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**ACTIVITY OF ACADEMICIAN OF THE ACADEMY OF SCIENCES OF
UKRAINIAN SSR V. P. VASYLIEV IN THE CONTEXT OF DEVELOPMENT
OF ENTOMOLOGIC RESEARCHES OF FRUIT CROPS IN THE SECOND
HALF OF THE 20th CENTURY**

The purpose of the article is to reveal the main directions of entomologic researches of fruit crops and measures to protect them from pests in the creative heritage of Academician of the Academy of Sciences of Ukrainian SSR V. P. Vasyliiev, determining its contribution to the organization of entomologic researches and practical implementation of effective technologies to protect fruit crops in different soil-climatic conditions of the Ukrainian SSR. The research is based on the use of the

historical-scientific, historiographical, source analysis, as well as the biographical method. The source base covers a wide range of published materials, which are based on the scientific works of V. P. Vasyliiev on various directions of entomologic science and protection of fruit crops from pests. The scientific novelty is in the substantiation of the scientist's creative contribution to the development of entomologic researches of fruit crops in the second half of the 20th century. The authors first systematized and analyzed the scientific works of V. P. Vasyliiev devoted to research of pests of fruit crops and measures of combating them are. Determined that as an innovator of advanced methods of plant protection, the scientist developed and substantiated a system of measures to protect fruit crops from insects and mites based on the development and application of new technologies, including agrotechnical, mechanical, biological, genetic, physiological and chemical methods. The priority of the scientist in the development and scientific substantiation of the zoning of the system of measures to control pests of fruit crops, taking into account the soil-climatic zones of the Ukrainian SSR has been proved. His publications have become the basis of the system of protection of fruit crops, agricultural crops and forest plantations and have not lost the significance up to the present.

Key words: *development, entomologic researches, methods of plant protection, pests, insects, mites, fruit crops, V. P. Vasyliiev.*

ДІЯЛЬНІСТЬ АКАДЕМІКА АН УРСР В. П. ВАСИЛЬЄВА В КОНТЕКСТІ РОЗВИТКУ ЕНТОМОЛОГІЧНИХ ДОСЛІДЖЕНЬ ПЛОДОВИХ КУЛЬТУР У ДРУГІЙ ПОЛОВИНІ ХХ СТОЛІТТЯ

Мета статті полягає у розкритті основних напрямів ентомологічних досліджень плодкових культур та заходів захисту їх від шкідників у творчій спадщині академіка АН УРСР В. П. Васильєва, визначенні його внеску в організацію ентомологічних досліджень, практичного впровадження ефективних технологій захисту плодкових культур у різних ґрунтово-кліматичних умовах УРСР. Дослідження ґрунтується на використанні історико-наукового, історіографічного, джерелознавчого аналізу, а також біографічного методу. Джерельна база охоплює широке коло опублікованих матеріалів, основу яких складають наукові праці В. П. Васильєва з різних напрямів ентомологічної науки та захисту плодкових культур від шкідників. Наукова новизна полягає в обґрунтуванні творчого внеску вченого у розвиток ентомологічних досліджень плодкових культур у другій половині ХХ століття. Вперше систематизовано та проаналізовано наукові праці В. П. Васильєва, присвячені дослідженню шкідників плодкових культур та заходів боротьби з ними. Встановлено, що як новатор прогресивних методів захисту рослин, науковець розробив та обґрунтував систему заходів захисту плодкових культур від комах і кліщів на основі опрацювання та застосування нових технологій, що включали їх агротехнічний, механічний, біологічний, генетичний, фізіологічний, а також хімічний методи захисту. Доведено пріоритет вченого у розробленні та науковому обґрунтуванні районування системи заходів боротьби зі

шкідниками плодівих культур з урахуванням ґрунтово-кліматичних зон УРСР. Його публікації стали основою системи захисту плодівих, сільськогосподарських культур та лісових насаджень і не втратили актуальності дотепер.

Ключові слова: *розвиток, ентомологічні дослідження, методи захисту рослин, шкідники, комахи, кліщі, плодіві культури, В. П. Васильєв.*

In the complete food ration of a person an important place is occupied by fruits that contain such substances, which are quite necessary for the body as vitamins, organic acids, microelements and so on. However, in gardening, crop losses and reduced fruit quality caused by destructive insects and mites remain a major problem. Because a stable habitat in perennial plantings creates the prerequisite for constant reproduction and accumulation associated with fruit crops of species that damage various tree organs: root system, skeletal parts, buds, sprouts, flowers, branches, leaves and fruits. The control of garden pests due to the large number of their species and diversity of livelihoods, nature of nutrition, timing of occurrence includes a set of measures and ways that scientists develop based on the formation of their research's strategies. Such historical and biographical studies are quite important, because they highlight the personalized contribution of individual scientists in the development of promising researches, which are aimed at the development of branch science and education.

At the end of the 18th century, foreign scientists began entomologic researches. A large number of them were devoted to the establishment of ecological features of soil entomofauna and the role of insects in soil-forming processes. In particular, the structure and activity of insects, the variety of forms, the interaction with the environment were studied by: English naturalists and entomologists G. White (1789), W. Kirbi (1800), Ch. Darwin (1837) [1, p. 6]; German naturalists and zoologists E. Heckel (1870), W. Gensen and C. Mebius (1877); Danish soil scientist P. Miuller (1887) [2]. In the 20th century, the study of insects was carried out by an American biologist, Academician of the National Academy of Sciences of the United States (1969), twice winner of the Pulitzer Prize (1979, 1981) – E. Wilson [3]. The definition of the biology of honey bees and various problems of beekeeping was

carried out by the Austrian ethologist K. Frisch, who was awarded the Nobel Prize in Physiology or Medicine (1973) [4].

In the first half of the 19th century, special entomologic and fauna studies on the territory of modern Ukraine were initiated by I. A. Krynytskyi, who studied beetles (1832) and spiders (1837) in Kharkiv Province. In universities and agricultural research stations in the second half of the 19th – at the beginning 20th centuries provincial entomologists I. I. Mechnykov, V. I. Mochulskyi, S. A. Mokrzhetskyi, J. K. Pachoskyi, V. P. Pospelov and P. A. Zabarynskyi for the first time began to work [5, p. 13]. They developed methods of pests control and created entomological stations, where studied the structure and taxonomy of different groups of insects, paying special attention to agriculture and forestry pests, worked out general problems of entomology and ecology [6, p. 156].

In 1887, P. A. Zabarynskyi conducted the researches on the control of ground-squirrel and bedbugs, V. I. Mochulskyi – of migratory locusts and Hessian flies. In 1889, J. K. Pachoskyi studied the fauna of membranous and semi-solid-winged. During 1893–1920, S. A. Mokrzhetskyi studied the entomofauna of the Crimea. He paid the greatest attention to the fight against insects that harmed field, garden crops and forest plantations. The pests in the Crimea were studied by F. Keppen (1884), scale-winged insects – G. Grum-Grzhymailo (1882) and V. Melioranskyi (1898) [7, p. 145]. Agrotechnical measures against the Hessian and Swedish flies were developed by I. A. Porchynskyi (1882), V. I. Filipiev (1883) and M. M. Kulagin (1908), who proposed cultivar changing as a means of protecting crops. In 1904, V. P. Pospelov developed a system of effective agrotechnical measures to control beet weevil, meadow butterfly, Hesse fly [8, p. 167]. Studies of soil entomofauna and the importance of insects activity in soil formation were carried out by O. A. Grym (1874), I. U. Palimpsestov (1882), V. V. Dokuchaiev (1883), P. A. Kostychev (1886), I. I. Mechnykov (1888), M. O. Kholodkovskyi (1896), E. Volni (1897) and N. A. Dimo (1905). In particular, O. A. Grym studied the role of scoop larvae, P. A. Kostychev – of fungus mosquitoes, I. I. Mechnykov – of Kuzka beetle [9, p. 4–5].

Scientists paid attention to determining the effectiveness of plant protection methods. According to the results of F. Keppen's researches during 1881–1883, the main measures of plant protection were considered to be the ways to destroy harmful insects by directly collecting them by hand or catching them with the help of the simplest devices [10, p. 31]. Subsequently, a more promising chemical method spread. In 1896, the Tavriya provincial entomologist S. A. Mokrzhetskyi recommended a system of chemical treatment of gardens in the Crimea as a method of protection against pests, which included spraying with Parisian greens [11, p. 6]. The use of the microbiological method for plant protection was initiated by I. I. Mechnykov, who proposed the use of muscardine – an insect disease caused by parasitic mold fungi [12, p. 24].

In the first half of the 20th century, the deserve special attention researches of such entomologists: I. D. Belanovskyi, Z. S. Golovianko, M. O. Hrosheim, I. I. Koraba, O. Y. Petrukha, O. V. Znamenskyi and others. The relevance of researches in agricultural entomology has also been distinguished, and the following scientists made a significant contribution in it: B. H. Averin, M. P. Diadechko, E. V. Klokov, M. V. Kurdiumov, O. H. Lebediev, M. A. Telenha, E. V. Zvierozomb-Zubovskyi and others. O. H. Lebediev, who researched the entomofauna of forest cenoses, attached great importance to the study of forest pests. Of particular note are his studies of pollinating insects and their role in pollinating entomophilic crops. He performed a general theoretical analysis of plant pollinators by species composition and their relationships with individual species of flowering plants. In 1935, in order to control the harmful insects, O. H. Lebediev for the first time theoretically substantiated the possibility of using sexually attractive substances – attractants [5, p. 17].

An important role belongs to the study of ecological characteristics of different groups of pests, as well as the application of biological methods of plant protection. In particular, V. H. Averin, M. P. Diadechko studied beetles, M. A. Telenha studied membranous-wingeds, E. V. Zvierozomb-Zubovskyi studied diseases of the Chinese silkworm [5, p. 15]. The results of researches conducted by M. A. Telenha

contributed to the destruction of a dangerous pests of gardens – blood aphids, as well as the widespread use of trichogramma in the Ukrainian SSR [13, p. 222]. In 1935, E. V. Klokov's researches included the most complete experimental material on the selection of crops for resistance and protection against the Hessian fly [8, p. 168].

For the development of entomologic research of fruit crops in the 20th century, a significant contribution was made by Ukrainian entomologist, an Academician of Academy of Sciences of Ukrainian SSR V. P. Vasyliiev (18.12.1912–24.09.2003). During the 1930s and 1940s, the scientist studied the distribution of species, developed methods for detecting and accounting for pests. In the second half of the 20th century he developed and substantiated a system of measures to protect fruit crops from mites and insects based on the development and application of new technologies, that included agrotechnical, mechanical, biological, genetic, physiological and chemical methods of protection. He proposed and scientifically substantiated the zoning of the system of measures to control pests of fruit crops, taking into account the soil-climatic zones of the Ukrainian SSR. Nowadays, in order to increase the competitiveness and export potential of the agrarian sector in Ukraine, it is important to find optimal ways to further development and improvement of plant protection systems against pests, which are based on technologies developed by the scientist.

Some pages of the creative and intellectual biography of Academician of Academy of Sciences of Ukrainian SSR V. P. Vasyliiev have been reconstructed in a number of publications by S. O. Trybel [14–15]. M. V. Krut's publications reveal the scientist's creative researches, which he carried out along with other Ukrainian entomologists during the period of scientific and organizational activities at the Ukrainian Research Institute of Plant Protection (now – the Institute of Plant Protection of NAAS) [16–17]. A series of articles written by V. A. Hrodskyi, V. A. Sanin and O. H. Vlasov represents the memories of his students, who considered him as a talented scientist and teacher [18–19]. However, so far, his achievements in the development of entomologic researches of fruit crops in the

Ukrainian SSR have not been studied and systematized, and no elaboration has been clarified on measures to protect them.

The purpose of the study is to reveal the main directions of entomological researches of fruit crops and measures to protect them from pests in the creative heritage of Academician of Academy of Sciences of Ukrainian SSR V. P. Vasyliev. Determining its contribution to the organization of entomologic researches, practical implementation of effective technologies for fruit crops in different soil-climatic conditions of the Ukrainian SSR.

The study is based on the use of general scientific principles of complexity and systematicity, multifactority and comprehensiveness, which provide a holistic solution to the research problem. Interdisciplinary and special historical methods, historiographical and source analysis were used. In the analysis, we preferred the biographical method as a basis for the reconstruction of creative and intellectual biography of V. P. Vasyliev, which is based on the vision of personality to reproduce the evolution of industry science and education. The source base covers a wide range of published materials, which are based on scientific works of scientist from different directions of entomologic science and protection of fruit crops from pests.



Fig. 1. Vadym Petrovych Vasyliev, 1946 [14]

Analyzing the biography of the entomologist, doctor of biological sciences (1953), professor (1958), Academician of Academy of Sciences of Ukrainian SSR (1964), Honored Scientist of the Ukrainian SSR (1973) Vadym Petrovych Vasyliev, we can conclude that he devoted sixty-seven years of his life to domestic entomologic science and protection of fruits crops, agricultural crops and forest plantations from pests and diseases. He was born on December 18, 1912 in Odesa in the family of a teacher (Fig. 1). While studying at school he showed interest in insects and collected a large collection of them [14, p. 81]. In 1935, after

graduating from the Kharkiv Agricultural Institute, he began working at the Ukrainian Research Institute of Viticulture and Enology (Odesa) [20]. During 1936–1953 he worked at the Ukrainian Research Institute of Horticulture (Kyiv) [19, p. 7]. In 1940 he defended his dissertation for the degree of Candidate of Biological Sciences at Kyiv Taras Shevchenko University. During 1941–1945 he was a soldier of the Cossack Cavalry Corps in the active army [18, p. 5]. Since 1946 he continued his activity at the Ukrainian Research Institute of Horticulture, where in 1952 he defended his dissertation for the degree of Doctor of Biological Sciences on the topic: «Ecological foundations of building a system of pests control of fruit crops» [16, p. 3]. During 1953–1979 he worked as the director of the Institute of Entomology and Phytopathology of Academy of Sciences of Ukrainian SSR (since 1956 – the Ukrainian Research Institute of Plant Protection) [21, p. 253]. During 1959–1984 he was the chairman of the Ukrainian Entomologic Society, in 1964–1984 – the vice-president of the All-Union Entomological Society [17, p. 152]. In the period 1959–1979 he represented the Ukrainian SSR in the European and Mediterranean plant protection organizations [22, p. 306]. More than 200 scientific works, including 10 monographs, 8 reference books and more than 10 brochures, are devoted to the improvement of agrotechnical, mechanical, biological, genetic, physiological and chemical methods of plant protection [15, p. 2].

V. P. Vasyliiev attached great importance to the development and practical application of effective measures to protect fruit crops from pests. As the end of 1940s, he concluded that powerful equipment was needed to effectively spray fruit trees in an adult garden. He considered the importance of the timeliness and efficiency of such spraying due to the fact that the chemical poison lost its activity if the duration of its use is increased by more than 3–4 days. However, during the hostilities in the Ukrainian SSR in World War II, almost all motor and tractor sprayers were destroyed. The absence of these machines in the collective and state farms of the country was the main factor that hindered the timely implementation of effective control of pests in gardens. Since most of the farms of the Ukrainian SSR had lots of gardens, which have the size of several hundred hectares, the scientist

proposed to solve this problem by spraying them from aircrafts. At his suggestion, the Civil Air Fleet Research Institute developed a perfect design for aircraft sprayers that finely sprayed the chemical liquid, as a result of which the tree crowns were evenly treated. To control garden pests, it was proposed to spray with pure diesel oil, concentrated suspensions of Parisian greens and calcium arsenate [23, p. 6].

Air spraying from airplanes was used to control pests of fruit crops widespread at that time: scale, apple moth and apple fruit-eater. In particular, in a 16-year-old plum orchard, aerial spraying with pure diesel oil proved to be effective, which ensured 60% of the death of scale. Measures to control apple moth were tested on 15-year-old «Borovynka» summer apple varieties. Air spraying with pure diesel oil was carried out in early spring to kill wintering caterpillars of apple moth, and 1% suspension of a Parisian greens – at the end of flowering, when the caterpillars began to feed freely on apple leaves. The best effect was provided by aerial spraying with Parisian greens, which reduced the infestation of trees with nests with apple moth caterpillars to 6,4%. Instead, pure diesel oil proved to be unsuitable due to low efficiency and significant damage to trees. Studies the apple fruit-eater were performed on 15-year-old winter apple trees «Snow Calville» and «Rennet Simirenko». They were sprayed from aircraft with 1% Parisian greens and 1,6% calcium arsenate. The aerial spraying with calcium arsenate was effective in the fight against apple fruit-eater, and increased the undamaged condition of fruits by 48,6% [23, p. 7–8]. Thus, high efficiency, extreme speed and relatively low cost of aerial spraying contributed to its widespread use in protection against pests of fruit crops in collective and state farms of the Ukrainian SSR.

V. P. Vasyliiev began to develop scientific measures to control apple fruit-eater in the late 1930s, working at the Ukrainian Research Institute of Horticulture. To increase their effectiveness, he attached great importance to determining the optimal timing of spraying, which could be determined by studying the development of this pests during the year. The scientist found out that in almost the entire territory of the Ukrainian SSR, except for its northern part, apple fruit-eater had two generations. Its caterpillar overwintered under the backward bark on tree trunks. In the spring, when

the average daily air temperature reached about 10° C, the caterpillars began to pupate. The flight of butterflies of the first generation of apple fruit-eater began in mid-May and lasted until the end of June. Researches have shown that butterflies laid their eggs on leaves, although the caterpillar did not feed on the leaves, but moved to the fruit. Most often the caterpillar bit into the fruit through the cup and less often – from its side. The caterpillar fed on seeds and during its development damaged 2–3 fruits. After the growth, the caterpillar climbed out of the fruit and looked for a place to pupate under the bark of trees. The pupate process began in late June. The flight of butterflies of the second generation of the apple fruit-eater began in mid-July and lasted until the end of September. The scientist found that the flight of the first generation of butterflies did not have time to end when the flight of the second generation began [24, p. 20].

Due to this feature of the development of the apple fruit-eater, during the summer in garden laid eggs and revived caterpillars. To protect the crop from these pests, it was necessary to maintain a lay of venom on the fruits during flights of butterflies throughout the summer. Therefore, the scientist recommended to carry out the first spraying at the end of flowering so that the poison got into the cup of the fruit and poisoned the caterpillars. The second and third spraying were performed in order to form a lay of venom on the fruit for poisoning the caterpillar, which passed from one fruit to another. In addition to spraying trees, for which Parisian greens were usually used, the scientist attached great importance to the application of mechanical measures. For example, the use of traps, bark cleaning and harvesting of damaged fruits, during which the wintering caterpillar was destroyed [24, p. 21].

In the middle of the 20th century, both in the Ukrainian SSR and in foreign countries, the chemical method with the use of insecticides began to be widely used to control insects. In particular, DDT (dichlorodiphenyltrichloroethane), which provided significant elimination of such dangerous pests as garden weevils. However, certain groups of pests were equally sensitive to different poisons. For example, pear medunitsa was not exposed to DDT at all. Rodent insects, in particular the caterpillars of the apple fruit-eater, were resistant to phosphorus-organic insecticides. In this

regard, V. P. Vasyliiev's assertion that pesticides provided the proper effect only when they were used to treat gardens in the timeframe determined on the basis of a study of the biology of certain species of pests became important. So that they are exposed to the poison in the least stable phase of development, or in such a period when they were on the surface of leaves, branches or fruits [25, p. 35]. Thus, the control of garden pests by chemical method was successful only if the application of a system of measures taking into account the phase of development of individual pests and the specific effects of different insecticides.

Back in 1939, the Swiss chemist P. Mueller discovered insecticidal properties in DDT and patented it in 1940. Although the first information about DDT was published in 1873 by an Austrian student O. Tseidler, who first received this new substance. In 1942, P. Miuller carried out the first field tests of a new contact insecticide on flies, Colorado beetles, aphids, moths and other pests. Various preparative forms of DDT were used: solutions, emulsions, granules. The new insecticide became the first reliable agent with stable action against pests of cereals, corn, vegetables, industrial and melon crops, in gardens and greenhouses. In 1948, P. Mueller received the Nobel Prize in Medicine «For his discovery of the high efficiency of DDT as a contact poison». This was the first and only case in history when a scientist received the highest award for the discovery of a contact poison – a pesticide. However, its purpose was not only for the preserved harvest, but also for the millions of saved lives. In particular, in 1944 in Italy – from typhus, in 1959 in Greece and in 1965 in India – from malaria and other dangerous diseases carried from insects to humans [26, p. 9].

In the 1960s, DDT was banned in agriculture in many countries of the world because the agrochemical was able to accumulate in the environment and living organisms, as well as adversely affecting human health and ecosystem biodiversity. However, it continued to be used to control pests in a limited amount. In the early 1970s, the use of DDT in the gardens of the Ukrainian SSR was also discontinued. However, due to its long-term systematic use from the middle of the 20th century, its existing remains were noted in the soil and tissues of fruit trees [27, p. 24]. In view of

this, V. P. Vasyliiev's researches on determining the amount of DDT accumulation in

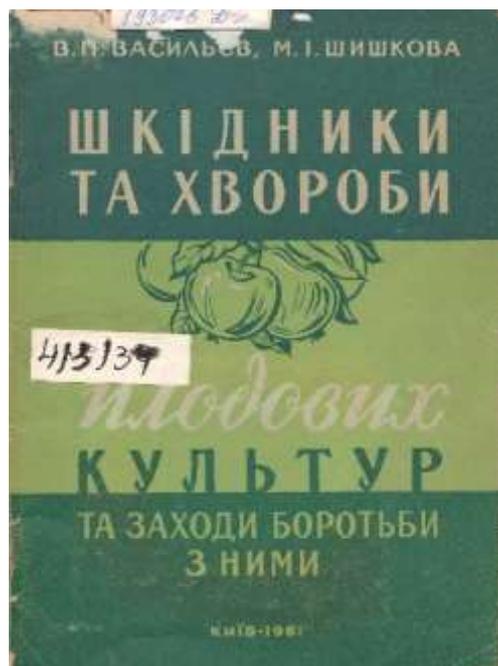


Fig. 2. Brochure of V. P. Vasyliiev & M. I. Shyshkova «Pests and diseases of fruit crops and measures to control them», 1961

and diseases of fruit crops and measures to control them» (1961) contains a list of

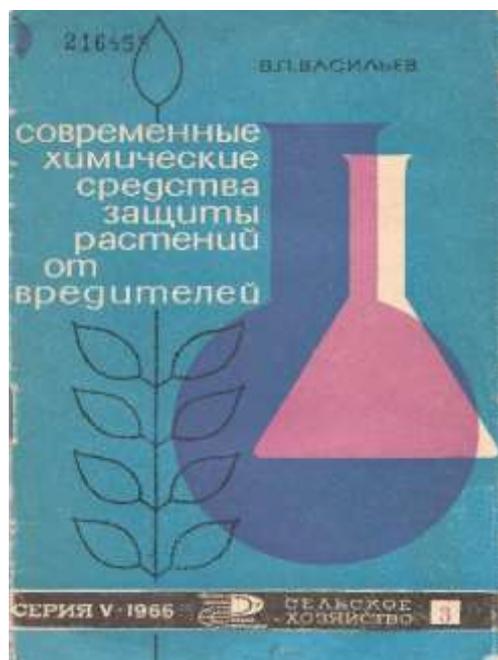


Fig. 3. Brochure of V. P. Vasyliiev «Modern chemical means of plant protection against pests», 1966

orchards during its long-term use was expanded. According to the results of the determination of the toxicological laboratory of the Kyiv Institute of Occupational Hygiene, it was found that repeated use of even small doses of DDT in spraying fruits caused food poisoning [28, p. 8]. However, with the cessation of DDT, a year later it was no longer detected in the fruit, which contributed to their safe consumption [29, p. 19].

The scientist summarized the achievements of the chemical method of protection against pests and diseases of fruit trees. In particular, in the brochure co-authored with M. I. Shyshkova «Pests and diseases of fruit crops and measures to control them» (1961) contains a list of

contemporary pesticides used to control pests and diseases of the garden (Fig. 2). The main pests and diseases are briefly described, indicating the most appropriate measures and timing of their control, as well as effective pesticides with their optimal concentrations. A system of measures to control pests and diseases of fruit trees in the calendare terms is recommended and a short list of basic precautions when working with pesticides is given [30]. In the brochure «Modern chemical means of

plant protection against pests» (1966) (Fig. 3) contains information about chemical means of control: against soil pests, pests whose larvae were contained inside the fruit and seeds, as well as pests that damage fruits outside [31].

It should be emphasized that in the second half of the 20th century, foreign scientists have been actively developing advanced methods of combating dangerous pests of fruit crops. For example, Canadian scientists have focused on a method based on the sexual sterilization of insects [32–35]. One of the essential elements of this method was to determine the size of their natural population. However, due to the inconspicuous way of life, observation of them became impossible. Researches using chemicals that attracted insects was also important [36–37]. However, these measures did not fully solve the problem due to the non-standard application. According to the results of researches, foreign scientists have concluded that the butterflies of the apple fruit-eater were significantly attracted to ultraviolet radiation [38–40]. V. P. Vasyliiev attached great importance to the introduction of the progressive at that time method of protection against butterflies of apple fruit-eater with the use of light traps [41, p. 64]. According to the results of the study, the scientist concluded that its accuracy and efficiency are quite high. He emphasized that the timely determination of the number of pests is a necessary condition for proper planning of measures to control them [42, p. 27].

V. P. Vasyliiev considered the management of agroecosystems to be the basis for effective protection of fruit crops. He saw this trend as the development of the doctrine of the system of entomologic measures, which gained widespread recognition in the first half of the 20th century. However, a more modern approach to substantiating agroecosystems did not provide all means of the highest possible level of crop protection, but to consistently eliminate the threat of damage to fruit crops. The scientist saw prospects in the creation of automatic control systems for plant protection based on agro-entomological zoning, forecasting possible damage not only in soil-climatic zones, but also in individual farms, determining the timing of economically feasible pests control measures. Such a system of entomological measures was differentiated by the scientist in the zonal section in accordance with the differences in the species composition of harmful fauna and the peculiarities of the life cycle of their individual species. He determined the feasibility of pesticides

by the following conditions: prevention of possible crop losses and prevention of pest reproduction to dangerous levels in subsequent generations [43, p. 32].

A significant achievement of Academician of Academy of Sciences of Ukrainian SSR V. P. Vasyliev was the implementation of the classification of



methods of protection of fruit crops from pests on the basis of basic methods: agrotechnical, mechanical, biological, genetic, physiological and chemical. The results of his researches are covered in the monographs: «Pests of Fruit Plantations» (1955) [44], co-authored with I. Z. Livshyts «Pests of Fruit Crops» (1958, 1984) [45–46] (Fig. 4), co-authored with I. Z. Livshyts, V. F. Peresyppkin «System of measures to protect fruit crops from pests and diseases» (1980) [47]. At different stages of scientific and technological progress, the role of

Fig. 4. Monograph of V. P. Vasyliev & I. Z. Livshyts «Pests of Fruit Crops», 1984

these methods in the overall set of pests control measures has changed significantly. Their importance and possibilities of effective use depended to a greater extent on the conditions of cultivation of different crops, which determined the features of the organization of protection of fruit crops from harmful insects and mites [48, p. 184].

The scientist found out that a set of agrotechnical measures was important to increase the durability and productivity of orchards, which was aimed at creating favorable conditions for the growth and fruiting of trees. These conditions included: tillage, fertilization, watering, trunk and crown care, which increased the resistance of trees to certain types of damage, such as weakening of the root system, and played a significant role in limiting the reproduction of stem pests: bark beetles, goldfinch [44, p. 6]. At the same time, agrotechnical measures used in the garden did not have a direct impact on the number of populations of the most dangerous pests.

The scientist recommended the main methods of mechanical control: cleaning the damaged bark of fruit trees with blunt scrapers, which was stacked on a spread

burlap and burned immediately; removal of winter nests of pests; removal and burning of damaged dried branches and shoots with caterpillars of fruit striped moth and oriental fruit eater; shaking beetles from trees on tarpaulins; catching caterpillars of apple fruit-eater with the help of traps; daily removal of fallen fruits [45, p. 16].

He considered important biological measures to control pests, which ensured the use of their natural enemies – parasites and predatory insects (entomophages), as well as agents that included cultures of microorganisms or products of their activities. For example, in Belarus, where the number of pests in orchards was small, the scientist recommended the release of insects – trichograms against apple fruit-eater. The use of trichograms was a cost-effective measure in gardens on the mountain slopes of the Carpathians, where it is impossible to spray with insecticides under the conditions of relief. To attract entomophages in gardens, the scientist recommended such a measure as the creation of a flower-nectar conveyor – sowing phacelia, buckwheat, mustard and other nectar carriers between rows of fruit trees at different times [47, p. 18]. However, this biological measure has not been widely used in practice, as it has made it impossible to carry out chemical control of the most dangerous pests, the reproduction of which is not restrained by natural predators.

In the 1970s and 1980s, the Ukrainian SSR and foreign countries' scientific research institutions updated studies aimed at finding new ways to control pests that were safe for humans and beneficial for fauna. These measures were based on genetic and physiological methods of regulating the behavior and activity of insects. The scientist proved the effectiveness of sexual sterilization of insects and the use of synthetic analogues of pheromones to catch males or disorientate them and create insecticides based on synthetic analogues of insect hormones that did not have a detrimental effect on entomophages and were not toxic to warm-blooded animals [47, p. 19]. However, these measures did not receive wide domestic and world practical use in gardens due to imperfect technologies of application, as well as high cost, which made them uncompetitive along with effective but much cheaper methods of chemical protection.

It should be noted that the chemical method was based on the use of toxic substances that in various ways entered the body of pests and caused their death. Toxic effects of chemicals used in plant protection were manifested in metabolic disorders, dysfunction of various organs, including the nervous system, changes in the activity of enzyme systems, changes in cellular, tissue levels. Chemical pesticides were mainly organic synthetic compounds that had a complex structure. The largest number of insecticides and acaricides, which were used both in world practice and in the Ukrainian SSR, was represented by organophosphorus compounds [44, p. 10].

The scientist considered a promising approach to chemical plant protection in the direction of using insecticides as a way to control the number of populations of harmful species. He determined the expediency of chemical treatment of orchards by such criteria as the economic level of harmfulness and the threshold of the number of pests at which the treatment should be carried out to prevent damage exceeding the economic level. The population size corresponding to the economic threshold was not a constant. Therefore, to adjust the average local indicators, the scientist recommended to take into account the following parameters: the time of occurrence of pests, the characteristics of the variety in terms of formation and harvesting, meteorological conditions, as well as the presence and number of natural predators [46, p. 8].

It is necessary to emphasize the value of the results of research by V. P. Vasiliev to determine the components of the complex application of insecticides: 1) Direct protection of leaves or fruits from damage, which was the most common in the practice of chemical plant protection. The criterion for the need for treatment was the number of pests at or above the economic threshold, identified during the survey of plantations. 2) Prevention of reproduction of permanent pests that are not restrained by biotic factors. Successful control of apple fruit-eater in the development zone of its two generations was achieved only under low population density. 3) Prevention of potential losses in cases where the detection and accounting of the number of pests were unreliable due to the hidden way of life. The probability of these losses was estimated by the level of reproduction of the species in the previous year [47, p. 25].

When using pesticides to control pests on fruit trees, the scientist focused on two conditions: obtaining the necessary level of technical efficiency and preservation of human health and reproduction of nature. He determined the effectiveness of chemical protection of fruit crops in the need to ensure the correct choice of the preparations for its toxicity to the harmful object, observance of optimum terms of processing and norms of an expense, as well as alternating systems of insecticides and acaricides with different physiological mechanism of toxic action to prevent selection of resistant pest's populations [45, p. 28].

It should be emphasized that for the safe use of chemicals, the scientist recommended the following basic requirements: not to exceed the residues of toxic substances in the fruit for hygienic standards and to prevent the accumulation of pesticide residues in the environment. The first requirement took into account the time from processing to the planned date of harvesting and selection of preparations, the detoxification period of which in plant tissues was shorter than this time. The second is the use of personal protective equipment and strict compliance with safety rules set out in the instructions for storage, transportation and use of pesticides [46, p. 21].

It can be concluded that the scientist-entomologist, Academician of the Academy of Sciences of Ukrainian SSR V. P. Vasyliiev made a significant contribution to the development of entomologic studies of fruit crops in the second half of the 20th century. He devoted sixty-seven years of his life to the development of national entomologic science and the protection of crops from pests and diseases. As an innovator of advanced plant protection methods, the scientist developed and substantiated a system of measures to protect fruit crops from insects and mites based on the development and application of new technologies, including their agrotechnical, mechanical, biological, genetic, physiological and chemical methods of protection. According to the results of the scientist's research, more than 200 scientific works have been published, including 10 monographs, 8 reference books and more than 10 brochures. His publications have become the basis of the system of protection of fruit crops, agricultural crops and forest plantations and have not lost its significance up to the present.

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