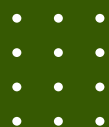


Edited by S. Stankevych, O. Mandych

MODERN TRENDS IN AGRICULTURE SCIENCE: PROBLEMS AND SOLUTIONS



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**MODERN TRENDS
IN AGRICULTURAL SCIENCE:
PROBLEMS AND SOLUTIONS**

Edited by S. Stankevych, O. Mandych

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The monograph is a collection of the results of actual achievements of domestic agricultural scientists, obtained directly in real conditions. The authors are recognized experts in their fields, as well as young scientists and postgraduate students of Ukraine. Research is conceptually grouped at 7 sections: Plants protection and quarantine; vegetable growing in open and closed ground; horticulture, fruit growing, viticulture; breeding and seed production; agrochemistry and soil science; agriculture and modern agricultural technologies; management and strategies for future development. The monograph will be interesting for experts in plant breeding, economics, plant protection, selection, agrochemistry, soil science, scientific workers, teachers, graduate students and students of agricultural specialties of higher education institutions, and for all those who are interested in increasing the quantity and quality of agricultural products.

Keywords: agriculture, modern technologies, plants protection, quarantine, vegetable growing, horticulture, fruit growing, viticulture, breeding and seed production, agrochemistry, soil, management, strategies, development.

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PLANTS PROTECTION AND QUARANTINE IN THE 21ST CENTURY:
**ENTOMOLOGICAL SCIENTIFIC SCHOOL OF KHARKIV
NATIONAL AGRICULTURAL UNIVERSITY
NAMED AFTER V.V. DOKUCHAIEV**

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A historical essay on the development of agricultural entomology in Ukraine since the nineteenth century up to the present days is presented. The most prominent stages and events on the way of the entomology development in the agrarian sector are highlighted. The prominent personalities that influenced the development of the world and national science on crops protection against the pests are mentioned. The role of the Entomological School of Kharkiv National Agrarian University named after V.V. Dokuchaiev as one of the oldest in Ukraine and Europe is defined separately. The main achievements of the outstanding entomologists of Kharkiv National Agrarian University named after V.V. Dokuchaiev such as I.K. Tarnani, V.G. Averin, O.O. Mihulin, B.M. Lytvynov, O.V. Zakharenko, Ye.M. Biletskyi and others are pointed out. The present state of the development of agricultural entomology in Ukraine and in Kharkiv National Agrarian University named after V.V. Dokuchaiev is described.

Key words: *agricultural entomology, plants protection, history of development, scientific schools, Ukraine, Kharkiv, Kharkiv National Agrarian University named after V.V. Dokuchaiev.*

Introduction. Protection of plants against pests is an essential reserve for obtaining the additional production of better quality. The most cost-effective branch of agricultural production is the payback of the expended funds. For example, in the United States, every dollar lost in chemical protection provides additional products for almost \$ 4 (Fedorenko et al., 2013). In the system of protective measures in world agriculture, the chemical method prevails now. For example, in the United States, plant production uses about 4 billion pesticides per year, and 2 billion dollars are used in France. However, the intensive and widespread use of chemical plant protection products along with the high economic effect also causes various side effects associated with the environmental pollution, deterioration of the people's health, the emergence of pesticide-resistant forms of harmful organisms, etc. This, in turn, requires additional funds to minimize these negative consequences.

In this connection, the problems of avoiding pest and environmental damage to plant products should be solved on the basis of the concept of integrated plant protection, according to which the greatest attention should be paid to natural factors of containment of the reproduction and development of harmful organisms. In particular, various alternative methods of plant protection such as the use of transgenic plants, biological control of pests, diseases and weeds, agro-technical method, etc. are of great importance.

According to the data of 1980, in Ukraine the pesticide load per one hectare of arable land and perennial plantations amounted to 2.04 kg of active substance and the pesticides only in agrarian production were used annually for the amount of about 342 million USA dollars. At present the volumes of pesticides sales in the country amount to only 150-170 million dollars per year, and in general the level of their use for plant protection is 20-30% of the minimum requirement. There is an extremely unsatisfactory provision of grain crops and sugar beets with chemical means of protection, in particular with the insecticides, which leads to significant losses of crop yields and deterioration of its quality. In this situation it is important to maximize the possibilities of existing methods and measures for the protection of plants, and, first of all it should be the organizational and economic, agro-technical, biological, and other methods of protection.

The great importance in the construction of ecologically-oriented and integrated systems for protecting crops from pests belongs to agricultural entomology (Fedorenko et al., 2013).

Entomology (from the Greek words *entomon*- insect and *logos* – study) is the science about insects. In the XVIIIth centuries it was singled out from Zoology as a separate branch of knowledge. According to the diverse values of insects in nature and human activity, now this science is divided into a number of disciplines which task is to develop scientific methods for protecting plants, humans and animals from harmful insects (Litvinov et al., 2005, Fedorenko et al., 2013).

The main task of agricultural entomology is to protect plants in order to reduce or prevent crops losses because of harmful animal organisms, especially insects, both during the growing season and during storage. The nature of the damage and the size of the yield shortage are connected not only with the behavior of the pests, but also with the corresponding reaction of the plant to the damage caused by its varietal characteristics, conditions of management, etc.

Materials and methods of the researches. As a result of a retrospective analysis of available literary sources, the authors made a historical review of the development of agricultural ectomology in Ukraine in the XIX-XXI centuries and the role of the entomological school of Kharkiv National Agrarian University named after V. V. Dokuchaiev.

Results. *The history of agricultural entomology development in Ukraine.* The varieties of physical and geographic conditions, as well as the large set of cultivated crops and natural vegetation determine the number of insects that damage the crops, gardens, forests and field protecting forest shelter-belts. More than 3000 species of insects, damaging useful plants are registered in the territory of Ukraine. Among them 680 species cause significant damage, 480 species are pests of agricultural crops and 200 species cause damage to forest plantations (Litvinov et al., 2005, Fedorenko et al., 2013).

The massive reproduction of insect pests has been observed in Ukraine since 1008 AD (webworm beetle in 1686 and winter moth in 1814). The massive proliferation of insect pests has always been a surprise to the farmers. The need to find measures to control pests and the desire of man to knowledge became the source of the origin of scientific entomology (Beletskij, 2006, Beletskij & Stankevich, 2018).

However, only in the nineteenth century Entomology was formed into an independent branch of knowledge. Even then, the vast majority of scientists understood that the effective measures to protect a given crop from

pests could only be developed on the basis of knowledge of the biology and ecology of insects and taking into account the accumulated theoretical knowledge of the science.

The history of plant protection science is closely linked to the diverse role of insects and other animals in nature and human life and needs to be studied in detail. Ukrainian researchers also rightfully belong to the cohort of prominent plant protection scientists in the world.

A great event in organizing and systematizing scientific researches in this area was the creation of the Russian Entomological Society in 1859, which was later transformed into the All-Union Entomological Society, and in 1949 the Ukrainian Entomological Society was created as a part of it. The members of the association were such prominent and well-known scholars as P.P. Semenov-Tian-Shanskyi, M.O. Kholodkovskiy, J.A. Porchynskiy, M.M. Rymyskiy-Korsakov, F.N. Keppen, M.M. Kulahin, M.V. Kyrdiumov, A.P. Semenov-Tian-Shanskyi, M.Ya. Kuznetsov, G.A. Kozhevnykov, O.G. Lebedev, V.P. Pospelov, O.V. Znamenskiy, V.G. Averin, Ye.V. Zverezomb-Zubovskiy, M.A. Telenha, O.J. Petrukha, M.P. Diadechko, V.I. Husev, M.M. Synytskiy, O.P. Cryshtal, S.I. Medvedev, I.D. Bilanovskiy, B.I. Belskiy, J.J. Korab, Z.S. Golovianko, B.S. Denysievskiy, A.I. Zrazhevskiy, G.N. Zhygaiev, O.V. Zahovora, Ye.M. Kititsyn, G.M. Kolobova, Ye.V. Ktokov, O.O. Mihulin, M.D. Taranukha, D.F. Rudnev, P.P. Savkovskiy, P.O. Svyrydenko, Ye.M. Savchenko, Z.M. Savitska, G.Yu. Sobol, I.K. Zahaikevych, V.G. Puchkov, V.P. Vasyliiev, I.Z. Livshyts, M.M. Palii, A.K. Olkhovska-Burkova, B.A. Areshnikov, P.I. Sussidko, V.M. Yermolenko, V.G. Dolin, Yu.P. Nekrutenko, V.G. Nadvorniy, V.S. Shelestova, V.M. Stovbchatyi, B.M. Lytvynov and many others (Litvinov et al., 2005, Fedorenko et al., 2013).

In the middle of the 70s of the nineteenth century the southern steppe zone of Ukraine was covered by the massive reproduction of the locust, winter moth, webworm beetle, corn ground beetles, scarab beetles, sun pests and other pests. The damages done to the agriculture by harmful insects were very large and, in general, significantly exceeded the losses from any group of harmful animals. These circumstances forced the Zemstva to seek practical help from the universities and the Department of Arable Farming. The first scientific centers were created in Odessa and Kharkiv and entomological commissions were established, their task was to study biology and ecology of insects and search for the measures to control them.

In 1867–1887 the famous biologist I.I. Mechnykov worked in Odessa. As a progressive scientist, he could not be indifferent to the national disaster.

PLANTS PROTECTION AND QUARANTINE IN THE 21ST CENTURY:

In that period I.I. Mechnykov carried out the fundamental research in the field of microbiological method for controlling scarab beetles. Subsequently, the results of these studies became the basis for the development of microbiological protection of plants from harmful organisms. The significant contribution to the entomological science at that time was made by the first provincial entomologists S.O. Mokrzhetskyi (the Crimea), I.K. Pachoskyi (Kherson), and P.A. Zabarynskyi (Odessa).

In 1878 the first Zemstvo entomological commission was created in Kharkiv and the second such commission was created in Odessa. Their task was to observe the plants pests and develop the measures to protect crops from them. In the period from 1881 to 1890 there were nine congresses of the commissions. The main attention was paid to the cereals pests and the commission in Odessa also examined the phylloxera. During this period the well-known scientists, the professors from Novorossiisk (Odessa) University O.A. Kovalevskyi and I.I. Mechnykov, the entomologists I.M. Vihdalm and P. Zabarynskyi were the members of the commission. In 1894 as a part of the Academic Committee of the Department of Agriculture, the first state institution on plant protection against pests was created in Russia. It was called the Bureau of Entomology and headed by J.A. Porchynskyi (Litvinov et al., 2005, Fedorenko et al., 2013).

At the end of the XIXth century the provincial Zemstvo councils formed the entomological bureaus which were governed by the provincial Zemstvo entomologists and the entomological commissions ceased their activity. In Ukraine the significant work on plant protection was carried out by three such bureaus as Tavriiske (the entomologist S.O. Mokrzhetskyi from 1893), Khersonske (the entomologist J.K. Pachoskyi from 1897), and Kharkivske (the entomologist I.V. Yemelianov from 1905 and V.G. Averin from 1913). They observed the appearance and spreading of the pests, and studied the measures of protection against them. The Tavriiske bureau specialized in the garden pests and Khersonske and Kharkivske ones concentrated their activity in the grain crops pests.

Besides the insects, at the end of the XIXth century the study of harmful mites and nematodes, which significantly damaged agricultural crops, began in Ukraine. V.A. Skorobyshevskyi made the first studies of the mites in the Crimea Nikitskyi Botanical Garden in the 1890s. In 1898 I.K. Tarnani informed about the existence of a root-knot nematode near Uman. Later there were found a sugar beet nematode near Kaniv, a potato stem nematode in Kyiv and Volyn regions, a seed gall nematode near Kerch and a hop cyst nematode in the Kyiv Botanical garden (Litvinov et al., 2005, Fedorenko et al., 2013).

PROBLEMS AND PERSPECTIVES PROSPECTS

During a long period weevils, webworm beetles, winter moths and other pests were a big disaster for the Ukrainian beetroot growers. According to the estimated calculations made by S.O. Mokrzhetskyi, the losses incurred only by the beetroot weevils in the late 90s of the nineteenth century, each year averaged 969 thousand rubles in gold, not taking into an account 500 thousand rubles, the cost of sugar beet replanting. In 1899 the beetroot weevils destroyed 5.5 % plantations of sugar beet, the expected harvest of which would cost 2.5-3 million rubles. In 1900-1901 the All-Russian Sugar Manufacturers Society created a Plant Protection Station in the town of Smila in Cherkaska Oblast. Since 1903, Yevhen Mykhailovych Vasyliiev, the founder of the system of sugar beet protection from harmful insects, has been working as a head of this station. In 1904, at the expenses of the Southern Russian Society for the Promotion of Agriculture and Rural Industry, the Kyiv Entomology Station was established, and the assistant of the Moscow Agricultural Institute V.P. Pospelov was proposed to head it. The main attention there was paid to the sugar beet pests, the pests of cereals and gardens; and the protective measures against them were also studied there. In 1906 Pospelov published a list of sugar beet pests, which contained more than 140 species. Ye.M. Vasyliiev was the chairman of the Organizing Committee of the First All-Russian Congress of Applied Entomology held in Kyiv in 1913. In 1911–1914 the scientific researches on Applied Entomology were carried out at the agricultural research stations. At the Poltava station M.V. Kurdiunov headed the entomology department and he had been working there for 3 years. He substantiated a new trend in the development of Agricultural Entomology, which had been developed by J.K. Pachoskyi, it was the agro technical method of limiting the number of pests. O.V. Znamenskyi became the follower of M.V. Kurdiunov. He continued to study the pests of grain crops and developed the doctrine of his predecessor. At the Odessa experimental station the same department was headed by O.M. Kyrychenko, who later became one of the prominent taxonomists of true bug line. In addition, in 1913 the Entomology Department was organized at the Kharkiv Agricultural Research Station. There it was headed by I.V. Yemelianov. The well-known entomologist M.O. Dobrovolskyi worked at this department. The objects of entomological research were cloropid goud flies, mites, sun pests and the European mole crickets (Litvinov et al., 2005, Fedorenko et al., 2013).

However, at that time neither the scale of scientific research nor the structure of the retarded agriculture allowed using the achievements of science in full measure, so the losses caused by harmful organisms remained huge; the protection of plants was of a random nature.

PLANTS PROTECTION AND QUARANTINE IN THE 21ST CENTURY:

After the October events of 1917 at the land departments of the province executive committees and research institution in Ukraine the entomological subdivisions were created. The department of Plant Protection, since 1925 headed by Viktor Hryhorovych Averin and the Republican Plant Protection station, headed by O.O. Mihulin (1932) were formed as parts of the Republican People's Commissariat for Agriculture. The scientific work concerning pest control was concentrated at the agricultural research stations in Kyiv, Poltava, Kharkiv, Myronivka, Skhidno-Stepove and Odessa.

In 1922, for the scientific provision of beet production, the General Management of sugar manufacturing in Kiev established a breeding department of high quality seeds with a network of experimental breeding stations. The Mliivsk Garden and Horticulture Research station, organized in 1921, was the center for scientific research on the garden pests.

In 1925, under the direction of V.G. Averin and O.O. Mihulin, for the first time in Ukraine in Balakliivskyi district of Kharkiv region the testing of aviation means for controlling the Italian locusts and their introduction into the agricultural production were made. The number of the locusts amounted to 250 individuals per 1 m². 1,5 thousand acres, or 70% of the inhabited area were sprayed (Litvinov et al., 2005, Fedorenko et al., 2013).

In 1926, under the direction of O.O. Mihulin, for the first time in Ukraine a signaling and forecasting service for the emergence and spreading of pests was created, the methods of which were later widely practiced in the territory of the former USSR. According to the task of the Council of Labor and Defense, in 1927, under the guidance of O.O. Mihulin a thorough survey of vineyards of Ukraine was conducted, and a map of phylloxera spreading in the republic was prepared. On this basis a system of measures for the protection of vineyards from this pest was developed.

In 1926–1967 J.J. Korab and A.P. Butovskyi conducted a series of studies on morphology, biology, distribution, and harmfulness of sugar beet nematode and they proposed crops protection measures against it. The results of these works are given in the monograph “Beetroot Growing” (1959).

Since the 30s of the XXth century the researches of the scientist from St. Petersburg I.M. Philipiev, the works by K.S. Kirianova and her data on the survey on the population of the main crops nematodes in the western regions of Ukraine have been of a very importance. Thanks to the works of K.S. Kirianova it became known that there were up to 50 species of nematodes of different groups on the arable land: parasitic, saprobiotic, mycogelidia and free-living ones.

PROBLEMS AND PERSPECTIVES PROSPECTS

In connection with the creation of collective and state farms in 1929–1930 the new tasks arose. In 1930-1931 about 30 institutes and research stations were organized, in particular, the Institute of Plant Protection in Kharkiv, the scientific director of it became the Phytopathologist T.D. Strakhov, and in 1932 he became the first dean of the first in Ukraine and the former USSR the Department of Plant Protection at Kharkiv Agricultural Institute. The Entomology Department at this institute was headed by M.Ya. Bonardovych. Due to certain objective reasons, in 1934 the Institute of Plant Protection was disbanded (Litvinov et al., 2005, Fedorenko et al., 2013).

At that time the largest entomological laboratories were created at the Ukrainian (later the All-Union) Institute of Sugar Beet (Kyiv), Ukrainian Scientific and Research Institute of Grain Farming (Kharkiv, then Dnipropetrovsk), and at the Ukrainian Scientific and Research Institute of Fruit Production (Kyiv). In other institutes of this branch (Ukrainian Scientific and Research Institute of Viticulture and Winemaking, the All-Union Research Institute of Hemp, Ukrainian Scientific and Research Institute of Cotton) and at the research stations of different departmental subordination were comparatively few departments of plant protection, and in some of them – only the positions of entomologists as a part of the departments of agricultural technology or departments of breeding.

In the early 30s of the XXth century, continuing to explore the fauna of mites in Ukraine, V.M. Voloshchuk described 26 species of mites, the pests of grain and the products of its processing in the repositories of the Crimea.

O.O. Hrossheim devoted many years to the detailed study of insects, the pests of fruit crops during his work at the Mliiv Garden and Horticulture Research station. In 1930 he published his original theoretical work “About Massive Reproduction of Pests”. This work was praised by the well-known entomologists: the professors O.G. Lebediev, F.O. Zaitsev, V.P. Pospelov and M.M. Troitskyi. O.O. Hrossheim regarded the question about the dynamics of insects in space and time as one of the central problems of the planetary life of the biosphere (according to V.I. Vernadskyi). The original researches on the ecology of insects in the early 30s were carried out at the Department of Terrestrial Animals of the Institute of Zoology of the Academy of Sciences of Ukraine under the direction of Professor O.G. Lebediev. In his paper “About the Importance of Harmful Insects Predictions”, published in 1930, he raised the problem of the occurrence of rhythmic fluctuations in the number of insects, their dependence on cosmic

factors or on meteorological influences, which operate, however, differently in different places (Beletskij, 2006, Beletskij & Stankevich, 2018).

In 1937 O.G. Lebediev published an article “Electromagnetic field as a forming factor in the life of plants and animals”. It contained a hypothesis about the influence of electromagnetic fields on insects, in particular their morphology and ecology. The research workers of the Institute of Zoology S.P. Ivanov, M.M. Levit and E.M. Yemchuk fulfilled the fundamental theoretical generalizations on the problem of the dynamics of insect populations and in 1938 they published the monograph “Mass Reproduction of Animals and the Theory of Gradation”, edited by the Academician I.I. Shmalhauzen. It was the first work in Ukraine and in the USSR, in which 325 literary sources of domestic and 686 sources of foreign ecologists on this problem were summed up (Beletskij, 2006, Beletskij & Stankevich, 2018).

In 1939 the Academy of Sciences of the UkrSSR joined the research on Applied Entomology. Three laboratories were created at the Institute of Zoology, and such well-known scientists as V.P. Pospelov, S.V. Zvierzomb-Zubovskiy and M.A. Telenh were invited to head it.

Before the war, the science of plant protection gained the significant development. The pest accounting service was created, the annual reviews of their spreading and forecasts of the expected emergence for the next years were made, which provided a scientific basis for the planning of works (Litvinov et al., 2005, Fedorenko et al., 2013).

In 1944, after the liberation of Ukraine, the restoration of activity of agricultural scientific establishments began. In 1946 an Agricultural Department of the Academy of Sciences of the Ukrainian SSR was organized, which encompassed 5 newly created institutes, including the Institute of Entomology and Phytopathology, later it was reorganized into the Ukrainian Research Institute of Plant Protection (now the Institute of Plant Protection of the National Academy of Agrarian Sciences). It is Scientific and Methodical Center for Plant Protection in Ukraine.

In the postwar period the country's agriculture faced many problems connected with the pests of sugar beet, cereals, vegetable crops, potatoes, forage grasses, garden plants, and vineyards. Then there appeared new opportunities for improving the protection measures connected with the introducing of the second generation of insecticides – synthetic organic compounds of chlorine and phosphorus. The attention was also paid to the breeding of pest-resistant crop varieties and using biological means. A whole cohort of scientists from many scientific institutions, research stations

PROBLEMS AND PERSPECTIVES PROSPECTS

and higher educational institutions of the agrarian type worked over the problems of plant protection (Litvinov et al., 2005, Fedorenko et al., 2013).

In the 50s and 60s the morphology, biology and plant protection measures from the European brown mite, the European red mite, two-spotted spider mite, and other species of mites were studied under the guidance of I.Z. Livshyts in the Nikitskyi Botanical Garden. During that period the researches at the scientific institutions of Ukraine were concentrated mainly on the questions of ecology of insects, methods of their accounting and development of the theoretical bases and methods of forecasting the population dynamics. The studies of economic thresholds of harmfulness, taxonomy and morphology of insects were widely carried out at that period.

At Kharkiv State University under the direction of Professor O.O. Ustinov a series of studies aimed at the ecologically substantiating measures to protect crops from parasitic nematodes was carried out. The prominent works “The Root-Knot Nematodes” (1959), “Nematode diseases of Agricultural Plants” (1957), “Stem Potato Nematode” (1955) are worth to paid attention to. N.M. Ladyhina continued the work of O.O. Ustinov with dignity (Litvinov et al., 2005, Fedorenko et al., 2013).

An important role in the development of ecological researches of insects belongs to the Professor of Kyiv National University O.F. Kryshtal. He is known to the wide scientific community as a talented organizer and a chairman of the organizing committee of the four the All-Union Ecological Conferences that took place in Kyiv. The first conference was held in 1940, the second one – in 1950. They were mainly dedicated to the discussion of the actual problems of the laws of mass reproduction of animals, including harmful insects, and its prediction. At the third (1954) and the fourth (1962) conferences, in addition to the problem of the population dynamics, the laws of the fauna formation of harmful and useful insects under the influence of human activity were widely discussed.

In the middle of 60s Professor S.I. Medvediev, the founder of the scientific school on the problems of fauna and ecology of insects, published the results of many years researches at the Department of Entomology of V.N. Karazin Kharkiv National University about the patterns of insect fauna formation in the anthropogenic landscape. Along with it, he convincingly proved that the anthropogenic landscapes were formed mainly from the local fauna. As a result of the violation of the trophic connections the fauna, to some extent, is impoverished.

The impoverishment is mostly expressed under the conditions of monoculture. Agricultural and technical measures partially reduce the

danger of mass reproduction; biological factors in modern agricultural technology do not play a significant role in agriculture. The chemical method of pest control, which prevailed at that time, is a present method; it does not contribute to the creation of sustainable, economically useful biocoenosis. O.O. Mihulin, the founder of a scientific school on the problem of the dynamics of pest populations, carefully analyzed the role of the main factors in the dynamics of the number of insects. At the same time, he especially emphasized that the violation in crop rotation and human economic activity in general had an impact on the emergence of massive proliferation of harmful insects. He convincingly proved that chemical method of treatment gave the economic effect only for a certain period of time, and in the future, new measures of crop protection would be needed.

If to keep in mind that the aviation and chemical treatment of forest plantations do not fully cover the area and are not always satisfactory fulfilled, then the population number in the following years is very likely to grow. Such phenomenon has been observed many times in the oak woods of Kharkiv region during the massive spreading of the European oak leafroller.

In the 20-60s of the last century the Ukrainian scientists also made a significant contribution to solving the problems of protecting crops from harmful rodents and snails. In this connection it should be mentioned the scientific works of B.Yu. Falkenshtein, Ye.V. Zverozomb-Zubovskiy, P.O. Svyrydenko, V.G. Averin, O.O. Mihulin, I.T. Sokura, and I.Ya. Poliakova. Their works were devoted to the study of distribution, peculiarities of development, the degree of rodent harmfulness and development of the protective measures. Such scientist as K.P. Hryvanov, I.M. Lykhariov, A.M. Sokolov and others conducted a great work in the field of studying the snails (Litvinov et al., 2005, Fedorenko et al., 2013).

In the 70s the reference book that described 186 families of harmful and useful species of mites was issued. In the 1980s and 2000s the scientists from the Department of Plant Protection of the Nikitskyi Botanical Garden under the direction of V.I. Mytrofanov, in addition to traditional ecological and faunal and taxonomic researches of parasitic and predatory mites in agroceonoses, also developed the ecological bases for the management of the sustainable development of agricultural landscapes on the basis of the ecosystems theory. They also gave a series of recommendations concerning the methods of research, determinations and the measures for the protection of plants from the mites. I.Z. Livshyts and V.M. Mytrofanov are included into the list of prominent acarologists (*akari* – mites) of the world.

PROBLEMS AND PERSPECTIVES PROSPECTS

The significant studies in the sphere of Theoretic and Applied Acarology are being conducted at the Institute of Zoology named after I.I. Shmalhauzen at the National Academy of Sciences; there the school of the acarologists has been formed. The important scientific data are included into the works about the biological basis of the harmfulness of acaroids mites and predatory and parasitic Cheyletidae mites. These works were published by the scientists in 1985 and 1990 accordingly. In the monograph “Predatory Mites in the Covered Soil”, published by I.A. Akimov and L.A. Kolodochka in 1991, the biological methods of protecting plants from two-spotted spider mites and the western flower thrips with the help of the predatory Phytoseiidae (L.) mites were examined (Litvinov et al., 2005, Fedorenko et al., 2013).

The studies on Agricultural Acarology are also conducted by the scientists of the Institute of Plant Protection, the Institute of Horticulture, and other institutions of National Academy of Agrarian Sciences, and also of agricultural higher educational establishments.

The scientists M.Ya. Dayilevskiy, M.A. Dobrovolskiy, O.O. Sylantiev, I.K. Rakhmaninov, I.K. Tarnani, Ye.V. Zviezoromb-Zubovskiy, M.O. Kamyshnyi, I.D. Bilanovskiy, Ye.M. Savchenko, V.V. Shcherbakov, V.P. Vasyliiev, M.A. Telenha, M.F. Rudniev, O.J. Petrukha, M.P. Diadechko, I.I. Korab, Ye.M. Zhytkevych, Ye.V. Klokov, B.M. Lytvynov, O.V. Zahovora, B.A. Areshnikov, J.T. Pokozii, V.G. Dolin, P.I. Sussidko, V.M. Pyssarenko, S.O. Trybel, V.P. Fedorenko, V.S. Shelestova, Ye.M. Biletskyi and others made a significant contribution to the theoretical and practical development of Agricultural Ecology during the historical period of its development in Ukraine.

The scientists of Zoology and Entomology Department of Kharkiv National Agrarian University named after V.V. Dokuchaiev have been carrying the researches in the field of agricultural entomology. Four academic schools, founded by the professors V.G. Averin (“Comparative and Ecological Approach in Population Dynamics Research”), O.O. Mihulin (“The Problems of the Dynamic of Harmful Organisms Population”), B.M. Lytvynov (“Ecologically Oriented System of Fruit Plantings Protection from Pests”), and Ye.M. Biletskyi (“The Problem of the Long Term Forecasting of Mass Reproduction of Harmful Insects”) were formed here (Puzik et al., 2016, Zabrodina et al., 2017, Ulyanchenko et al., 2018).

The present stage of the agro-industrial complex development is characterized by the growing influence of economic activity on the agricultural biocoenosis and on the biosphere in general. Along with it, the

problems of insect population ecology, the forecasting of their mass reproduction outbreaks, foundation of ecologically oriented, environmental and resource-saving technologies of plant protection are paid the special attention to. The vast majority of these issues are successfully solved by the Ukrainian research establishments and educational institutions (Litvinov et al., 2005, Fedorenko et al., 2013).

The Department of Zoology and Entomology named after B.M. Lytvynov is the flagship of domestic agricultural entomology. The Department of Zoology and Entomology was founded in 1840 after joining the Marimont Institute of Agricultural Management of the Warsaw Forestry School. At that distant time, the foundations of educational, methodological and scientific works were laid by the well-known Professors V.M. Yastrzhembskyi and L.F. Bogutskyi; the Master of Zoology, Professor A.D. Karpynskyi, who headed the Department from 1840 to 1871; the Ph. D. in Natural Sciences Ye.M. Vasyliiev (a well-known scientist, an expert on sugar beet pests), who headed the department from 1876 to 1890 (Litvinov et al., 2005, Golikova et al., 2011, Fedorenko et al., 2013).

The period from 1890-1905 was marked by a sharp decrease in the number of students after their riots in 1891-1892. It was connected with the difficult internal situation in Russia, the prolonged severe drought, poor harvest and the terrible famine of 1891-1892 (35 million people were starving in Russia at that time). But, despite the difficulties, the government, following the results of the commission, agreed to maintain the higher agricultural education in Russia (Beletskij, 1996, Biletskij, 2006).

From 1905 to 1930, the Department was headed by the Professor Ivan Kostiantynovych Tarnani, a talented teacher, naturalist and popularizer, student's favorite. In 1914, after moving to Kharkiv together with the institute, he improved the teaching of Zoology and Entomology, and conducted the researches on harmful organisms in Kharkiv province.

From 1930 to 1956, the Department was headed by the Professor, Doctor of Agricultural Sciences V.G. Averin, and a well-known encyclopedic scientist, who headed the Plant Protection Department of the People's Commissariat of Agriculture of Ukraine. He devoted 26 years to scientific researches on the problems of plant protection, and for the first time, in the 1930s of the last century, he substantiated the necessity of a comparative and ecological approach while studying the population dynamics in Zoology and Entomology. He has trained three Philosophy Doctors (Kirichok, 2001, Golikova et al., 2011, Puzik et al., 2016, Zabrodina et al., 2017, Ulyanchenko et al., 2018).

PROBLEMS AND PERSPECTIVES PROSPECTS

From 1956 to 1971, the Department was headed by the Doctor of Biological Sciences, Professor O.O. Mihulin, an outstanding scientist in the field of Theoretical and Applied Zoology and Agricultural Entomology. For several years O.O. Mihulin has been in charge of the Central (Republican) Plant Protection Station. Under his leadership, in 1925, a signaling and pest spreading forecasting service was organized in Ukraine, the methods of which were later extended in the territory of the former USSR, and in 1926 Iziium and Kupiansk observation posts were organized. In accordance with the task of the “Soviet of Labor and Defense” organization under the guidance of O.O. Mihulin (1927) a comprehensive survey of the Ukrainian vineyards was conducted; the map of phylloxera spreading in the republic was made. On the basis of this work, the law about the measures to combat this pest has been issued. Professor O.O. Mihulin founded a historic and statistical approach to the protection of plants when analyzing the population dynamics of harmful organisms. He trained two Doctors of Sciences and 23 Philosophy Doctors (Kirichok, 2001, Golikova et al., 2011, Puzik et al., 2016, Zabrodina et al., 2017).

Under the direction of V.G. Averin and O.O. Mihulin (1924) for the first time in Ukraine in the area of Savyntsi village in Balakliiskiy district of Kharkiv region an aero-chemical way of protecting crops from the Italian locust was tested, and it was introduced into production. In 1931–1932 V.G. Averin and O.O. Mihulin took an active part in the creation of the first Plant Protection Faculty in Ukraine at Kharkiv Agricultural Institute named after V.V. Dokuchaiev (Puzik et al., 2016, Zabrodina et al., 2017).

From 1971 to 1991 the Department was headed by the Doctor of Biological Sciences, Professor B.M. Lytvynov, a well-known scientist and teacher, a follower of the scientific and pedagogical school of Professors V.G. Averin and O.O. Mihulin. The Department was well known far beyond Ukraine (Kirichok, 2001, Golikova et al., 2011, Evtushenko & Baydik, 2011, Evtushenko & Baydik, 2015, Puzik et al., 2016).

Lytvynov B.M. is the founder of the fundamental trend, namely the population dynamics of fruit crop pests and he also developed a complex environmentally-oriented system of crops protection. His thesis research goes beyond the traditional chemical methods of plant protection and has all the signs of the integrated protection, although this term is not used in his work of many years. The protection of fruit plantings proposed by him combines the study of a complex of organisms interrelated for a long time (15 years) and a special tactics of destructive measures by regulating the number of the pests and bringing it to a certain size, as well as the use, in addition

to chemical, biological and microbiological methods of protection (Kirichok, 2001, Golikova et al., 2011, Evtushenko & Baydik, 2011, Evtushenko & Baydik, 2015, Puzik et al., 2016).

Lytvynov B.M. has trained two Doctors of Sciences and 24 Philosophy Doctors. The students and followers of B.M. Lytvynov continue the researches of his scientific school concerning the urgent issues of improving the environmentally-oriented protection of fruit and other crops from pests.

Lytvynov B.M. is a co-author of two editions of the textbook “Agricultural Entomology” (1976, 1983) edited by A.O. Mihulin, the “Guide to the Protection of Plants” (1989), the manual “Agricultural Entomology” (1997), the last two works were published by his edition. To ensure the educational process during the years of Ukraine's independence, the editorial board published the textbooks “Agricultural Entomology” (2005), “Agricultural Entomology Workshop” (2009), two editions of the textbook “Pests of Forest Plantations” (2005, 2008), and “Agricultural Entomology. The Names of the Main Pests of Agricultural Crops and Forest Plantations” (2007, 2010) edited by him (Puzik et al., 2016, Zabrodina et al., 2017, Ulyanchenko et al., 2018).

B.M. Lytvynov paid a great attention to the improvement of the educational process, and the aesthetic appearance of the Department. Under the direction of the scientist and thanks to his active participation, a series of unique visual training manuals for the preparation, control and self-control of students' knowledge on special disciplines: Zoology, General and Agricultural Entomology (the co-author is the Associate Professor V.I. Oparenko) was created. For 11 years B.M. Lytvynov successfully headed the Kharkiv Branch of the Ukrainian Entomological Society, for 5 years he headed a Specialized Academic Council for the defense of Doctors of Sciences and Ph. D. in the specialty “Entomology”, for 15 years he placed himself at the head of the economic and contractual thematic work on the introduction of new scientific developments of the Department in production, for many years Lytvynov was the editor-in-chief of the collected articles of the scientific works of the Faculty of Plant Protection's staff (Biletskij, 2015, Evtushenko & Baydik, 2015).

According to the decision of the Academic Council of Kharkiv National Agrarian University named after V.V. Dokuchaiev (proceedings № 2, February 25, 2015) the Department of Zoology and Entomology was given the name of Professor B.M. Lytvynov (Puzik et al., 2016, Zabrodina et al., 2017, Ulyanchenko et al., 2018).

Professors V.G. Averin, O.O. Mihulin, B.M. Lytvynov laid the foundation of the priority direction in Ecology and Plant Protection, the direction of managing the dynamics of harmful and beneficial organisms population, they trained the talented students and their followers. At that time, the staff of the Department worked fruitfully under the leadership of these scientists. The considerable attention was paid to training the Doctors of Sciences and Philosophy Doctors. In the 1960s and 1980s, the teachers of the Department developed and implemented the course “Harmful Nematodes, Mites, and Rodents” into the educational process, they specified the economic thresholds of harmfulness of many species, developed and produced the first in the institute the automated training stands on the taxonomy of insects and pests of agricultural crops.

Professors Ye.M. Biletskyi, B.M. Lytvynov and Associate Professor M.O. Bilyk carried out the large-scale studies on the biology and ecology of egg parasites in order to seasonally colonize them against the sun pest and codling moth. However, under modern conditions this method has not proved itself.

The group of scientists from the Institute of Plant Cultivation named after V.Ya. Yuriev (Y.M. Biletskyi, V.M. Grama, V.P. Grytsayi) and from Kharkiv National Agrarian University named after V.V. Dokuchaiev (B.M. Lytvynov, V.I. Oparenko, M.O. Filatov) made the monographic studies of the fauna and ecology of the wild bees, the pollinators of alfalfa. The effective methods for preservation, accumulation and protection of the pollinators have been determined, and the integrated protection of seed alfalfa from harmful organisms has been developed (Puzik et al., 2016, Zabrodina et al., 2017, Ulyanchenko et al., 2018).

Maintaining the famous traditions of the founders of the Faculty of Plant Protection, Professors V.G. Averin and O.O. Mihulin, the scientists of the Department of Zoology and Entomology of Kharkiv National Agrarian University named after V.V. Dokuchaiev continue the researches in the direction of “Development of the Theory and Methods for Managing the Populations Dynamics of Harmful and Useful Insects on the Basis of Phytosanitary forecasts”. The scientists of the Department have substantiated the systematic theory of the population dynamics cycling and its technological solution as for developing a long-term (strategic) forecast of mass reproduction of harmful insects (Ye.M. Biletskyi). On the basis of this theory, an inter-system method of prediction of the massive propagation of the webworm beetle, winter moth, chloropid goud flies, sun pest, corn

PLANTS PROTECTION AND QUARANTINE IN THE 21ST CENTURY:

ground beetle and the locusts for Africa and the Middle East, the cotton bollworm for the People's Republic of China (Ye.M. Biletskyi), the apple ermine, fruit moth and blossom weevil (B.M. Lytvynov, M.D. Yevtushenko), the cabbage moth and butterfly (L.Ya. Sirous) has been developed (Puzik et al., 2016, Zabrodina et al., 2017, Ulyanchenko et al., 2018).

Under the direction of Professor O.V. Zakharenko the fundamental faunal studies of net-winged insects in Ukraine and other regions and the studies of their ecology and economic significance were carried out. At the same time Professor O.V. Zakharenko paid the special attention to the researches in the field of nature conservation in Ukraine and to developing the environmental protection measures.

J.T. Pokozii, D.A. Khovrina, Z.P. Borysova, L.F. Krasnopolska, Kh.Kh. Ramakaiev (the Dean of Plant Protection Faculty in 1970-1992), V.I. Tsybulko, K.G. Vahanova, A.J. Kovalyk, V.I. Oparenko, O.V. Zakharenko, G.I. Sharuda, O.I. Miezentssev, O.L. Zozulia, A.P. Lukianchenko, and O.S. Tertyshnyi were the members of the Department in different time.

From 1991 to 2010, the Department of Zoology and Entomology was headed by the Doctor of Biological Sciences, Professor, Academician of the Academy of Pedagogic Sciences of Ukraine Ye.M. Biletskyi. He substantiated the system theory of the population dynamics cycling and developed an inter-system method for forecasting mass reproduction of harmful insects. This method is used in Ukraine, the countries of CIS, the Congo, Nigeria, and the countries of the Middle East, the state of Florida (USA) and in China. Ye.M. Biletskyi has trained two Doctors of Sciences and 13 Philosophy Doctors. He founded a scientific school “The Problems of the Long-Term Prediction of Mass Reproduction of Harmful Insects”. Ye.M. Biletskyi is a co-author of the branch standards of Educational Qualification Directions “Bachelor” and “Master” in the direction of “Plant Protection” at the Ministry of Education and Sciences; he is also a co-author of the educational textbook and manual “Agricultural Entomology” and five monographs. He published the monograph entitled “Mass Reproduction of Insects. Their History, Theory, and Forecasting” (2011). At the Department of Zoology and Entomology, in the whole, four scientific schools were created by the Professors V.G. Averin, O.O. Mihulin, B.M. Lytvynov, and Ye.M. Biletskyi.

From 2010 to 2016, the Ph. D. in Agricultural Sciences, Associate Professor G.V. Baidyk headed the Department of Zoology and Entomology

PROBLEMS AND PERSPECTIVES PROSPECTS

named after B.M. Lytvynov. She is one of the many followers of Professor B.M. Lytvynov. Her scientific interests are the study of the laws of the long-term dynamics of pest populations of cereal crops and the improvement of the integrated system of plant protection. She is a co-author of one textbook and seven manuals, etc. (Puzik et al., 2016, Zabrodina et al., 2017, Ulyanchenko et al., 2018).

From 2018 the Department has been headed by B.M. Lytvynov's follower, Ph. D. in Biological Sciences, Professors, the Honored Rector of Kharkiv National Agrarian University M.D. Yevtushenko.

At present the Department is run by the Professors M.D. Yevtushenko (the Honored Rector of Kharkiv National Agrarian University, he was at the head of the University in 1996–2007), V.L. Mieshkova, Ye.M. Biletskyi, the Associate Professors G.V. Baidyk, L.Ya. Sirous, I.P. Lezhenina, M.O. Filatov, D.D. Yushchuk (the Administrative Vice-Rector), I.V. Zabrodina (the Dean of Plant Protection Department), S.V. Stankevych (the Deputy Dean of Plant Protection Department), the teacher Yu.V. Vasylieva, Ph. D. in Agricultural Sciences V.V. Vilna and senior laboratory assistants N.P. Varzhelenko, and A.O. Salina. The Department trains specialists of the Education Level “Bachelor” and “Master” in the field of “Protection and Quarantine of Plants”. The teachers of the Department provide the educational process at the following faculties: Plant Protection, Agronomy, and Soil Science, and Forestry (the full-time and extra mural forms of training).

During the years of Ukraine's independence, the teachers of the Department issued the textbook “Agricultural Entomology” (2005), the manuals “Agricultural Entomology Workshop” (2009), and “The Pests of Forest Plantations” (2005, 2008) with the stamp of the Ministry of Agrarian Policy of Ukraine. They also published the textbooks for the Ukrainian agrarian universities and, in fact, fully ensured the educational process at the Department.

The main trend of the research work at the Department is to substantiate the theory and develop the techniques for managing the dynamics of harmful and useful insects' populations on the basis of phytosanitary forecasts of different ages, which includes 14 sections.

In 1980 the laboratory on the problems of insect ecology was formed at the Department. It was headed by Ph.D. in Biological Sciences V.M. Grama. The staff and the teachers of the Department developed the ecological bases of the integrated protection of agricultural crops taking into account the environmental protection. The laboratory ceased its work in

2010 (Puzik et al., 2016, Zabrodina et al., 2017, Ulyanchenko et al., 2018).

Professor O.V. Zakharenko (1948–2004) studied the fundamental problems of taxonomy and ecology of insects. He was the leading entomologist-neuropterologist of the world level, the ecologist, who investigated the problems of the steppe, and was the specialist in nature saving. He has developed new approaches to the organization and optimization of nature conservation. Professor O.V. Zakharenko founded the journal “The News of the Kharkiv Entomological Society” and for many years was its editor-in-chief. He has trained one Doctor of Sciences and three Philosophy Doctors.

V.L. Mieshkova, the Doctor of Agricultural Sciences, Professor has trained seven Philosophy Doctors. She is an author of four monographs, one patent, a co-author of a textbook with the stamp of the Ministry of Agrarian Policy, etc. Her scientific interests are the study of the dynamics of forest insects’ population, their spreading and harmfulness.

At present the follower of B.M. Lytvynov’s scientific school, Professor M.D. Yevtushenko together with his students I.V. Zabrodina, S.V. Stankevych and V.V. Vilna fruitfully conducts the researches in the priority areas, namely, the many-years population dynamics and the forecast of mass reproduction of pests of fruit crops, rape and mustard. According to the results of the researches in relation to pests of rape and mustard, M.D. Yevtushenko and S.V. Stankevych got two patents for useful models and a gold medal at the “Agro-2014” exhibition in Kyiv. M.D. Yevtushenko is the Honored Worker of Education of Ukraine, the author and co-author of three textbooks, two workshops, 20 manuals, four monographs, three inventions, etc. He has trained three Philosophy Doctors for the Department.

The fundamental investigations of the structure and functioning of the two-winged complex in agricultural coenoses are studied by Associate Professor I.P. Lezhenina (she has trained one Ph. D.); she is a co-author of the textbook “The Red Book of the Kharkiv Region” The investigation of I.P. Lezhenina and Yu.V. Vasylieva are dedicated to a complex of pests, pollinators and entomophags of seed amaranth. They received a patent for a useful model. They are the co-authors of two manuals on Rodentology (Puzik et al., 2016, Zabrodina et al., 2017, Ulyanchenko et al., 2018).

The methods of using wild bees’ pollinators of alfalfa and other melitophyll crops and the bases of their protection are developed by Associate Professor M.O. Filatov. For this development he received a gold medal at the “Agro-2013” exhibition in Kyiv. He is a co-author of the editions “The Red Book of Ukraine”, “The Red Book of the Kharkiv Region”, “The Red Book of Dnipropetrovsk Region” and “The Red Book

of the Crimea”.

The Postgraduate Courses and Doctoral Studies in the specialty “Entomology” are functioning at the Department. Over the past half century 85 Philosophy Doctors and eight Doctors of Sciences have been trained.

Ye.M. Biletskyi, M.D. Yevtushenko, V.L. Mieshkova, G.V. Baidyk, and L.Ya. Sirous, the teachers of the Department, during several cadences took an active part in the certification of the personnel of the highest qualification at the Specialized Scientific Council in the specialty “Entomology and Phytopathology”.

On the occasion of the 175th anniversary of the Department on May 21–22 2015, an International Scientific and Practical Conference “Fundamental and Applied Researches in Zoology” has been held (Puzik et al., 2016, Zabrodina et al., 2017, Ulyanchenko et al., 2018).

Conclusions

The need to find the measures to control pests and the aspiration of man to knowledge became the source of the origin of Scientific Entomology. The history of plant protection science is closely linked to the diverse role of insects and other animals in nature and human life and it needs to be studied in detail. Ukrainian researchers are also rightfully assigned to the cohort of prominent plant protection scientists in the world.

In 1878 the first Zemstvo Ecological Commission was created in Kharkiv, and in 1882 the second such commission was formed in Odessa. Their task was to observe the crop pests and develop the measures to protect the plantations from them. At the end of XIXth century the provincial Zemstvo councils formed the entomological bureaus, which were governed by the provincial Zemstvo entomologists, and the entomological commissions ceased their activities. Three such bureaus, namely Tavriiske (entomologist S.O. Mokrzhetkyi since 1893), Khersonske (entomologist J.K. Pachoskyi since 1897) and Kharkivske (entomologist I.V. Yemelianov since 1905 and V.G. Averin since 1913) carried out a significant work in Ukraine.

After the October events in 1917, the Subdivisions on Entomology were created at the land departments of the province executive committees and research institutions of Ukraine. The department of plant protection, since 1925 headed by Viktor Gryhorovych Averin, and the Republican Plant Protection Station at the head of O.O. Mihulin (1932) at the People’s Committee of Land were formed. In 1930–1931, about 30 institutes and research stations were organized; in particular, the Institute of Plant

PLANTS PROTECTION AND QUARANTINE IN THE 21ST CENTURY:

Protection in Kharkiv, the phytopathologist T.D. Strakhov was appointed on the position of its director. In 1932 T.D. Strakhov became the first Dean of the first in Ukraine and former USSR Plant Protection Department at Kharkiv Agricultural Institute.

In 1946 an agricultural department at the Academy of Sciences of the Ukrainian SSR was organized, which encompassed 5 newly created institutes, including the Institute of Entomology and Phytopathology, later reorganized into the Ukrainian Research Institute of Plant Protection. Now it is the Institute of Plant Protection of the National Academy of Agrarian Sciences and the Scientific and Methodical Center for Plant Protection in Ukraine.

The Department of Zoology and Entomology named after B.M. Lytvynov of Kharkiv National Agrarian University was founded yet in 1840 after joining the Marimont Institute of Agricultural Management of the Warsaw Forestry School.

From 1905 to 1930, the Department was headed by the Professor Ivan Kostiantynovych Tarnani; from 1930 to 1956, the Department was headed by the Professor, Doctor of Agricultural Sciences V.G. Averin; from 1956 to 1971 it was headed by Doctor of Biological Sciences, Professor O.O. Mihulin. From 1971 to 1991 Doctor of Biological Sciences, Professor B.M. Lytvynov was at the head of the Department; from 1991 to 2010 it was Doctor of Biological Sciences, Professor, and Academician of the Academy of Pedagogic Sciences of Ukraine Ye.M. Biletskyi; from 2010 to 2016 it was headed by Ph. D. in Agricultural Sciences, Associate Professor G.V. Baidyk. Since 2018 Ph. D. in Biological Sciences, Professor, the Honored Rector of Kharkiv National Agrarian University named after V.V. Dokuchaiev M.D. Yevtushenko has been at the head of the Department.

Four academic schools, founded by the professors V.G. Averin (“Comparative and Ecological Approach in Population Dynamics Research”), O.O. Mihulin (“The Problems of the Dynamic of Harmful Organisms Population”), B.M. Lytvynov (“Ecologically Oriented System of Fruit Plantings Protection from Pests”), and Ye.M. Biletskyi (“The Problem of the Long Term Forecasting of Mass Reproduction of Harmful Insects”) were formed at the Department.

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