenoses.

One of the major factors that reduce the species diversity and number of natural insect populations is the excessively ungrounded application of pesticides. The decrease in pesticide loading on agrocenoses that took place in the last 10–12 years has led to a significant increase in the species diversity (Krikunov, 2001; Sumarokov, 2003).

Some 20–30 year-old apple gardens are not inferior to natural and semi-natural (shelterbelt forests and parks) plantations in biodiversity. Taking into account the abundance of arable land characteristic for the region and the role of fruit plantations as "islands" of biodiversity, it makes sense to preserve some insufficiently fertile old gardens transferring them into the park plantations (Yevtushenko, 2003, 2006).

Various types of the entomophages and pathogens greatly influence the number and harmfulness of many pest species of fruit plantations. They affect the phytophages throughout the vegetation period of the trees. In fact it is possible to detect a particular parasitoid, predator or disease at any stage of the pest development. The share of the infected phytophages depends on the peculiarities of weather conditions, application of pesticides, agro-technical measures under the garden conditions, weed destruction, presence of the nectariferous plants and green-manure plants in the gardens or adjacent agricultural land and a number of other factors (Tkalenko, Hrodskyi, Korovin, 2008; Shevchenko, 2008; Kryvosheiev, Omeliuta, 2004).

The methods aimed at the use of the natural enemies play the top priority role in regulating the number of pests of fruit and berry crops (Kolesova, 1995).

Materials and Methods

The authors have analysed 186 literary and electronic sources from the end of the 19th to the 21st centuries. In the course of the analysis special attention was paid to the methods and ways of controlling the apple-blossom weevil on fruit plantations both in Ukraine and abroad. The protective measures were considered in such directions as agro-technical, physic and mechanical, chemical, biological, biotechnical and selective and genetic ones. Each of them is noteworthy and has both a number of disadvantages and indisputable advantages in comparison with other methods.

Results and Discussion

At the pre-imago stages of development the main factors in the death of the apple-blossom weevil are the infestation of larvae and pupae with the parasitoids, larvae disease, cannibalism, destruction by predators and leafworms feeding on the same buttons, rapid opening or underdevelopment of the button (Matveichik, 1998; Tretiakov, 1984). The Hymenoptera line is one of the largest insect lines including a large number of the beneficial species. The largest number of the entomophages used for the biological destruction of harmful species belongs to the Parasitica suborder (Suhoniaiev, 1969).

According to the data of I.O. Porchynskyi (1912) and M.D. Zerova (1992) the entomophages of the apple-blossom weevil have been studied most carefully. The main role in the regulation of this pest number is played by the membrane-winged insects. The most known species of the apple-blossom weevil entomophages and the predatory bug of the genus Anthocoris (family Anthocoridae) belong to Ichneumonidae, Braconida and Pteromalidae. According to the literary sources and the researches of V.F. Drozda (2000) the entomophages play a certain regulative role in the apple-blossom weevil ontogenesis. Among them are the parasitoids of larvae and pupae of *Habrocytus grandis* Walk., *Tetrastichys pospjelovi* Kurd. – the primary and secondary parasitoid (the Braconidae family), *Scambus annulatus* Kiis., *S. pomorum* Ratz. (the Ichneumonidae family) as well as *Syrrhizus delusorius* Först. (the Braconidae family) which infects the beetles (3.2-12.6%).

In the 30's more than 30% of weevil larvae were infected with tachinid pimple in the gardens near Moscow. Recently as a result of the application of chemical measures the number of the beneficial insects that destroy the weevils has decreased. The adult insect feeds on the flower nectar of the umbelliferous crops (dill, parsley, carrots, etc.) as well as buckwheat, garden radish, phlox, lemon balm and many other crops (Eberg, 1965). According to the data of O.F. Nikolaieva (1973) the natural enemies are also important in some gardens of the Oriel region where they destroy up to 30-40% of the larvae and pupae of the apple-blossom weevil. She revealed the natural enemies of the apple-blossom weevil; they are the ichneumon wasps *Habrocytus tenuicornis* Foerst. (Chalcididae) and *Scambus* sp. (Ichneumonidae), the predatory bug *Anthocoris nem*orus L. and the insectivorous birds.

From 1976 to 1980 Matviievskyi et al. (1987) studied the influence of the entomophages on the number dynamics of the apple-blossom weevil in Ukraine. Such entomophages as ichneumonids flies from the Chalcid, Ichneumonid and Braconid families and some samples of tachinids were bred from the larvae and pupae of the apple-blossom weevil. The populating of larvae and pupae with the entomophages were in the range of 8.1–21.7%. But during the years of the research a significant effect of the entomophages on reducing the number of the apple-blossom weevil has not been noticed. In the Kharkiv region the parasitoids of the apple-blossom weevil from a line of Hymenoptera were also found and identified. They are *Scambus annulatus* Kiss*., Scambus planatus* Htg. (Ichneumonidae), *Triaspis pallipes* Nees*.* (Braconidae), and *Habrocytus grandis* Walk*.* (Pteromalidae) (Yevtushenko, 2009; Zabrodina, 2007).

Due to the research of V.F. Drozda (2000), carried out in the private and bad-groomed industrial gardens (Opened Joint Stock Partnership "Berezanske") of the Kyiv region during 1993-1998 it was found that at the pre-imago stages of development the determining factors led to the death of the apple-blossom weevil were the parasitoids of larvae and pupae; the rate of death was up to 27.9%. According to the reproductive strategy the entomophages of the apple-blossom weevil belong to the synovigenic species. The ovogenesis of the females has a cyclic character and in order to have a valuable nutrition they need to feed on carbohydrates

(nectariferous plants) as well as protein (host hemolymph) throughout the whole life cycle. They are developing synchronously with the hosts. However under the most favourable conditions, the absence of the insecticide treatments and in the presence of the nectariferous plants the level of infestation of the apple-blossom weevil with the parasites is negligible. This fact is evidenced by the condition of the fruit trees growing on the territory of the Institute of Plant Physiology and Genetics. The annual rate of the population here is 90–100%; the damage of the buds is 18– 48%, the damage of buttons is 25–70%, and the damage of the flowers and leaves is 15–45%. It has been also determined that the role of the predators in the ontogenesis of the apple-blossom weevil was insignificant; on the average they destroyed from 1.6 to 5.2% of larvae and pupae (Drozda, 2000).
An important factor in the death of the beetles in the spring is the death caused by the parasitoid *Syrrhizus delusorius* Först. from the Braconidae family; from 1.0 to 15.4% of the apple-blossom weevil imago were infected with it under the conditions of the Moscow region at different times (Tretiakov, 1989).
Habrocytus grandis Walk*.* from the *Pteromalidae* family and *Scambus annulatus* Kiis*.* from the *Ichneumonidae* family are also the parasitoids of larvae and pupae of the apple-blossom weevil under the conditions of the Moscow region and Belarus. At the same time *Habrocytus grandis* Walk. dominates in the gardens where the protective measures were carried out. Under the conditions of the Moscow region the death of larvae and pupae of the apple-blossom weevil from the parasitoids reaches 23.1% (Tretiakov, 1984). In Belarus the parasitism of pre-imago stages ranged from 0.09 to 10%, and the parasitism of the imago did not exceed 0.6% (Matveichik, 1998).
Under the conditions of Belarus the entomophages practically don't play any role in changing the number of the apple-blossom weevil. But in some years the infestation of larvae with a complex of the parasitic membrane-winged insects from the Ichneumonidae and Braconidae families reaches 24% in some gardens. The main parasitoids of the weevil larvae in Belarus are *Scambus calobatus* Grav. and *Bracon intercessor* Nees., which fly out in June (Ambrosov, 1976).
In Georgia (Okroshiashvili, 1996) the infestation of pre-imago stages with the parasitic membrane-winged insects from the Pteromalidae family is 16 – 56%, and the death of the apple-blossom weevil during the winter is 2 %.
In Poland (Piekarska, 1998) the infestation of pre-imago stages of the apple-blossom weevil parasitoids was 3.2–5.4 %, and the main species are *Scambus annulatus* Kiis., *S. calobatus* Grav., and *S. pomorum* Ratz.
In the Netherlands (Zijp, 1992, 2002) the main parasitoids of the apple-blossom weevil are *Syrrhizus delusorius* Först. and *Scambus pomorum* Ratz. *Syrrhizus delusorius* Först. They were found in only six of the fifteen gardens populated by the apple-blossom weevil in the Netherlands; and in two gardens the infestation of the hibernating apple-blossom weevils reached 30% (Zijp, 2002).
22.3–41.3% of the individuals die at the pre-imago stages of the apple-blossom weevil development, and only 13.1–33.8 % of the individuals die from parasitism and predators. Taking into account the high fertility of the apple-blossom weevil and the ratio of sexes close to one, we can conclude that the main factor in reducing the number of the apple-blossom weevil is the death from the parasitoids and soil entomophages at the imago stage during the migration of the beetles to hibernation and one more factor is the unfavourable winter conditions (Tretiakov, 1982). The representatives of the Carabidae and Staphylinidae dominating in the soil in the leaf litter, where the apple-blossom weevil imago get migrating to hibernation or falling under the force of sharp mechanical irritations, constitute the most part of the apple-blossom weevil zoophages (Yevtushenko, 2004). In addition the birds, especially the tomtit (*Parus mayor* L.), peck the beetles in the hibernating places and in the crown of the trees in summer (Zerova et al., 1992). The sparrows (*Passer domesticus* L., *Passer montanus* L.) rearing their chicks with the apple-blossom weevil larvae are of great benefit in reducing the number of the beetles in the Moscow suburbs (Blagosklonov, 1972; Eberg, 1965).
Both the abiotic factors and the biotic ones influence the number of the apple-blossom weevil. Thus, according to M.M. Tretiakov (1984) the optimum temperature for the egg laying is in the range of 12–15°C. At a temperature of 15°C the egg laying lasts 1.6 days on the average, and at a temperature of 25°C it lasts only 6 days (Tretiakov, 1984). Therefore the prolonged spring season facilitates the egg laying process of the apple-blossom weevil and the realization of all its reproductive potential (Duan et al., 1996). On the contrary in the years with high spring temperatures the intensive opening of the buttons causes the eggs and young weevil larvae to fall out of them. Thus, under the conditions of the Kiev region the death of the pre-imago stages of the apple-blossom weevil due to the rapid button opening reached 14.8–25.6% (Dospiekhov, 1985), in the Moscow region it reached 21,5% (Tretiakov, 1984).
The parasitic membrane-winged insects play a certain role in regulating the number of the apple-blossom weevil (*Anthonomus pomorum* L.). 12 species of the most common entomophages of the apple-blossom weevil are known; 6 species belong to the Ichneumonidae family, 5 species belong to the Braconidae family and 1 species belongs to the Pteromalidae family*.* Among them 11 species are the primary parasitoids and one species may be both the primary and the secondary parasitoid. *Syrrhizus delusorius* Forst. (Braconidae) infects the adult beetles; *Habrocytus grandis* Walk. (Pteromalidae) develops on the larvae as well as on the pupae, and the remaining species are the parasitoids of the larvae*.* The parasitoids usually infect up to 20% of the apple-blossom weevil larvae. The trophic connections of the main entomophages *Anthonomus pomorum* L. are shown in Figure 1 (Zerova et al., 1992)*.*

The Ichneumonidae family

Ichneumon wasps are one of the most numerous groups of parasitic membrane-winged insects in the complexes of the entomophages of many insect pests, including trophically connected ones with the fruit crops.
Most species of ihneumonids are the primary parasitoids that infect the host larvae, usually of younger age. The ichneumonids have the largest body size among all parasitic membrane-winged insects; the length of their bodies is 3–25 mm. The wings are usually well developed; rarely females (and sometimes males) are wingless. The ovipositor is short or very long. The colour of the body is usually black, often with numerous white, yellow or red spots; rarely may it be completely light.
The ichneumonids mainly infect the larvae and pupae of other insects (the exception is the insect larvae with an incomplete transformation). During the sexual maturation the females need extra carbon and protein nutrition and perform it at the expense of the nectar and hemolymph of the hosts. Both ecto- and endoparasitoids are known among the ichneumonids, some of them are the secondary parasitoids (Zerova, Kotenko, Tolkanets, 2010).
Scambus Hartig genus, 1838. The genus is widespread in the northern hemisphere. There are 24 species in the European part; 10 of them are registered in the fruit garden agrocenosis.

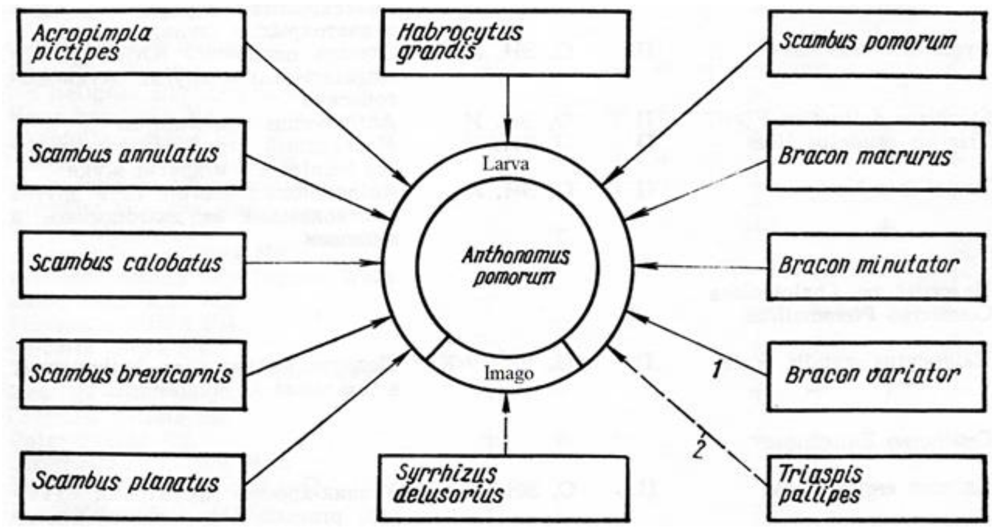

Figure 1. Scheme of trophic connections of main entomophagous species. *Anthonomus pomorum* L.: 1 (continuous line) – ectoparasite, 2 (dotted line) – Endoparasite (Zerova et al., 1992).

The insects are slim, the length of their bodies is 4.5–12 mm. The ovipositor does not exceed the length of the body. In the fore wing the second back vein extends from the mirror between its middle and outer margin. The body is usually black; the legs are from reddish-yellow to yellow, the hind tibiae on the top are darkened.

All members of the genus are ectoparasitoids of the hidden living hosts: weevils (Curculionidae), galloforming membrane-winged insects (Cynipidae and Tentredinidae) and various Lapidopterae (Glyphipterigidae, Gracillariidae, Choreutidae, Geometridae, and Tortricidae). *Scambus annulatus* Kiss. (Figure 2). It is distributed in the European part of the Union of Independent States except the north, in the Caucasus, Kazakhstan, Irkutsk and the Chita regions; in Central Europe and North America.

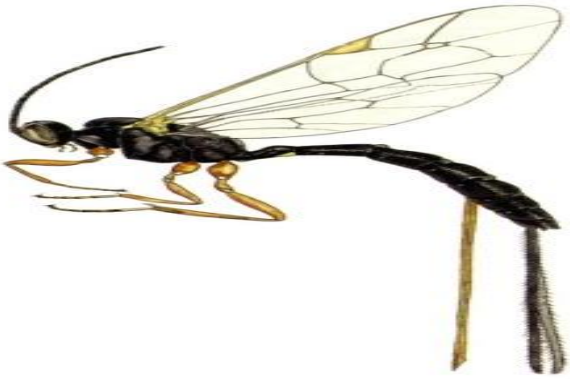

Figure 2. *Scambus annulatus* Kiss.

Females: the vagina of the ovipositor is almost equal to the length of the abdomen. The abdomen is usually black or dark brown. The length of the body is 5–8 mm. The hind coxae are red. The pterostigma is yellowish with brownish margins. *Anthonomus pomorum* L., *Spilonota ocellana* F., *Choreutis pariana* Cl., *Callisto denticulella* Thunb are the ectoparasitoids of larvae.

Males: the head is accurately narrowed to its hind end. The notch on the front thighs is mat and subtly granulated.

It is a common single primary ectoparasitoid of the scaled-winged caterpillars from the families of Glyphipterygidae, Gracillariidae, Choreutidae, Geometridae, and Tortricidae, the larvae of some galloforming membrane-winged insects (Cynipidae, and Thenthredenidae) and the larvae of weevils (Curculionidae). They infect the larvae of the III–IV generations. 2–3 generations develop per year. An adult larva hibernates in a white translucent cocoon next to the host's remains. The imago flies from the beginning of May to the end of August (Zerova, Kotenko, Tolkanets, 2010).

***Scambus planatus* Htg**

It is distributed in the southwest and south of the European part of the Union of Independent States, in the Caucasus, Irkutsk, the Chita regions, and Western Europe.

Females: the head is not narrowed to the back end. The longitudinal dorsal keels of the propodium are often significantly obliterated. The ovipositor is equal to the length of the abdomen. The body is black; the legs are reddish-yellow, the hind tibiae are whitish with a dark pattern at the base and on the top. The length of the body is 8–11 mm. It is the endoparasitoid of the larvae *Anthonomus pomorum* L., and caterpillars *Archips rosana* L., *A. xylosteana* L., *Pandemis heparana* Den. et Schiff., *Ancylis achatana* Den. et Schiff. (Zerova et al., 2010).

Males: the head is almost narrowed to its hind end. The hind coxae are black. The hind tibiae are whitish with dark rings in front of the base and on the top *Braconidae* family.

It includes more than 15 thousand species; among them more than 2 thousand are found in the countries of the former USSR. The braconids are always present in the apple gardens and are the parasitoids of many dangerous pests.

It is one of the largest families of the ichneumon wasps. As a rule the braconids are capable of active flight, but in some species the females do not have wings or they are shortened. The body length of the braconids is from 1 to 25 (more often 2–7) mm. The body in most cases consists of a combination of black and yellow or reddish-brown colour. The ichneumonids are often completely black or brown. The braconids are the primary parasitoids of the larvae and sometimes of the adult insects from the lines of scaled-

winged, sheathed-winged, two-winged, membrane-winged, bugs and net-winged. The larvae develop inside the host (endoparasitoid) or outside of it (ectoparasitoid). The larvae of ectoparasitoids and most endoparasitoids leave the host before pupation and spin a cocoon of a characteristic shape and colour near the substrate. Sometimes a cocoon hangs on a cobweb. A part of the endoparasitoids is pupating inside the mummified host. Most braconids are flying parasitoids. In many terrestrial ecosystems they are high in number and are effective natural regulators of the insect number (Zerova et al., 2010).
Triaspis Haliday genus, 1835. The species of this genus parasitize in the larvae of the beetles (Bruchidae, Curculionidae, Rhinchitidae, and Scolytidae). There are 2 species in the apple gardens.
Triaspis pallipes Nees. (Figure 3). It is distributed in the European part of the former USSR, in the Caucasus, Western Europe and China.

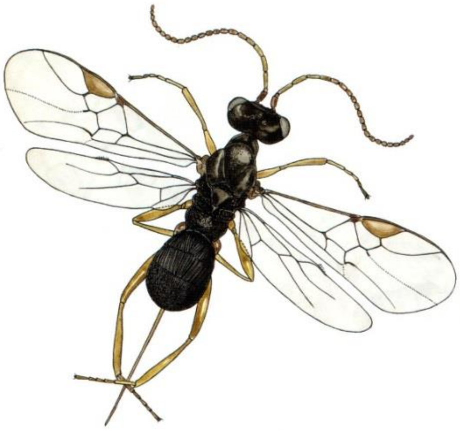

Figure 3. *Triaspis pallipes* Nees.

The first three abdominal tergits form a testa with two transverse sutures. The testa is very short, almost spherical in shape. The ovipositor is equal to the length of the abdomen and thorax taking together. The antennae have 21–24 segments. The abdominal testa is wrinkled-dashed, longitudinally crossed: the third tergit is sometimes almost smooth. The body is black; the legs and tentacles are brownish-yellow, the wings are light; the body length is 1,8–2,5 mm. It is the parasitoid of the apple-blossom weevil, other weevils and some bruchid weevils.
The common, sometimes numerous species is found both in natural ecosystems and in agrocenoses. They fly from April till October. It is an egg-larval endoparasitoid of *Coleoptera* from the Bruchidae and Curculionidae families, as well as from some Apionidae and Attelabidae families (Zerova, Kotenko, Tolkanets, 2010).

Pteromalidae family
The forms of medium size (3 mm) belong to the large family of Pteromalidae. The colour is mostly green; the ovipositor in most species is short. The host range is very wide. The primary and secondary parasitoids of many insect species from different lines are known among the pteromalids. In the fruit gardens the pteromalids are represented by almost 20 species from 10 genera; among them the effective regulators of the number of the apple trees pests are known. The species biology is very diverse (Zerova, Kotenko, Tolkanets, 2010).

Genus of *Habrocytus Thoms.*, 1878
Their post marginal vein is longer than the radial one. The fore margin of the clypeus is even or with a slight groove. The abdomen is elongated, long, and conically sharpened to the top. The genus includes 50 European species; among them 4 species are constantly found in the agrocenosis of the fruit garden. They are mainly the secondary parasitoids of many scaled-winged insects as well as of the blossom beetles.

Pteromalus (Habrocytus) varians *(Spinola) (=grandis* Walker) (Figure 4).
It is distributed in the north of the European part including the Leningrad region and in Western Europe**.**
The middle zone of the intermediate segment is found only in the centre and has a clear dotted line. The head is large, the face is long, and the length of the cheek is slightly more than the longitudinal diameter of the eye. The abdomen is equal to the length of the head and the thorax taking together or slightly longer, the body is bright green, the legs are light. The body length is 3–4 mm. The body is dark green with a metallic lustre. The distance from the fore margin of the intermediate segment to the spiracles does not exceed their diameter. The female's antennae have the rings. The male's head (view from above) lacks 3 notches. The marginal vein is 1.6–1.8 times longer than the radial one. The male's abdomen usually has a large light spot.
It is the single primary endoparasitoid of larvae and pupae of many weevils including *Anthonomus pomorum* L. It can be found everywhere from the forest stands to the farmlands (Zerova et al., 2010).
The problem of improving the integrated protection of plants from the pests, in particular in fruit cenoses, has led many researchers to reasoning its separate aspects: agro-ecological (Khushcha, 1991), agro-biological (Tertyshnyi, 1996), ecological and biological (Krykunov, 2000), biocenotic (Drozda, 2001), and agro-biocenotic (Yanovskyi, 2003) which emphasise the necessity for a justified restriction of the volume of toxic substances and the introduction and extension of biological methods for plant protection. Therefore there is a necessity for further improvement of the integrated plant protection by expanding the capabilities of the biological protection arsenal, in particular at the expense of the representatives of soil entomofauna in the garden cenoses; and the fact that in the course of their development most insects (about 90%) in any case are connected with being in the soil (during the pupa stage or during hibernation) should be taken into account (Yevtushenko, Hrama, 2007). It should be noted that the concept of an integrated approach in plant protection has changed significantly since its appearance. At the initial stage the integrated protection of fruit gardens should be characterised as an agro-technical and partly biological method with a gradual tendency to increase the share of chemical pesticides for protection of the gardens from the pests and diseases; from the second half of the 1930s the chemical method became the dominant one (Yevtushenko, Hrama 2007; Yevtushenko, Hrama 2007; 2007, 2008, 2011).

Figure 4. *Pteromalus (Habrocytus) varians (*Spinola*) (=grandis* Walker).

Modern technology should include the measures to manage the growth and fruit-bearing of fruit trees as well as the methods of suppressing the harmful fauna to economically imperceptible level with the minimal negative impact on the environment and preserving the natural regulatory mechanisms. At the same time it is important to get across a pest control strategy on regulating their development, limiting their number and stabilizing the phytosanitary condition of the fruit garden agrocenosis (Manko, Vlasova, Hrodskyi, 2002; Chernii, 2007).

The garden weevils, especially the apple-blossom weevil, are one of the most dangerous pests of the apple plantations. In the absence of the proper protection they are capable of destroying the garden yields from year to year (Chugunin, 1938).

The harmful fauna of the garden plantations of Germany in Göfchen and Lagerhof made up 180 species, the most numerous of which were the representatives of the *Curculionidae* family. One of the most well-known species is *Sitona lineatus* L. as well as *Rhynchaenus fagi*, the latter has severely damaged the beech and fruit trees (Kolbe, Bruns, 1988).

The weevils belonging to two families prevailed in the apple gardens of the Kharkiv region. They are the apple-blossom weevil (*Anthonomus pomorum L.*), *Sciaphobus squalidus* Gyll., *Otiorrhynchus fullo* Schrnk. and weevils belonging to the Polydrosus genus from the Curculionidae family; *Coenorrhinus pauxillus* Germ, hawthorn weevil (*Coenorrhinus aequatus* L.), and brown leaf weevil (*Phyllobius oblongus* L.*)* from the Rhynchitidae family (Zabrodina, 2008, 2009).

The reason for the significant losses of the seed fruit yields is the underestimation of the economic importance of the pests, the insufficient study of their biological and ecological features, as well as the late implementation of the protection measures and the lack of the effective zonal systems of the protective and preventive measures (Okroshyashvili, 1996).

The system of protective measures of different forms apple trees in the gardens should be corrected taking into account the species composition of the pests and their response to the difference in the main meteorological factors in the tree crowns (Hrodskyi, 2009).

When carrying out the pest control measures it must be remembered that preventing a pest from the appearance is always easier than controlling them in the case when they have already appeared on a mass scale and started to cause harm. The most favourable time for the preventive measures in order to protect the fruit gardens is considered to be autumn and early spring (before bud swelling), when the pest is still dormant (Rodionov, 1932).

First of all the basis of the integrated system is the use of agricultural and mechanical methods and application of the biological and herbal preparations. Chemicals should be used in that case when they do not have a negative effect on the beneficial fauna of the garden agrocenosis and the environment, and if other protective measures do not produce the desired result (Karakosha, 2000).

The best periods for controlling the apple-blossom weevil are the early appearance of weevils and their feeding on buds, their fearfulness and ability to hibernate in hiding places and partially under the bark of the trees. In addition the attention should be paid to the brown, dry buttons that are easily falling off (Samoilovych).

First and foremost the essence of pest control in the garden consists in timely and thorough destruction of the hibernating stock. The apple-blossom weevil hibernates in the trees under the dead bark, in the bark cracks and in the hollows as well as among the plant residues and in the surface layer of the soil. First of all it is necessary to clean the trunks of the fruit trees and the skeletal branches from the old bark with the help of a garden knife. The remains of the old bark that have been cleared away are taken outside the garden and burned out or buried into the soil to a depth of 40 cm or more. It is better to do it in wet weather trying not to damage the living bark. Having cleaned the bark, one can be guaranteed to get rid of a great part of the hibernating pest stock. After falling off the leaves it is necessary to carefully gather them under the trees and destroy; during this process the great number of weevils that is going to hibernate in the litter also will be destroyed. Then the soil around the trees should be dug over, which also facilitates a significant reduction of the pest number. In the winter it is necessary to take care of attracting the birds to the gardens (Alexeieva, 1992; Grossheim, 1925, 1931; Drozda, 2002; Lapa et al., 2006; Tertyshnyi, 1995; Shevchuk, 2005).

Spraying the apple trees in the spring before the buds opening with the so-called "lime milk" has remained one of the preventive measures to control the apple-blossom weevil for many years. The spraying was extensive so that the sprayed trees seemed to be plastered; 2–3 apple trees in the garden left untreated and the weevils from all over the garden gathered in them and in the morning the weevils were shaken off from those trees on the blanket lying under the tree and then destroyed (Vasiliev, 1924, 1960; Vovk, 1926; Iliinskii et al., 1965).

The trapping band made from the straw and shavings were put on the tree trunks. These bands were put around the trunk up to a height of 1 m. The weevils climbing up the trunk (although the beetles have wings, but they do not use them at this time) crawled into these plaited things where they were collected and destroyed. The glue bands can be used instead of the trapping ones. From time to time the bands were cleaned (Goriainov, 1923; Dekhtiariov, 1928; Drozdovskyi, 1999; Korolkov, 1919; Chugunin, Yuganova, 1937; 1946).

According to the data of V.A. Karakosha (2000) under the conditions of the Kiev region the use of agro-technical techniques in the personal gardens is more relevant and effective than in the industrial ones. The location of trees on the personal plots makes it possible to use various mechanical and agricultural techniques in details. The use of such techniques as removing the old dead bark from the trunks and skeletal branches, collecting and destroying the plant residues, and digging over the pans of the of apple trees in the recommended time reduces the damage caused by the apple-blossom weevil by 21%. The agro-technical techniques that are included in the system proposed by the author make it possible to reduce the number of chemical treatments per season on the personal apple plantations by 25–30%. Thus, the author has found that the use of such agro-technical measures as digging over the pans of the apple trees and putting the trapping bands onto the cleared tree trunks on the personal plots are the important elements in reducing the number of pests in the protective systems (Karakosha, 2000).

In the spring, when the weather is warm, the weevils begin to appear in the trees. In the case of their appearance in the trees it is necessary to shake the trees off. Shaking off as a method of control has existed in the garden practice for a long time. In the literary sources we find the attempts to scientifically substantiate this method of control in the works of the researches of Nyzhnii Novgorod Station of Plant Protection. According to their data it turns out that when conducting the common single shaking off under the economic conditions, the proportion of the shaken individuals inhabited the tree reached 59–65% (Pisniachevskyi, 1926; Chugunin, 1932).

According to Ya.V. Chugunin (1932) 50–60% of the apple-blossom weevil can be destroyed under the single shaking off, and under the double shaking off 70–75% of the weevil are destroyed.

The common economic shakings off have a very low effect because they are not taken into account temperatures and other meteorological data. With a mass appearance such shaking off can destroy no more than half the stock of the beetles per tree and does not reduce the damage caused by them, but it only weakens the competition between the individuals in the fight for food. The weevils are shaken off onto the panels (tarpaulin or film) spread under a tree. It is done in calm and not rainy weather when the air temperature does not exceed 10,0C (Drozdovskyi, 1999; Tertyshnyi, 1995; Shevchuk, 2005).

Each shaking off should be timed to strictly settled phenological phases of development. The first shaking off should be started long before the buds opening during the appearance of the buds "crying"; the second – at the time of the buds bursting and it should be finished before the buttons denudation (Chugunin, 1932).

A. Eberg (1965) proposes to conduct the shaking off in the Moscow region early in the spring during the period from the buds swelling to the buttons detachment. The triple shaking off reduces the density population of trees by the apple-blossom weevil by 65–80%.

During the researches carried out by T.T. Bezdenko (1958) in the gardens of Belarus on the average 23 beetles were shaken off from a tree. After the triple shaking off, the damage of the buttons reached 7%, and in the trees under control it was 37%. Thus, although after shaking off some beetles remain in the trees and cause damage, the number of the weevils in the garden is significantly reduced.

In the past shaking the beetles off the trees early in the morning was the most common method of monitoring the apple-blossom weevil. However, this method is the most labour-intensive (Yevtushenko, 2004; Tertyshnyi, 1995; Chugunin, 1932; Chugunin, Yuganova, 1937). At present the domestic scientists have proposed a modified method of calculating in which the calculations are conducted using a lift net. The beetles are calculated by shaking off from four branches 50 cm long, one on each side of the crown. At any density of the pest population and the garden area of up to 20 hectares it is sufficient to make the calculations of ten trees moving along the diagonal of the garden. Shaking off from 10 to 40 beetles from 100 branches of 50 cm length indicates the necessity for conducting the protective measures (Yevtushenko, 2004).

Most part of its development the apple-blossom weevil spends in the buttons. Therefore, it is necessary to control the beetles that came out of the hibernating places. The chemical measures of protection should be applied only during the years of mass appearance of the pest. The oriented criteria for the use of the extermination measures on fruit plantations are 40–50 beetles per middle aged tree (Drozda, 2001; Slavgorodskaia-Kurpiieva, Matviievskyi, Bogdan, 1987; Livshyts, Petrushova, 1979).

To determine the thresholds of the phytophagous insects' harmfulness is one of the fundamental issues. Taking into account the importance of this problem, the scientists paid and continue to pay the proper attention to it (Ignacimuthu, 2001).

Most authors recommend to control the apple-blossom weevil in the period of the buds opening (a phenophase of a green cone) if there is the exceeding of the economic threshold of harmfulness (Vasiliev, Hrodskii, Omeliuta 1981; Drozda, 2001; Yevtushenko, Zabrodina, 2009; Lapa, Drozda, Melnychuk, 2006).

Nikolaieva (1973) recommends carrying out the insecticide treatment of fruit plantations in terms which would allow preserving the garden entomophages. The first treatment against the beetles appearing from the hibernating places is carried out during a period of a green cone; the second treatment is carried out in 10–12 days after blossoming. It is carried out selectively on the fruit crop varieties most damaged by the pest. At this time the entomophages of the apple-blossom weevil are still in the buttons and thus avoid the treatment.

Under the Ukrainian conditions the economic threshold of harmfulness for the individual farms is as follows: before the sap flow there are 15–20 beetles per 1 m of the trapping band; during the bud opening while shaking off there are 30–40 beetles per tree or 10–15% of the damaged buds among 100 examined ones (Drozda, 2001; Karakosha, 2000).

In the Kiev region the threshold number of the apple-blossom weevil is the presence of 40 female pests in one 10-15 year-old tree; the offspring of these females can cause damage to up to 60% of Jonathan variety buttons and 80% damage of Snowy Calville buttons. Chemical treatments should be carried out in the presence of more than 40 females of the apple-blossom weevil or 80 beetles of both sexes per tree (Matviievskyi, Loshchitskyi, Tkachev, 1987).

As Ya.M. Kudas and M.M. Dolia (2002) indicate, the threshold number of the apple-blossom weevil is the presence of 40–50 female pests per 10–13 year-old tree, the offspring of which can cause the damage to 80% of buttons.

According to the data of Yu.P. Yanovskyi (2003) the economic threshold of harmfulness under the conditions of seedling cultivation is 0,01–0,02 beetle/seedling; in the mother plantation of vegetative rootstocks there are 0.01–0.05 beetle/slip, in the field of wild trees there are 0.01–0.03 beetle/plant.

According to N.Ya. Kashyrska (1991) under the conditions of the Central Chernozem Zone of the Russian Federation such average indices as 1 beetle per 1 m^2 of the crown projection while poor blossoming, 1.5–2.0 beetles while medium blossoming, and 3–4 beetles while the apple blossoming is heavy can be taken as the economic threshold of harmfulness when conducting shaking off during the period of swelling the buds.

In the Non-Chernozem Zone of the Russian Federation the damage of even 10% of the apple tree buttons caused by the apple-blossom weevil can be economically significant (Tretiakov, 1989).

V.F. Drozda (2000) gives the data on applying the insecticides of various action and biological preparations when controlling the apple-blossom weevil. The spraying was carried out before the imago nutrition; thus, consuming the treated food the beetles brought the preparation into the organism. The highest efficiency was shown by Bi 58 new (2 L./ha); it was 80,6%. When using the bacterial preparations, the death of the beetles began only on the ninth day after the treatment. During this period there were sharp cold snaps and, as a result, the beetles migrated to the shelter. Under such conditions their death did not exceed 56% (Drozda, 2000).

Under the conditions of the Kiev region V.A. Karakosha (2000) tested the preparations Confidor, Mavrik 2F and Bi – 58 new. The obtained results indicate that these preparations have high biological efficiency. The most effective among them was Confidor, 20% water soluble concentrate (0,3 L./ha) which caused the death of 96,3% of the apple-blossom weevil in 3 days; in 12 days the further death of the beetles decreased to 90,8. The insecticides applied by the author against the apple-blossom weevil have shown high toxicity and long duration, which allowed to keep the phytophage at the level of the economic threshold of harmfulness not only in the phase of a green cone, but also in the phase of button detachment (Karakosha, 2000).

Yu.P. Yanovskyi (2005) tested some new preparations against the apple-blossom weevil in the Middle Dnieper region. According to him, the Actara preparation at a rate of 0,25 L./ha showed the highest efficiency. It caused the death of 98.7% of the beetles on the 10th day after treatment. The application of Confidor and Calypso preparations at a rate of 0,25 L./ha led to the death of 93.6 and 94.1% of the beetles respectively.

In some years only the four-side spraying of 2–3 rows around the perimeter is sufficient. The authors (Kolesova, Chmyr, 2000) point out that in early spring the preparations Nurelle-D (1.5 L/ha) and Basudin (1.0 L/ha) were the most effective in controlling the apple-blossom weevil. Both preparations caused 100% death of the beetles, although the effectiveness of these preparations is significantly decreasing during late treating, when the beetles already had time to lay their eggs in the buttons.

In controlling the apple-blossom weevil in the apple trees in Moldova (Yakymchuk, Mutena, 2008) the insecticides of various chemical groups have been tested. The high efficiency was shown by Bi–58 new (79.4–96%), Fastac (68–92%), Nurelle D (64–92%), and Confidor (77,4–85%). The plant-derived preparation NeemAzal has destroyed 92% of the pests, but it has not yet been registered in Moldova.

The effective entomophages of the apple-blossom weevil can be dwstroyed during treatment against the first generation of the codling moth. These undesirable effects can be avoided by applying the integrated garden protection. Determining the biological efficiency, it is necessary to take into account not only the effect of the preparations but also the preservation of the entomophages in total (Tkachev 1992).

The old beetles die after tree blossoming; and the larvae, pupae and young beetles develop in the damaged buttons; so in the gardens severely damaged by the apple-blossom weevil, the damaged buttons were shaken off and destroyed after dropping of the petals (Kolisnychenko, Siadrysta, 2004; Shcherbynovskyi, 1925); or these buttons should be put in a box and cover with a metal net to allow the parasitoids to escape (Drozda, 2000).

Another situation was observed while using the preparations controlling the juveniles. The acceptable results regarding the efficiency of the biological preparations have been obtained against the background of high efficiency of the insecticides. The combined action of the biological preparations together with the entomophages has every reason to be proposed for using them on the personal plots. Taking into account the needs and specific character of plant cultivation in the private sector, the possibility of using lepidocide and bitoxibacillin together with the regular shaking the trees off in controlling the apple-blossom weevil was separately investigated (Drozda, 2000).

The application of bitoxibacillin and lepidocide in controlling the leafworms during the summer significantly reduced the number of the apple-blossom weevils leaving for hibernation (Tretiakov, 1987).

According to some authors the use of phosalone allows to preserve the useful entomofauna of the fruit garden (Niemczyk, Skorupinski, 1994; Wurm, Polesny, 1998). In Poland (Niemczyk, Skorupinski, 1994) the efficiency of phosalone in controlling the apple-blossom weevil accounted to 71–78%. At the same time the concentration of the preparation (0.1 or 0.2%) and method of its application do not influence its efficiency.

It should also be borne in mind that the decrease in the number of the juveniles does not affect the harmfulness of the population in the current year. It is rather a prophylactic treatment aimed at reducing the pest number in the future, because a large part of the imago of the apple-blossom weevil is outside the garden and is always a potential threat to it (Drozda, 2000).

One alternative to using a chemical pest control method may become the use of the biological method, especially in the old gardens This is based on an analysis of the trophocenotic consortive connections of the apple garden phytophages, in which the majority of dendrophilic species should be considered as nutrients that cause the preservation of the parasitic species populations during the years of the garden pest depressions. Another condition for the preservation of the parasitic species in the garden cenoses is to create a forage reserve for feeding their imago. Trophic bonds can be retained as dominant only in the absence of treating the garden with the insecticides or with insignificant treatments. The use of a chemical method of protection leads to significant changes in the consortium formula (Yevtushenko, 2004).

Some authors recommend clearing away the bark on the litter in July and August and then destroy it. Careful conducting of this measure destroys the considerable number of the beetles that went into the summer diapause (Bezdenko, 1958; Yevtushenko, Zabrodina, 2008; 2009; Zabrodina, 2008; Chugunin, 1954).

Conclusion

Modern systems of plant protection, including fruit crops, consist in developing and implementing the integrated measures that preserve the crops from the harmful organisms while being the safest for the environment, animals and humans. The transition to such integrated systems involves the application of a biological method of pest control, reducing the number of pesticide treatments, the ability to use the preparations of selective action together with the entomophages, etc. An important reserve in this program is the activation and use of natural resources of the beneficial insects (parasitoids and predators) which limit the number of harmful insect-phytophages.

References

Alekseeva S.A. (1985). Borba s vreditelyami i boleznyami v plodovyh pitomnikah Kabardino-Balkarii. Sadovodstvo, 3, 17–19. (in Russian).

Ambrosov A.L., Bolotnikova V.V. & Mercalova O.S. (1976). Kak zashitit sad ot vreditelej i boleznej. Minsk. Urozhaj (in Russian).

Aristov M.T. (1926). O roli Anthonomus pomorum L. v periodichnosti plodonosheniya yabloni. Leningrad (in Russian).

Aristov M.T. (1931). Yablonnyj cvetoed (Anthonomus pomorum L.). Moscow. Selhozgiz (in Russian).

Aristov M.T. (1932). O vredonosnosti yablonnogo cvetoeda. Trudy po zashite rastenij, Leningrad, 1(6), 6–30. (in Russian).

Aristov M.T. (1932). Vrednye nasekomye plodovogo sada. Moscow. Selhozgiz (in Russian).

Batiashvili I.D. (1959). Vrediteli kontinentalnyh i subtropicheskih plodovyh kultur. Tbilisi (in Russian).
Beleckij E.N. (1987). Teoriya ciklichnosti dinamiki populyacij i metody mnogoletnego prognoza massovogo razmnozheniya vrednyh nasekomyh. Thesis of Doctoral Dissertation. Kiev (in Russian).
Beleckij E.N. (2008). Populyacionnye cikly, prichiny i sledstviya. Visnik Kharkiv National Agrarian University, Seriya "Entomologiya ta fitopatologiya", 8, 17–27. (in Russian).
Beleckij, E. N., Stankevich, S. V. (2018). Policiklichnost', sinhronnost' i nelinejnost' populjacionnoj dinamiki nasekomyh i problemy prognozirovanija, Vienna, Premier Publishing s.r.o. Vienna (in Russian).
Beleckij, E. N., Stankevich, S. V., Nemerickaja, L. V. (2017). Sovremennye predstavlenija o dinamike populjacij nasekomyh: proshloe, nastojashhee, budushhee. Sinergeticheskij podhod. Vesti Kharkiv National Agrarian University V. V. Dokuchaeva. Series Fitopatologija i jentomologija, 1–2, 22–33. (in Russian).
Beletskij, E. N. (2011). Massovye razmnozheniia nasekomykh. Istoriia, teoriia, prognozirovanie. Kharkov. Maidan (in Russian).
Bezdenko T.T. (1958). Zashita plodovogo sada ot vreditelej. Minsk (in Russian).
Blagosklonov K.N. (1972). Ohrana i privlechenie ptic. Moscow. Prosveshenie (in Russian).
Boldyrev M.I., Alekseeva S.A. & Titov D.A. (1989). Sistema zashity plodovyh kultur ot vreditelej i boleznej. Moscow. Agropromizdat (in Russian).
Borisoglebskaya M.S. (1975). Yablonnyj cvetoed. Zashita rastenij, 11, 61–62. (in Russian).
Borisoglebskaya M.S. (1977). Plodovye dolgonosiki. Zashita rastenij, 6, 60–61. (in Russian).
Borodin D.N. (1917). Borba s vreditelyami sadov po mesyacam. Poltava, Hutoryanin (in Russian).
Chernij A.M. (2007). Konceptualni osnovi integrovanogo zahistu plodovogo sadu vid shkidnikiv. Zahist i karantin roslin: Mizhvidomchij tematichnij naukovij zbirnik UAAN, In-t zahistu roslin. Kiyiv, 53, 390–403. (in Ukrainian).
Chizh O.D., Filov V.V. & Gavrilyuk O.M. et al. (2008). Intensivni sadi yabluni. Kiyiv. Agrarna nauka (in Ukrainian)
Chugunin Ya.V. & Yuganova O.N. (1937). Borba s vreditelyami plodovogo sada. Moscow. Selhozgiz (in Russian).
Chugunin Ya.V. & Yuganova O.N. (1946). Fenologicheskij kalendar po zashite sada ot vreditelej i boleznej. Simferopol. Krymizdat (in Russian).
Chugunin Ya.V. (1932). Effektivnost otryahivaniya sadovyh slonikov pri razlichnyh usloviyah. Zashita rastenij, 3, 81–99. (in Russian).
Chugunin Ya.V. (1932). K voprosu o predopredelennosti razvitiya zavyazi v socvetii yabloni i o vybore butonov samkoj Anthonomus pomorum L pri kladke yaic. Trudy po zashite rastenij, Leningrad, 1(6), 37–44. (in Russian).
Chugunin Ya.V. (1935). Borba s vreditelyami plodovogo sada. Moscow. Selhozgiz (in Russian).
Chugunin Ya.V. (1938). Sadovye dolgonosiki i mery borby s nimi. Tr. Krym. plodovodcheskoj stancii (1913–1938). Vol. 1. Moscow. (in Russian).
Chugunin Ya.V. (1950). Rol sadovyh dolgonosikov v periodichnosti plodonosheniya yabloni, v svyazi s problemoj likvidacii ih massovogo zapasa. Thesis of Doctoral Dissertation. Simferepol (in Russian).
Chugunin Ya.V. (1954). Rol sadovyh dolgonosikov v periodichnosti plodonosheniya yabloni v svyazi s problemoj likvidacii ih massovogo zapasa. Thesis of Doctoral Dissertation. Harkov (in Russian).
Dehtyarov M.S. (1928). Shkidni komahi v sadu ta zahodi proti nih. Harkiv. Radyanskij selyanin (in Ukrainian).
Diamandidi M.K. (1923). Glavnejshie vrednye nasekomye plodovih sadov stepnogo Prichernomorya i mery borby s nimi. Odesa. Narodnyj komitet zemledeliya (in Russian).
Dospehov B.A. (1985). Metodika polevogo opyta. Moscow. Agropromizdat (in Russian).
Dovgan S.V. (2009). Modeli prognozu rozvitku ta rozmnozhennya fitofagiv. Herson. Ajlant (in Ukrainian).
Drozda V.F. (2000). Yablunevij kvitkoyid, Zahist roslin, 6, 14–15. (in Ukrainian).
Drozda V.F. (2001). Biocenologichne obgruntuvannya integrovanogo zahistu plodovogo sadu vid shkidnikiv v Lisostepu Ukrayini. Thesis of Doctoral Dissertation. Kiyiv (in Ukrainian).
Drozda V.F. (2001). Porogi shkodochinnosti. Zahist roslin, 2, 21–22. (in Ukrainian).
Drozda V.F. (2002). Vesnyani roboti v sadu. Zahist roslin, 4, 21 –22. (in Ukrainian).
Drozda V.F. (2002). Zimovij sad. Zahist roslin, 1, 21–22. (in Ukrainian).
Drozdovskij E.M. (1999). Dvenadcat mesyacev. Zashita i karantin rastenij, 4, 45–46. (in Russian).
Duan J.J., Weber D.C., Hirs B. & Dorn S. (1996). Spring behavioral patterns of apple blossom weevil. Entomologia Experimentalis et applicata, Vol. 79, 1, 9–17.
Eberg A. (1965). Yablonnyj dolgonosik-cvetoed. Zashita rastenij ot vreditelej i boleznej, 5, 39–40. (in Russian).
Evtushenko N.D. (2003). Rol plodovyh nasazhdenij v sohranenii bioraznoobraziya. VI z'yizd Ukrayinskogo entomologichnogo tovaristva (Bila Cerkva). Nizhin, 38–39. (in Ukrainian).
Filippov N.A. (1990). Problemy biometoda. Zashita rastenij, 10, 3–5. (in Russian).
Gamina E.Sh. & Rotar L.M. (1991). Yablonnyj cvetoed i mery borby s nim. Sadovodstvo, vinogradarstvo i vinodelie Moldovy, 4, 32–33. (in Russian).
Gincenberg A. (1912). Kak borotsya s yablonovym cvetoedom. Kursk, Izd-vo Kurskogo otdela plodovodstva (in Russian).
Goryainov A.A. (1923). Vrediteli sada i ogoroda. Moscow (in Russian).
Grodskij V.A. (2009). Vliyanie osnovnyh klimaticheskih pokazatelej na chislennost i vredonosnost nekotoryh vidov vreditelej na raznyh formah yabloni. Informac. Byulleten VPRS MOBB, Kiev, 39, 100–103. (in Russian).
Grossgejm M.A. (1925). Borotba z shkidnikami plodovih kultur. Kiyiv. Derzhsilgospvidav (in Ukrainian).
Grossgejm M.A. (1931). Sadovi shkidniki. Harkiv. Derzhsilgospvidav (in Ukrainian).
Grossgejm N.A. (1925). Proekt programmy rabot po vreditelyam intensivnyh kultur na Ukraine. Sadovye vrediteli. Trudy soveshaniya po opytnomu delu v oblasti specialnyh kultur. Harkov (in Russian).
Hull L.A., Beers E.H. & Meagher R.L. (1985). Integration of biological and chemical control tactics for apple pest through selective timing and choice of synthetic pyrethroid insecricides. J. econ. Entomol, 78(3), 714–721.
Husha V. (1991). Agroekologicheskoe obosnovanie sistemy zashity yabloni ot glavnejshih vreditelej v yugo-vostochnoj chasti Polshi. Thesis of Doctoral Dissertation. Kiev (in Russian).
Ignacimuthu S. (2001). Insect pest management strategies–current trends and future prospects. J. Sci and Ind. Res, 60(7), 606–608.
Ilinskij A.A., Litvinov B.M. & Rodigin M.N. (1965). Fenologicheskij kalendar rabot v sadu. Moscow. Kolos (in Russian).
Kamyshnyj N.S. & Soloveva A.I. (1927). Vrediteli i povrezhdeniya sadovyh kultur. Vrediteli i povrezhdeniya v 1926 godu. Harkovskaya oblastnaya selsko-hozyajstvennaya opytnaya stanciya; Entomologicheskij otdel, Harkov, 7, 49–57. (in Russian).

Karakosha V.A. (2000). Dominuyuchi fitofagi prisadibnih yablunevih nasadzhen ta prijomi regulyuvannya yih chiselnosti v umovah lisostepovoyi zoni Ukrayini. Thesis of Doctoral Dissertation. Kiyiv (in Ukrainian).
Kashirskaya N.Ya. (1991). Obosnovanie ekonomicheskih porogov vredonosnosti listogryzushih vreditelej yabloni i yablonnogo cvetoeda. Thesis of Doctoral Dissertation. Moscow (in Russian).
Kazanskij A.N. (1915). Yablonnyj cvetoed ili yablonnyj dolgonosik. Materialy po izucheniyu vrednyh nasekomyh Moskovskoj gubernii. Moscow, 6, 16–17. (in Russian).
Kolesova D.A. & Chmyr P.G. (2005). Zashita plodonosyashih sadov yabloni i grushi. Zashita i karantin rastenij, 6, 50. (in Russian).
Kolesova D.A. (1995). Biologicheskaya zashita sada ot vreditelej. Zashita rastenij, 9, 38–39. (in Russian).
Kolesova D.A. (1996). Yablonnyj cvetoed. Zashita i karantin rastenij, 5, 27–28. (in Russian).
Kolisnichenko V.S., Syadrista O.B. (2004). Plodovi ta vinogradni nasadzhennya. Karantin i zahist roslin, 4, 27. (in Ukrainian).
Korchagin V.N. (1980). Yablonnyj cvetoed. Zashita rastenij, 5, 63. (in Russian).
Korolkov D.M. (1919). Borba s glavnejshimi vreditelyami sada i ogoroda i nekotorymi vreditelyami polya. Moscow (in Russian).
Krikunov I.V. & Zamorskij V.V. (2001). Vidovij sklad fitofagiv v yablunevih sadah riznogo tipu za intensivnogo insekticidnogo navantazhennya. Zahist roslin, 1, 17. (in Ukrainian).
Krikunov I.V. & Zamorskij V.V. (2002). Efektivnist entomofagiv. Zahist roslin, 3, 16. (in Ukrainian).
Krikunov I.V. (2000). Ekologo-biologichne obgruntuvannya zahistu yabluni vid osnovnih luskokrilih shkidnikiv v umovah Pravoberezhnogo Lisostepu Ukrayini. Thesis of Doctoral Dissertation. Kiyiv (in Ukrainian)
Kudas Ya.M. & Dolya M.M. (2002). Yablunevij kvitkoyid. Zahist roslin, 1, 21. (in Ukrainian).
Lanak Ya., Shimko K. & Vanek G. (1972). Atlas boleznej i vreditelej plodovyh, yagodnyh, ovoshnyh kultur i vinograda. Bratislava. Priroda (in Russian).
Lapa O.M., Drozda V.F. & Melnichuk S.D. (2006). Osnovi integrovanogo zahistu zernyatkovih sadiv. Kiyiv. National Agrarian University (in Ukrainian).
Litvinov B.M., Vassiliu V.A. & Lukyanchenko A.P. (2004). Osobennosti razvitiya yablonnogo cvetoeda Anthonomus pomorum L. (Coleoptera: Curculionidae) v vostochnoj lesostepi Ukrainy. Visnik Kharkiv National Agrarian University. Ser. "Entomologiya ta fitopatologiya", 5, 49–51. (in Russian).
Livshic I.Z. & Petrushkova N.I. (1961). Zashita plodovogo sada ot vreditelej i boleznej. Simferopol, Krymizdat, 26 –27. (in Russian).
Livshic I.Z. & Petrushova N.I. (1979). Rekomendacii po uchetu chislennosti vreditelej yabloni i prognozu neobhodimosti borby s nimi. pod. red. T.A. Ishenko. Moscow. Kolos (in Russian).
Mamaev K.A., Lenskij G.K. & Soboleva V.P. (1981). Borba s vreditelyami i boleznyami plodovih, yagodnyh i ovoshnyh kultur. Moscow. Kolos (in Russian).
Manko O.V., Vlasova O.G. & Grodskij V.A. (2002). Bagatorichnij monitoring vidovogo skladu i chiselnosti komah ta klishiv na yabluni v stepovij zoni krayini. Zahist roslin, 6, 10–11. (in Ukrainian).
Matvejchik M.A. (1998). Estestvennye faktory regulirovaniya chislennosti yablonnogo cvetoeda. Aktualnye problemy biologicheskoj zashity rastenij. Minsk (in Russian).
Matvievskij A.S., Loshickij V.P. & Tkachev V.M. (1987). Integrirovannaya zashita sada. Kiev. Urozhaj (in Russian).
Mozgovoj Yu.G. (1932). K harakteristike povedeniya Anthonomus pomorum L. Trudy po zashite rastenij, Leningrad, 1(6), 31–36. (in Russian).
Nasekomye i kleshi–vrediteli selskohozyajstvennyh kultur. (1974). Zhestkokrylye. O.L. Kryzhanovskiy (Ed.). Leningrad. Nauka, 2, 336. (in Russian).
Niemczyk E. & Skorupinski G. (1994). Effectiveness of phosalone (zolone) in the control of apple blossom weevil (Anthonomus pomorum L.) and the apple sucker (Psylla mali Schm.) as well as its selectivity to predatory mites (Phytoseiidae). Journal of fruit and ornamental plant research. V. II, 1, 21–29.
Nikolaeva A.F. (1973). Dolgonosiki i trubkoverty – vrediteli plodovyh kultur centra srednerusskoj vozvyshennosti. Thesis of Doctoral Dissertation. Voronezh (in Russian).
Nikolskaya M.N. (1926). Vliyanie ugneteniya butonov yabloni lichinkami Psylla mali Sh. na velichinu vyhodyashih iz nih zhukov. Zashita rastenij, 4(2), 222–225. (in Russian).
Okroshiashvili K.K. (1996). Yablonnyj cvetoed v Gruzii. Zashita i karantin rastenij, 3, 32. (in Russian).
Piekarska B.H. & Wilkaniec B. (1998). Parasitoids of the family Ichneumonidae reared from larvae of the apple blossom weevil (Anthonomus pomorum L.) in the environs of Poznan. Progress in plant protection, 38(2), 447–449.
Pisnyachevskij A.A. (1926). Materialy po ekologii yablonnogo cvetoeda (Anthonomus pomorum L.). Zashita rastenij, 3(2), 124–142. (in Ukrainian).
Rilishkene M.A. & Zayanchauskas P.A. (1985). Chislennost i vredonosnost yablonnogo cvetoeda v sadah Litovskoj SSR v 1967–1968 gg. Acta entomol. lituanica, Litva, 8, 70–77. (in Russian).
Ritus-Potapova T.M. (1928). Osobennosti cveteniya yabloni v svyazi s biologiej yablonevogo cvetoeda (Anthonomus pomorum L.). Zashita rastenij ot vreditelej, 5, 25–31. (in Russian).
Rodionov Z. (1932). Osennie (ili ranne-vesennie) raboty po borbe s vreditelyami v sadah. Na zashitu socialisticheskogo urozhaya, 17–18, 20–23. (in Russian).
Samojlovich E.N. Glavnejshie nasekomye, vredyashie plodovodstvu i mery borby s nimi. Leningrad. Mysl (in Russian).
Savkovskij P.P. (1990). Atlas vreditelej plodovyh i yagodnyh kultur. Kiev. Urozhaj (in Russian).
Savzdarg V.E. (1956). Vrediteli plodovyh i yagodnyh kultur. Moscow. Selhozgiz (in Russian).
Sevesku A. (1966). Vrediteli plodovyh derevev, yagodnikov i vinogradnoj lozy. Zashita rastenij (albom). Buharest. Meridian. Vol. 1 (in Russian).
Sherbinovskij N. (1925). Zashita urozhaya ovoshej i plodov ot vrednyh nasekomyh. Moscow. Novaya derevnya (in Russian).
Shevchenko N.G., Krivosheyev S.P. & Omelyuta V.P. (2004). Prognozirovanie razvitiya amerikanskoj beloj babochki v Kievskoj oblasti. Zahist i karantin roslin, 50, 208–214. (in Russian).
Shevchuk I. (2005). Zahist sadu do cvitinnya roslin. Propoziciya, 3, 90–92. (in Ukrainian).
Shevchuk I. (2005). Zahist sadu do rozpuskannya brunok. Propoziciya, 2, 78–80. (in Ukrainian).
Shevchuk I. (2006). Integrovanij zahist grushi vid shkidnikiv u zoni Pivnichnogo Lisostepu. Zahist roslin, 2, 76–79. (in Ukrainian)
Shrejner Ya.F. (1907). Nastavlenie po borbe s yablonnym cvetoedom ili dolgonosikom (Anthonomus pomorum L.). Sankt-Peterburg (in Russian).
Shrejner Ya.F. (1915). Kratkoe rukovodstvo po borbe s vreditelyami plodovogo sada iz klassa nasekomyh. Petrograd. (in Russian).

Shtundyuk-Alekseeva S.A. (1985). Borba s vreditelyami i boleznyami v plodovyh pitomnikah Kabardino-Balkarii. Sadovodstvo, 3, 17–19. (in Russian).
Slavgorodskaya-Kurpieva L.E., Matvievskij A.S. & Bogdan L.I. et al. (1987). Rekomendacii po opredeleniyu ekonomicheskih porogov vredonosnosti vreditelej selskohozyajstvennyh kultur i ih ispolzovaniyu v praktike zashity rastenij. Kiev. Urozhaj (in Russian).
Slavgorodskaya–Kurpieva L.E., Zhernovoj A.S. & Alpeev A.E. (1993). Zashita plodovo-yagodnyh kultur i vinograda ot vreditelej i boleznej v fermerskih i priusadebnyh uchastkah Ukrainy. Doneck. Donechchina (in Russian).
Sokolov A.M. & Sokolova R.A. (1974). Ustojchivost plodovyh rastenij k vreditelyam i boleznyam. Moscow. Kolos (in Russian).
Sorochinskij L.V., Protasov N.I. & Bolotnikova V.V. (1998). Vrediteli i bolezni sada i ogoroda i mery borby s nimi na dachnyh i priusadebnyh uchastkah. Minsk. Sovremennoe slovo (in Russian).
Soshnikov V.I. (1989). Yablonnyj cvetoed. Zashita rastenij, 4, 24–25. (in Russian).
Stankevych, S. V., Baidyk, H. V., Lezhenina, I. P., Filatov, M. O., Martynenko, V.I., D'yakonov, V.I., Nepran, I. V., Mykhailenko, V. O., Havva S. V., Bondarenko, D. V., Novosad, K. B., Kava, L. P., Yakovlev, R. V., Nemerytska, L. V., Golovan, L. V., Klymenko, I. V. (2019). Wandering of mass reproduction of harmful insects within the natural habitat. Ukrainian Journal of Ecology, 9(4), 578-583.
Stankevych, S. V., Yevtushenko, M. D., Zabrodina, V., Biletskiy, Ye. M., Baidyk, H. V., Lezhenina, I. P., Filatov, M. O., Sirous, L. Ya., Vasylieva, Yu. V. (2019). V.V. Dokuchaiev Scientific school of Kharkiv National Agrarian University and development agricultural entomology in XIX-XXI centuries. Ukrainian Journal of Ecology, 9(2), 170-178.
Stankevych, S.V., Vasylieva, Yu.V., Golovan, L.V., Zabrodina, I.V., Lutytska, N.V., Nakonechna, Yu.O., Molchanova, O.A., Chupryna, Yu.Yu., Zhukova, L.V. (2019). Chronicle of insect pests massive reproduction. Ukrainian Journal of Ecology, 9(1), 262-274.
Stankevich, S. V., Beleckij E. N., Zabrodina, I. V. (2019). Ciklicheski-nelinejnaya dinamika prirodnyh sistem i problemy prognozirovaniya: monografiya. Vankuver, Accent Graphics Communications & Publishing, 232. (in Russian).
Sugonyaev E.S. (1969). Pereponchatokrylye–entomofagi. Zashita rastenij, 6, 34–36. (in Russian).
Sumarokov O.M. (2003). Vidove riznomanittya i ekologichna struktura fauni turuniv (Coleoprera, Carabidae) v agrocenozah sonyashniku stepovoyi zoni Ukrayini. Zahist i karantin roslin : Mizhvidomchij tematichnij naukovij zbirnik UAAN, In-t zahistu roslin, Kiyiv, 49, 174–187. (in Ukrainian).
Tertishnij O.S. (1995). Plodovi dovgonosiki ta borotba z nimi. Sad, 8, 27–28. (in Ukrainian).
Tertishnij O.S. (1996). Agrobiologichne obgruntuvannya zahistu yabluni, slivi ta chornoyi smorodini vid shkidnikiv v umovah Shidnogo Lisostepu Ukrayini. Thesis of Doctoral Dissertation. Kiyiv (in Ukrainian).
Tertyshnyj A.S. (1988). Plodovye dolgonosiki, Zashita rastenij, 7, 54–55. (in Russian).
Tkachev V.M. & Onishenko L.G. (1992). Biologichnij zahist sadu vid shkidnikiv i hvorob. Kiyiv. Urozhaj (in Ukrainian).
Tkachev V.M. (1992). Biologicheskij kontrol chislennosti vreditelej sada. Zashita rastenij, 6, 19–21. (in Russian).
Tkalenko G.M., Grodskij V.A. & Korovin O.A. (2008). Entomofagi ta entomopatogeni zimuyuchih stadij shkidnikiv sadu v Stepovij zoni Ukrayini. Zahist i karantin roslin: Mizhvidomchij tematichnij naukovij zbirnik UAAN, In-t zahistu roslin. Kiyiv, 54, 393–396. (in Ukrainian).
Tretyakov N.N. (1982). Nekotorye dannye o biologii i ekologii yablonnogo cvetoeda (Anthonomus pomorum L.), Nauch. dokl. vyssh. shkoly. biol. nauki, 8, 35–37. (in Russian).
Tretyakov N.N. (1984). Faktory dinamiki chislennosti yablonnogo cvetoeda Anthonomus pomorum L. Izvestiya TSHA, 5, 120–128. (in Russian).
Tretyakov N.N. (1987). Dejstvie bakterialnyh preparatov lepidocida i bitoksibacillina na yablonnogo cvetoeda. Izvestiya TSHA, 3, 120–125. (in Russian).
Tretyakov N.N. (1989). Rol paraziticheskih nasekomyh v regulirovanii chislennosti yablonnogo cvetoeda pri ispolzovanii pesticidov. Izvestiya TSHA, 4, 90–95. (in Russian).
Troickij N.N. (1925). Yablonnyj dovgonosik (Anthonomus pomorum). Eksperimentalnaya stanciya po prikladnoj entomologii GIOA. Leningrad (in Russian).
Tryapicyn V.A., Shapiro V.A. & Shepetilnikov V.A. (1982). Parazity i hishniki vreditelej selskohozyajstvennyh kultur. Leningrad. Kolos (in Russian).
Vasilev I.V. (1924). Nasekomye vredyashie sadu i borba s nimi. Harkov (in Russian).
Vasilev V.P. & Livshic I.Z. (1984). Vrediteli plodovyh kultur. Moscow. Kolos (in Russian).
Vasilev V.P. (1988). Vrediteli selskohozyajstvennyh kultur i lesnyh nasazhdenij. Kiev. Urozhaj (in Russian).
Vasilev V.P., Grodskij V.A. & Omelyuta V.P. (1981). Sistema zashity yabloni ot vreditelej. Zashita rastenij, 4, 32– 33. (in Russian).
Vasiliu V.A. & Lukyanchenko A.P. (1998). Izmenenie biohimicheskogo sostava plodov yabloni i grushi v zavisiiosti ot osveshennosti i povrezhdennosti plodozherkami. Izvestiya Harkovskogo entomologichnogo obshestva, Harkov, 6(1), 137–139. (in Russian).
Vasiliu V.A. (1998). Fenologiya i vredonosnost yablonnogo cvetoeda (Anthonomus pomorum L.) v Vostochnoj Lesostepi Ukrainy. Vestnik zoologii (praci V z'yizdu Ukrayinskogo entomologichnogo tovaristva), Kiev, 9, 34–38. (in Russian).
Vasilyev V.P. & Shishkova M.I. (1961). Shkidniki ta hvorobi plodovih kultur ta zahodi borotbi z nimi. Kiyiv. Urozhaj (in Ukrainian)
Vasilyev V.P. (1960). Shkidniki i hvorobi sadu ta borotba z nimi. Kiyiv. Vid-vo s.-g. literaturi (in Ukrainian)
Vasilyev V.P., Degtyarova O.S. & Shestopalova V.S. et al. (1976). Zahist sadu vid shkidnikiv i hvorob. Kiyiv. Urozhaj (in Ukrainian).
Vassiliu V.A. (1999). Yablunevij kvitkoyid ta yabluneva plodozherka u Shidnomu Lisostepu Ukrayini (fenologiya, shkodochinnist, prognoz). Thesis of Doctoral Dissertation. Harkiv (in Ukrainian).
Vinnichenko I.F. (1988). Mery borby s dolgonosikom v yablonevyh sadah intensivnogo tipa. Zashita selskohozyajstvennyh kultur ot boleznej, vreditelej i sornyakov v usloviyah MSSR. Kishinev SHI. Kishinev (in Russian).
Vinokurov G.M. (1917). Dolgonosik cvetoed (Anthonomus pomorum L.). zemskogo byuro borby s vreditelyami. Tiflis. Tiflis.-Erivan. Karsk (in Russian).
Vitkovskij L.N. (1926). Yablonnyj cvetoed (Anthonomus pomorum L.), kak vreditel vishni. Byuleten o deyatelnosti Ulyanovskoj Stazra za 1926 god, 59–65. (in Russian).
Volkodav V.V. & Konverska V.P. (2002). Sortova reakciya yabluni. Zahist roslin, 6, 12–14. (in Ukrainian).
Volodichev M.A. (1974). Vredonosnost yablonnogo cvetoeda i metod ee izucheniya. Trudy Vseros. NII zashity rastenij, 3, 24–29.(in Russian).
Vovk I. (1926). Shkidniki sadu. Harkiv (in Ukrainian).
Vyangelyauskajte A. (1992). Yablonnyj cvetoed. Zashita rastenij, 4, 61. (in Russian).
Wurm L. & Polesny F. (1998). Experiments on the control of the apple blossom weevil in biological fruit cultivation. Mitteilungen Klosterneuburg, Rebe und Wein, Obstbau und Fruchteverwertung, 48, 1, 34–36.

Yakimchuk A.P. & Mutena M.M. (2008). Novaya ugroza yablonevym sadam. Zashita i karantin rastenij, 6, 20–21. (in Russian).
Yakimchuk A.P. & Mutena M.M. (2008). Raznica vo vredonosnosti i fenologi razvitiya fitofagov stanovitsya zametene. Zashita i karantin rastenij, 5, 54. (in Russian).
Yanovskij Yu.P. (2003). Agrobiocenotichne obgruntuvannya zahistu plodovih rozsadnikiv vid osnovnih shkidnikiv zernyatkovih kultur u Lisostepu Ukrayini. Thesis of Doctoral Dissertation. Kiyiv (in Ukrainian).
Yanovskij Yu.P. (2005). Zahist sadzhanciv plodovih kultur u piznoosinnij period. Propoziciya, 10, 84–85. (in Ukrainian).
Yevtushenko M. D. & Grama V.M. (2011). Zmina paradigmi v sistemi teoriyi i praktiki zahistu plodovih sadiv v Ukrayini za storichchya: monografiya. Kharkiv National Agrarian University V. V. Dokuchayeva, Harkiv (in Ukrainian).
Yevtushenko M. D. (2004). Osnovni trofichni zv'yazki komah ta yih dinamika v konsorciyi yabluni. Visnik Kharkiv National Agrarian University, Ser. "Biologiya", 2, 108–116. (in Ukrainian).
Yevtushenko M.D. & Grama V.M. (2007). Materiali do istoriyi vivchennya komah yablunevih sadiv Ukrajni: I period (60-ti roki HIH st. 1917 r.). Visnik Kharkiv National Agrarian University. Seriya "Entomologiya ta fitopatologiya", 7, 49–64. (in Ukrainian).
Yevtushenko M.D. & Grama V.M. (2007). Materiali do istoriyi vivchennya komah yablunevih sadiv Ukrajni (1918–1941) (II period). Visnik HNAU, Ser. "Entomologiya ta fitopatologiya", 7, 65–78. (in Ukrainian).
Yevtushenko M.D. & Grama V.M. (2008). Zmina paradigmi v sistemi teoriyi i praktiki zahistu plodovih sadiv v Ukrayini za 1860–1941 rr. (I i II periodi). Zahist i karantin roslin: Mizhvidomchij tematichnij naukovij zbirnik UAAN, In-t zahistu roslin. Kiyiv, 54, 180–188. (in Ukrainian).
Yevtushenko M.D. & Zabrodina I.V. (2008). Zaselenist yablunevim kvitkoyidom Anhonomus pomorum L. (Coleoptera: Curculionidae) stovburiv ta skeletnih gilok yablun. Visnik Kharkiv National Agrarian University, Ser. "Entomologiya ta fitopatologiya", 8, 41–46. (in Ukrainian).
Yevtushenko M.D. & Zabrodina I.V. (2009). Deyaki osoblivosti biologiyi, shkodochinnosti ta dinamiki chiselnosti yablunevogo kvitkoyida. Innovacijni agrotehnologiyi v umovah globalnogo poteplinnya. Proceed. Int. Sc. Conf. Melitopol. Kirilivka (in Ukrainian).
Yevtushenko M.D. & Zabrodina I.V. (2009). Entomofagi yablunevogo kvitkoyida ta yih znachennya v sadu NDG "Dokuchayevske" Harkivskogo NAU im. V.V.Dokuchayeva. Visnik Kharkiv National Agrarian University, Seriya "Entomologiya ta fitopatologiya", 8, 34–38. (in Ukrainian).
Yevtushenko M.D. (2005). Teoretichni osnovi prognozu masovogo rozmnozhennya osnovnih shkidnikiv yabluni v Ukrayini. Zahist i karantin roslin, Mizhvidomchij tematichnij naukovij zbirnik UAAN, In-t zahistu roslin, Kiyiv, 51, 3–9. (in Ukrainian).
Yevtushenko M.D. (2006). Bioriznomanittya yablunevih sadiv. Visnik Kharkiv National Agrarian University, Ser. "Entomologiya ta fitopatologiya", 12, 21–24. (in Ukrainian).
Zabrodina I.V. & Yevtushenko M.D. (2002). Osoblivosti shkodochinnosti yablunevogo kvitkoyida Anthonomus pomorum L. (Coleoptera, Curculionidae) v umovah Harkivskoyi oblasti. Proceed. Int Sc. Conf. "Molod za bioriznomanittya". Kharkiv National Agrarian University V.V. Dokuchayeva, 64–65. (in Ukrainian).
Zerova M. D., Kotenko A. G. & Tolkanic V. I. (2010). Atlas evropejskih nasekomyh-entomofagov. Kiev (in Russian).
Zerova M.D., Tolkanec V.I. & Kotenko A.G. (1992). Entomofagi vreditelej yabloni yugo-zapada SSSR. Kiev. Nauk. Dumka (in Russian).
Zhemchuzhina A.A., Stepina N.P. & Tarasova V.P. (1985). Zashita rastenij na priusadebnyh uchastkah. Leningrad. Agropromizdat (in Russian).
Zijp J.P. & Blommers L.H.M. (1992). Syrrhizus delusorius and Scambus pomorum, two parasitoids of the apple blossom weevil. Proceedings of the Section Experimental and Applied Entomology of the Netherlands Entomological Society, 3, 46–50.
Zijp J.P. & Blommers L.H.M. (2002). Biology of Centistes delusorius, a parasitoid of adult apple blossom weevil. Agricultural and Forest Entomology, 4(4), 275–282.

Citation:
Zabrodina, I.V., Yevtushenko, M.D., Stankevych, S.V., Molchanova, O.A., Baidyk, H.V., Lezhenina, I.P., Filatov, M.O., Sirous, L.Ya., Yushchuk, D.D., Melenti, V.O., Romanov, O.V., Romanova, T.A., Bragin, O.M. (2020). Ukrainian and international experience of integrated protection of apple-tree from apple-blossom weevil (*Anthonomus pomorum* Linnaeus, 1758). *Ukrainian Journal of Ecology, 10*(1), 277-288.