Ukrainian Journal of Ecology

Ukrainian Journal of Ecology, 2022, 12(1), 59-64, doi: 10.15421/2022_336

REVIEW ARTICLE

Comparative modern features of the development, reproduction and spread of pathogens of viral diseases of flora and fauna

M.M. Dolya[1], D.V. Sakhnenko[1*], R.M. Mamchur[1], S.V. Stankevych[2], I.V. Zabrodina[2], L.V. Nemeryts'ka[3], I.A. Zhuravs'ka[3], N.I. Hellaf[1]

[1]*National University of Life and Environmental Sciences of Ukraine, Kiev, 03041, Ukraine*

[2]*V.V. Dokuchaev Kharkiv National Agrarian University, V. Dokuchaevske, Kharkiv Region, 62483, Ukraine*

[3]*Zhytomyr Agrotechnical College, Zhytomyr, 10031, Ukraine*

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

Received: *14-Jan-2022*, ***Manuscript No.*** *UJE-22-51685*; ***Accepted:*** *05-Feb-2022*, ***Pre QC No.*** *P-51685*; ***Editor assigned:*** *16-Jan-2022*, ***Pre QC No.*** *P-51685*; ***Reviewed:*** *26-Jan-2022*, ***QC No.*** *Q-51685*; ***Revised:*** *31-Jan-2022*, ***Manuscript No.*** *R-51685*; ***Published:*** *16-Feb-2022.*

In modern conditions of growing crops, the control of vectors of viral and phytoplasmic plant diseases with resource-saving nutrition systems, as well as progressive moisture-saving tillage, is of paramount importance. In particular, the control of seasonal and long-term dynamics of the number of insects-phytophages, ticks, as well as other carriers of pathogens of viral diseases, which in recent years have significantly reduced the yield of varieties and hybrids of agricultural crops and caused significant economic damage. At the same time, the systemic management of cenoses, as well as the control of a complex of harmful species-phytophages, according to the stages of organogenesis should be an integral part of a high-quality technological process of agricultural production. A comprehensive solution to this problem with the determination of the causes and consequences of the development, reproduction, survival and spread of viroses and phytoplasmoses in the forms of formation of agrocenoses is the basis for maintaining the ecological and phytosanitary situation of lands using biologically oriented technologies for growing grain and other crops. High-quality monitoring and control of the complex of virus vectors with optimization of the three links of the farming system is essential: soil cultivation, crop fertilization, plant protection, as well as short-rotation crop rotations, healthy seeds and highly efficient aggregates. This indicates the importance of modern scientific substantiation of technologies for growing field crops, as the basis for high-quality grain production according to biological laws with the control of common types of insects, mites, phytohelminths and other cenoses that breed in winter wheat, corn, sunflower crops. and other groups.

In 2006-2021, work was carried out to monitor quantitative and qualitative changes in the structures of carriers of cultivated plant viroses with the determination of mechanisms for self-regulation of agrocenoses and the development of resource-saving technologies for growing crops. The indicators of the formation of harmful species-phytophages that spread pathogens at the cellular level were determined and an analysis was made of the features of morpho-physiological changes in the growth and development of varieties and hybrids of field crops with an assessment of the relationship, as well as the effectiveness of measures to control viral diseases of both agricultural crops and individual animal species of the world based on the results of many years of research, a comparative assessment of the characteristics of biology, ecology, distribution of the virosis complex on plants and pathogens of viral diseases of the plant and animal world through migration cycles has been compiled.

Keywords: Plants, Animals, Viruses, Phytoplasmosis, Development cycles, Vector distribution.

Introduction

In Ukraine, in modern forms of development and organogenesis of plants, more than 90 species of pathogens of viral diseases multiply, which are formed with a characteristic feature of the structure and regular relationships at the species and population levels. So, according to the shape of viruses in plants, it is noted: rod-shaped (Tabaco mosaic virus tobacco mosaic virus): 5% nucleic acid, Filamentous (plum ball virus Plum pox virus), Spherical or isometric (tobacco bronze Cum virus): 15-45% acid, Bacilliform (alfalfa mosaic virus, currant riversia): 1% nucleic acid and others (Atlas, 2001; Andreychin, 2002).

Most plant viruses contain single-strand linear RNA, less often double-stranded (twisted into a spiral) and only individual viruses (cauliflower mosaic virus) have DNA, which indicates the importance of monitoring the above pathogens of plant viral diseases with modeling patterns of relationships in trophic chains of living organisms (Forterre, 2010; Boyko, 2013). A characteristic feature is the type of nutrition of viruses, in particular obligate parasitism. Viruses penetrate into a plant cell when they are pricked by insects, ticks and other species or due to minor tissue damage, as well as with seeds of field, vegetable, fodder and other crops.

Noteworthy are the features of virus reproduction, in particular, the penetration of the pathogen into a damaged cell with its characteristic effect on protein forms and the structure of the nucleic acid according to the replication characteristic of each type of

viral nucleic acid. The specifics of the synthesis of viral protein, the formation of mature viral particles are also indicated, however, the patterns of mechanisms for the preservation of pathogens of viroses along the food chain by other groups of organisms, including humans, are not well understood (Zaporozhyan, 2008; Mauck, 2014; Gudz, 2016).

To determine the factors of development of carriers of viral and phytoplasmic plant diseases with resource-saving nutrition systems, as well as progressive moisture-saving tillage, are of paramount importance. In particular, the control of seasonal and long-term dynamics of the number of insects-phytophages, ticks, as well as other carriers of pathogens of viral diseases.

Results

The harmfulness of viral diseases is manifested in a decrease in yield and deterioration in the quality of plant products, sterility of flowers, a decrease in winter hardiness of plants, seed germination, but the role and significance of pathological processes over the past decades as a result of plant damage by other pathogens is not noted. Thus, a decrease in the starch content in potato tubers and sugar content in beets can reach 2-3%, but there is no effect of such changes on the development of pathogens of the kingdom of fungi and bacteria. It is characteristic that the latent form of viruses does not lead to the death of plants, but contributes to their defeat by other diseases. The total economic damage caused by viruses is on average more than 20% (Martelli, 2012; Boyko, 2016).

In 2010-2021, the intensity of damage to crops by individual pathogens of viral diseases increased. Of the mechanisms and carriers, their complex action acquired paramount importance. It is characteristic that with contact-mechanical contact, when plant organs (aboveground or underground) come into contact in relatively thickened crops and when caring for plants (passination, cutting flowers, picking fruits), pathogens of viral diseases spread locally (Dolya, 2004; Boyko, 2013). More than 20% of phytopathogenic viruses (legume viruses, cucumber green mottled mosaic virus) were transmitted to seeds. However, cereal grain viruses have not been sufficiently studied according to modern cultivation technologies, in particular with seeds (Dolya, 2004). The plant viruses that reproduce vegetatively (potatoes, strawberries) are transmitted with planting material. Changes in the global migrations of viruses through pollen (necrotic ring spot virus), as well as pathogens of viral diseases spreading with plant debris and soil, as well as tobacco mosaic and necrosis viruses and through the stems of parasitic plants (midwife)-fodder virus legume herbs.

During the years of research, the indicators of the spread of pathogens of viral diseases of cereal crops by ticks, as well as insect vectors that feed on or parasitize plants (aphids, leafhoppers, thrips, bugs, and others) turned out to be a priority. For a comparative characterization of individual periods and processes of transformation of both plant and animal viroses associated with the physiological state and functioning, their influence was assessed by individual changes in health processes from cell to organism (Fig. 1.). At the same time, the determining factors in the formation of morpho-physiological and qualitative changes and the functioning of biological systems are complex dependencies, manifested in the comparative processes of transformation and changes in trophic relationships. The isolated persistent viruses that retain their infectious ability in the insect body throughout the entire period of their life (bronze of tomatoes, potato leaf curl, yellow potato dwarfism, beet top curl) (Polishchuk, 2001; Kalinina, 2016), as well as species at the cellular level, including seeds of agricultural crops. Mainly in the first periods of formation of cenoses.

Of particular importance are also non-persistent viruses transmitted by insects within 1 hour, after which the viroformity of the virus decreases (pea, beet mosaic virus, cucumber mosaic virus); c) nematodes parasitizing on the roots of plants (ring spot of tomatoes, raspberries). Certain types of fungi are also important, in particular in the spread of tobacco necrosis virus (zoospores of *Olpidium brassicae* Dang.), potato virus (zoospores of *Synchytrium endobioticum Schilb.*), beet rhizomania (zoospores of *Polymyxa betae*) and others. In a plant, viral particles are localized mainly in the phloem and move with the flow of nutrients from top to bottom. From cell to cell, viruses move along plasmodesmata (cytoplasmic vessels connecting the protoplasms of neighboring cells) (Lyuta, 2018). The above vectors and ways of spreading plant viral diseases indicate the importance of generalizing and systematizing a complex of factors and factors with the reasonable application of control measures for these pathogens in the cultivation of crops.

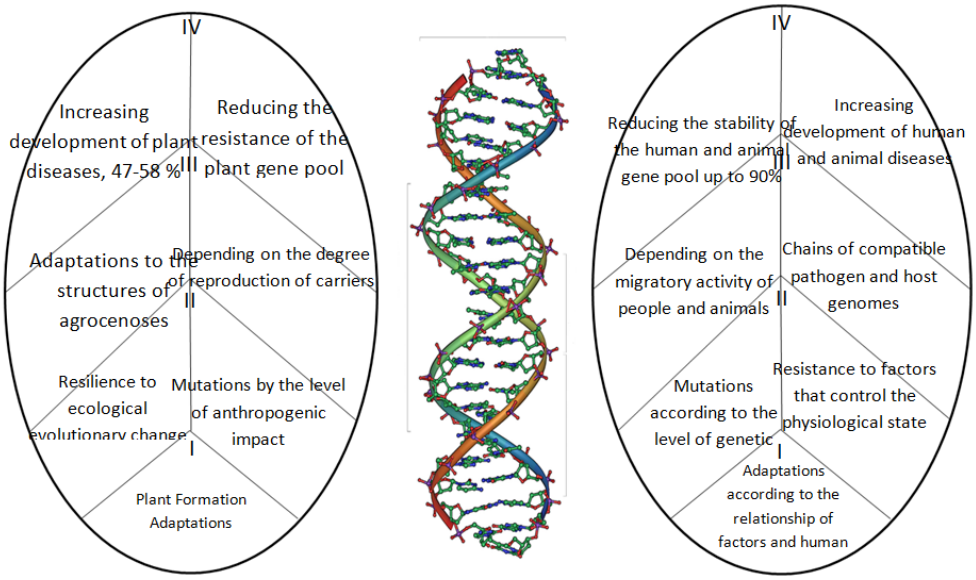

Fig. 1. Comparative features of the periods of development, reproduction and spread of viral diseases of flora and fauna.

Particularly noteworthy are the consequences of damage to cultivated plants by pathogens of viral diseases with the formation of changes, in particular in inhibition of growth and resistance of field crops to other pathogens of lesions, as well as stunting of the entire plant (yellow dwarfing of potatoes), shortening of internodes ("witch brooms" of potato tops) inhibition of the growth of the main shoots with increased formation of lateral shoots (tomato aspermia) and others (Pradeu, 2016).

There are also characteristic signs in color-the appearance of mosaic, chlorotic circles, striped patterns (plum puff, raspberry ring mosaic), yellowing of the veins (bordering of the gooseberry veins), general yellowing of the leaves (beet jaundice, 9). Particular consequences are deformation of organs: wrinkled potato mosaic, tomato mosaic (leaf threadiness), as well as necrosis-the appearance of spots of gray, brown, black-brown colors (tomato streak, striped potato mosaic, plum ball) (King, 2012; Shirobokov, 2014).

During the years of observation, changes in the reproductive function of plants were noted: the sterility of flowers, the formation of fruits without seeds, the fall of the ovaries (tomato aspermia), as well as the intensification of these negative processes against the background of the aftereffect of the chemicals used in crop production. Thus, monitoring of the seasonal and long-term dynamics of the development of viral diseases and cultivated plants indicates the reservation and changes in the structures of the formations and viability of viruses. Methodological developments regarding the sources of primary infection of viral diseases, in particular, with the assessment of such changes in the structure of field crop rotations, are of current importance:

- Crop area patterns and levels of vector control under new cropping technologies;
- On phase monitoring and localization of perennial weed species (couch grass, sow thistle, field birch and others);
- Resource-saving system, with control of the levels of vegetative propagation (root crops, tubers, bulbs);
- Comprehensive assessments of the degree and structure of pathogens of viral diseases in crop seeds;
- Models of seasonal and long-term dynamics of the number of carriers;
- Control of the level of agrotechnical and other measures to prevent seasonal development and reproduction of viruses through plant residues and soil (cucumber green mottled mosaic virus) (Mauck, 2014).

During the years of research, the intensity and high survival rate of pathogens of viral diseases were revealed when plants were weakened by adverse environmental conditions (insufficient lighting, low temperature contribute to the development of tomato streak). So, low temperature contributes to the development of a mosaic of raspberries and strawberries, and high temperatures-to the rim of gooseberry veins. The levels and indicators of the balance of mineral nutrition were of particular relevance (Fig. 2). Thus, unbalanced mineral nutrition influenced the studied processes of migration of vectors and the resistance of grain colossus crops to viral diseases in the phase of ear appearance and milky-wax ripeness of grain, as well as the processes of survival of pathogens in seeds.

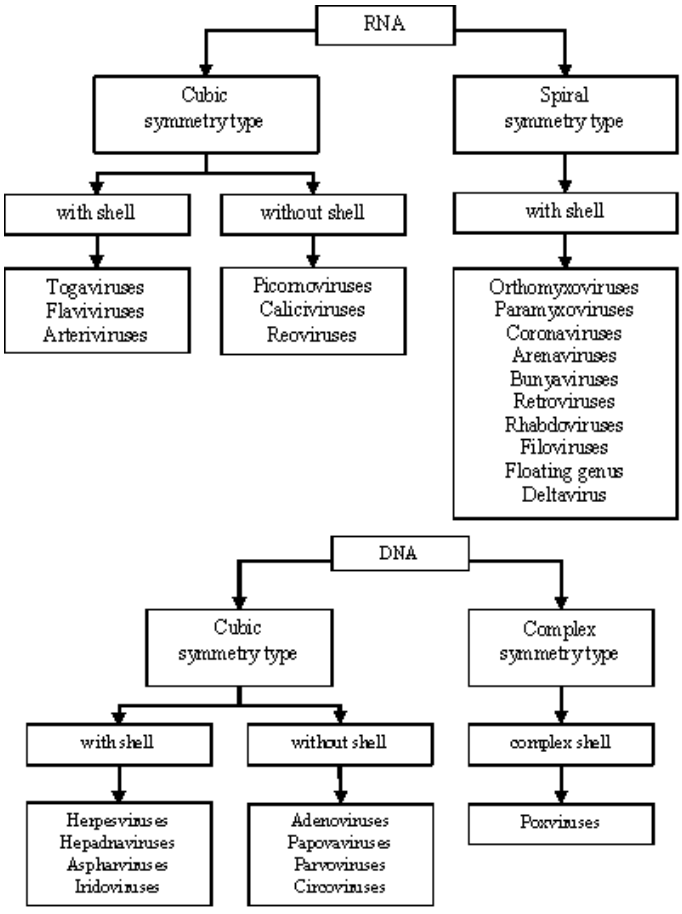

Fig. 2. Classification of the main viruses of the animal and plant world.

The main factors in the emergence and spread of emerging infections for humans and animals are biological and environmental factors, in particular, the genetic variability of viruses (mutation), which manifested itself as a fundamental property of viral pathogens. As is known, it allows the pathogen to avoid the influence of the host's immune system, increase its virulence and induce resistance to antiviral drugs. The formation of the persistence of the pathogen in the body contributes to its preservation in nature as a biological type of pathogen activation with the possibility of the next epidemic or pandemic processes.

In addition, an increase in human contacts with birds and animals with the creation of optimal conditions for unpredictable distribution with the possibility of increasing virulence, as well as genetic recombinations between the genes of the viruses themselves, and between the genes of the viruses and host cells (Polishchuk, 2001; Peshetnik, 2010; Kalinina, 2016). Socio-economic factors remain an important factor in the spread of viral infections, which are a significant cause of the emergence and spread of emerging and re-emergent infections. It is noted that the epidemic risk of developing diseases is largely related to the level of the socio-economic situation of the country. The most dangerous and severe infectious diseases, as a rule, occur more often in countries with high population density and low living standards (Warren, 2012; Andriychuk, 2014; Shirobokov, 2018). The following mechanisms for the penetration of viruses into the body of a certain type of animal are distinguished (Table 1).

Table 1. Mechanisms of penetration of viruses inside the organism.

Horizontal	**Vertical**
Airborne (aerosol)	Transplacental
Fecal-oral	Integration into the genome of cells of the reproductive system
Transmissible	
Via Contact (through the skin or mucous membranes)	
Sexual (through the urogenital tract)	
Parenteral (artificial)	

The causative agents of human viral diseases are more than 450 types of viruses, including 170 respiratory viruses and 90 intestinal viruses, including 100 arboviruses, pathogens of hepatitis A, B, C, D, E, F, G, HIV-1, HIV-2, about 200 papillomavirus serotypes, 8 herpesviruses, parvoviruses, hantaviruses, arenaviruses. Ways of spread of viruses in the body:

- Cellular
- Lymphogenous
- Hematogenous
- Neurogenic

An acute infection occurs over a relatively short period of time, the course is accompanied by the release of viruses into the environment with the death or complete recovery of the body. It is urgent to control productive types of infection at the cell level (hepatitis A, influenza, reovirus infections, rhinovirus infection, etc.). A persistent infection (persistentia-stubbornness, constancy)-occurs during prolonged interaction of the virus and the body with a possible latent slow chronic consequence. So, a latent infection is a latent infection that is not accompanied by the release of the virus into the environment. Associated with the integration of the genome or with a defective state of the virus or with the persistence of subviral components (adenoviruses, herpesviruses, HIV, retroviruses, HBV).

Biological features are special in chronic infection-a long pathological process with periods of remissions and exacerbations (the virus is released into the external environment).-adenoviruses, herpesviruses, hepatitis B, C, B viruses, etc. However, slow infection is characterized by a relatively long incubation period (months and years), followed by a slow but steady development of disease symptoms leading to severe impairment of body functions and death (slow infections caused by prions-kuru, Creutzfeldt-Jako disease slow infections caused by viruses-subacute sclerosing panencephalitis-measles virus, multifocal leukoencephalopathy-polyomavirus JC).-Intrauterine infection-infection in the 1st year of birth.

Noteworthy is the autonomous type of viral infection, in which the viral genome replicates independently of the cellular genome. In this case, the integration type of viral infection, in which the viral genome partially or completely integrates with the cellular genome and replicates along with it. Integration infection occurs due to the physical union of the genome of the virus and the cell. In this form of infection, the viral genome replicates and functions as an integral part of the cellular genome (Andreychin, 2002; Forterre, 2010; Pradeu, 2016). A characteristic feature of an acute viral infection is a form of infection in which, after the formation of viral progeny, the cell either dies or recovers and does not contain viral components. In a chronic viral infection, cells continue to produce viral particles or their components for a long time and transmit this ability by inheritance. In this case, we highlight the following factors that determine the pathogenesis:

- Virus tropism
- Cell permissivity
- The reaction of cells to a viral infection
- The body's response to changes occurring in cells and tissues under the influence of a viral infection.

The reproduction of viruses, early stages are distinguished, when viral structures are prepared for the reproduction of infectious progeny, and later stages, including the synthesis of virus-specific molecules, the composition of virions, and the release of the virus from the cell. The early stages include the adsorption of the virus on the cell surface, its penetration into cells and undressing (deproteinization) of the virus, accompanied by the removal of protective membranes and some proteins. At the same time, the

adsorption of the virus on the cell surface is a highly specific process due to the recognition of surface viral proteins (attachment proteins) of receptors located in the plasma membrane. As a result, the targeted function of viruses is carried out-delivery of the virion to a sensitive cell capable of producing infectious viral progeny.

It is indicated that cellular receptors are also found in certain recesses on the cell surface-covered holes lined from the side of the cytoplasm with a special high-molecular protein.

Receptors serve not only to attach viral particles to the cell surface, but also for further intracellular transportation in combination with a virus particle. Cellular receptors may be common to large groups of viruses that differ in serological properties. This feature, combined with the vulnerability of the adsorption process for a number of compounds, indicates the prospects for the use of antiviral therapy at this stage of virus reproduction (Kalinina, 2016-2017).

Blocking the infectious process can be done by destroying receptors, adding synthetic peptides that compete with viral attachment proteins and receptors, and by neutralizing receptors with monoclonal antibodies. The penetration of the virus into the cell is carried out in the same way as the penetration of extracellular nutrients, some hormones, growth factors and other particles necessary for the life of cells, that is, by receptor endocytosis. This mechanism consists in the fact that after attaching to the receptors located at the bottom of the covered pits, endocytic vacuoles arise that merge with other intracellular vacuoles, forming a receptorosome, a large short-lived vacuole containing a receptor-associated ligand, the viral lobe.

The above comparative features of the development, reproduction and spread of viroses in modern evolutionary processes of the formation of living organisms have certain patterns, which should be taken into account in the measures of protection of both animal and plant organisms.

Conclusion

Based on the analysis of scientific literature in the historical aspect of the research, the main processes and periods, the features of the distribution and control mechanisms of virus carriers in the flora and fauna are identified. In view of the feasibility of controlling common representatives of the kingdom of viruses and phytoplasmosis, a complex of factors has been identified that contribute to the intensive spread of these organisms due to competitive ability, as well as anthropogenic impact, biotic factors and abiotic factors that control genetic stability and chains of formations and stability of cenoses. The plant viroses and pathogens of viral diseases of the animal world are controlled by the level of resistance of populations of individual species, as well as the intensity of anthropogenic load in combination with ecological and cenotic factors that affect the relationship at the post-generative level. Summarizing information on the otnogenetic spectra of the formation of the viability of plant and animal viruses, it is advisable to use complex indices to assess cenopopulations and forms of their viability in the dynamics of biological diversity and features of integration, areal zonal nature. In 2006-2021, indicators of the spread of pathogens of viral diseases of grain crops by ticks, as well as insect vectors that feed on or parasitize plants, turned out to be a priority. Non-persistent viruses, which are transmitted by insects, have acquired special significance, after which the viroformity of the virus is reduced by nematodes that parasitize the roots of plants. In modern conditions of the development of flora and fauna, it is important to take into account the processes of virosis transformation and their influence on the resistance of the plant gene pool to a complex of harmful organisms, which should be taken into account in monitoring and control systems for viroses of the flora and fauna.

References

Allen, G. (2002). Respiratory infections by herpesviruses types 1 and 4. International Veterinary Information Service, pp:67-78.

Andreychin, M., Rudenko, A., Ivakhiv, O., Chemich, M. (2002). Classification of infectious and parasitic diseases. Ternopil: Ukrmedknyha, 1:143 (in Ukrainian).

Andriychuk, O., Koroteeva, O., Molchanets, O., Harina, A. (2014). Viral infections of humans and animals: Epidemiology, pathogenesis, features of antiviral immunity, therapy and prevention. Kyiv University Publishing and Printing Center, 1:415 (in Ukrainian).

Apatenko, V. (2003). Viral infections of farm animals. RVV KhGZVA, pp:122-125 (in Ukrainian).

Atlas, R. (2001). Principles of microbiology. McGraw-Hill, Boston, Massachusetts.

Bezpal'ko, V., Stankevych, S., Zhukova, V., Zabrodina, I., Turenko, V., Horyainova, V., Poedinceva, A., Batov, O., Zayarna, O., Bondarenko, S., Dolya, M., Mamchur, R., Drozd, P., Sakhnenko, V., Matsyura, A. (2020). Pre-sowing seed treatment in winter wheat and spring barley cultivation. Ukrainian Journal of Ecology, 10:255-268 (in Ukrainian).

Bhatnagar, R., Johnson, G.R., Christian, R.G. (1976). Electron microscopy for rapid identification of animal viruses in hematoxylin-eosin sections. Canadian Journal Comparative Medecine, pp:416-419.

Boyko, A. (2013). Security and viruses. Ecological Safety of Agro-Industrial Production. DIA, pp:18-44.

Boyko, A. (2016). Paradoxesof virology: problemsand challenges. Bulletin of Agricultural Science, 10:43-46.

Boyko, O., Grigoryuk, I., Melnichuk, M. (2011). Fungi Basidiomycetes: Properties in ecological niches, producers of biologically active substances. Agroecological Journal, 3:69-75 (in Ukrainian).

http://virology-online.com/viruses/CORZA4.htm

Dolya, M., Pokoziy, R., Mamchur, R. (2004). Phytosanitary monitoring. HHC IAE, p:294 (in Ukrainian).

Fauquet, M., Mayo, M.A., Maniloff, J. (2006). Virus taxonomy. Eight Report of the International Committee on Taxonomy of Viruses. London: Academic Press, p:1259.

Forterre, P. (2010). Defining Life: The Virus Viewpoint. Origin Life Evolutionary Biosphere, 40:151-160.

Galatyuk, O., Radzykhovsky, M. (2013). Organization of preventive and health measures for infectious animal diseases. Zhytomyr, p:456 (in Ukrainian).
Gudz, S., Peretyatko, T., Galushka, A. (2018). Virology, LNU, p:536 (in Ukrainian).
Kalinina, O. (2016). Taxonomic characteristics of DNA-genomic viruses of vertebrates and humans. Scientific Bulletin of LNUVM and BT named after Gzhytsky S, 18:83-87 (in Ukrainian).
Kalinina, O. (2017). Taxonomic characteristics of RNA-genomic viruses of vertebrates and humans. Scientific Bulletin of LNUVM and BT Named After SZ Gzhytsky, 19:30-35. (in Ukrainian).
King, A.M.Q., Adams, M.J., Carstens, E.B., Lefkowitz, E.J. (2012). Virus taxonomy. Ninth Report of the International Committee on Taxonomy of Viruses. Elsevier, p:1327.
Lu, R., Zhao, X., Li, J. (2020). Genomic characterisation and epidemiology of 2019 novel coronavirus: Implications for virus origins and receptor binding. Lancet, 395:565-574.
Lyuta, V., Kononov, O. (2018). Microbiology with the technique of microbiological research, virology and immunology: A textbook. VSV "Medicine", p:576 (in Ukrainian).
Martelli, G.P. (2012). Grapevine virology highlights: 2010-2012. The International Council for the Study of Virus and Virus-like Diseases of the Grapevine: Proceedings of the 17th Congress of ICVG, pp:13-31.
Mauck, K.E., De Moraes, C.M., Mescher, M.C. (2014). Biochemical and physiological mechanisms underlying effects of Cucumber mosaic virus on hostplant traits that mediate transmission by aphid vectors. Plant, Cell and Environment, 37:1427–1439.
Polishchuk, V., Budzanivska, I., Ryzhuk, S. (2001). Monitoring of viral infections of plants in biocenoses of Ukraine. Phytosocial Center, p:220 (in Ukrainian).
Pradeu, T. (2016). Mutualistic viruses and the heteronomy of life. Study Historical Philosophy and Biology Biomedical Sciences, 59:80-88.
Peshetnik, G. (2010). Diagnosis of wheat infections with the action of abiotic factors. Virusology, p:21.
Rima, B.K., Duprex, W.P. (2006). Morbilliviruses and human disease. Journal. Pathology, 208:199-214.
Shirobokov, V. (2018). Medical virology. Institute of Encyclopedic Research of the National Academy of Sciences of Ukraine (in Ukrainian).
Shirobokov, V., Yankovsky, D.S., Dyment, G.S. (2014). Microbes in biochemical processes, the evolution of the biosphere and the existence of mankind FOP Veres, p:464 (in Ukrainian).
Warren, E. (2012). Review of medical microbiology and immunology, McGraw-Hill Professor Medical Technology, p:688.
Zaporozhyan, V. (2008). Molecular-genetic determinants of multifactorial diseases: Current state of the problem and prospects of research. Integrative Anthropology, 2:4-7.

Citation:
Dolya, M.M., Sakhnenko, D.V., Mamchur, R.M., Stankevych, S.V., Zabrodina, I.V., Nemeryts'ka, L.V., Zhuravs'ka, I.A., Hellaf, N.I. (2022). Comparative modern features of the development, reproduction and spread of pathogens of viral diseases of flora and fauna. *Ukrainian Journal of Ecology.* 12:59-64.