

CHALLENGES OF FASCIOSIS SPREADING IN CATTLE IN UKRAINE IN 2021-2023

Lytvynenko O. P.¹ (ORCID ID 0009-0003-0682-8917), **Miroshnichenko O. I.**¹ (ORCID ID 0009-0001-0445-1963), **Pishanskiy O. V.**¹, **Kovalenko V. L.**¹ (ORCID ID 0000-0002-2416-5219), **Gerilovych A.P.**² (ORCID ID 0000-0002-3280-4172).

¹ - State Scientific Research Institute of Laboratory Diagnostics and Veterinary and Sanitary Expertise, Kyiv, Ukraine, e-mail: 2431519@ukr.net

² - One Health Institute, NGO, Kharkiv, Ukraine.

Abstract. *The paper presents a comparative analysis of the epizootic process of cattle Fasciolosis dynamics in Ukraine from 2021 to 2023. The data are broken down by region. The risk zones are determined, and the territory of Ukraine is conditionally divided into dangerous, threatened, and temporarily not-dangerous areas.*

Grazing ruminants' helminths are common worldwide and harm cattle productivity and food security. The concern that climate change can increase the frequency and intensity of helminth infections has been growing. In Ukraine, this concern stems from case reports and theoretical life-cycle models, which allow us to assess the impact of climate change on helminth epidemiology. We believe that this study is the first attempt to investigate geographic and climatic trends in cattle helminth infections spreading by region. In the total of 474209 conducted tests, 6967 cases had positive results, and the average infection rate of cattle with Fasciola from 2021 to 2023 was 1.5 % in the regions with mild climate.

Fasciolosis infection spread depends on the elevation of the farm and agricultural region. The studies show that meteorological changes can significantly contribute to understanding the impact of climate on infectious disease dynamics. If local environmental conditions are taken into account, the impact of climate change on disease dynamics can be clearer on a local scale. We recommend developing a strategy for extensive sample selection across Ukraine to monitor changes in helminthic disease risk and inform on adaptation strategies to increase productivity and protect the health of the cattle.

Keywords: Fasciolosis, spreading, epizootic process, territory

All agricultural mammalian animals can be infected with Fasciolosis. It is more severe in younger animals. If Fasciolosis is not treated on time or not at all, the frequency of Fasciolosis infection cases increases with age due to reinvasion and superinvasion. The course of Fasciolosis and all its specific epizootic are closely related to abiotic and biotic features, including anthropogenic factors of the region. These include the average annual temperature, humidity, soil, and water salinity, the number and type of infected animals, their migration from one area to another, the size and environment conditions of pastures, the number of mollusk habitats, as well as factors that ensure or impede the development of Fasciola larvae, including the degree of implementation of the proposed measures against Fasciolosis, and others (Charlier J, et al., 2014; Phelan P, et al., 2015).

The common liver fluke or sheep liver fluke (*Fasciola hepatica*) is a trematode parasite that infects a wide range of hosts, including ruminants, horses, rabbits, and humans (Gasbarre L.C., 2014). It causes the parasitic infection Fasciolosis and is widespread all over the world (Rose H., et al., 2015). The infection is often subclinical and can cause productivity losses due to liver damage (Vande Velde F., et al. 2015) and a decrease in weight, milk yield, and fertility (Sutherland I.A., et al., 2011).

Preventing the spread of helminthiasis among agricultural animals and taking measures against them is one of the basic principles of helminthology. Various scientists have been conducting research in this area for a long time, but it has not yet been possible to prevent completely infections caused by helminthiasis (Vercruysse J., et al., 2018; Matthews, K., et al., 2004; Smolynets, I.B., et al., 2016).

According to the analysis of scientists, it was found that Fasciolosis is quite widespread, which negatively affects the development of livestock and causes significant economic losses in agriculture. Animals affected by Fasciolosis show a decrease in the productivity of meat, milk, and wool; their meat quality becomes worse, their liver is rejected and they have their early death (Vande Velde F., et al. 2015).

For example, it has been proven that a cow infected with Fasciolosis loses at least 20-40 kg of live weight and a significant amount of milk. This causes significant losses to livestock farmers. Untimely treatment for Fasciolosis leads to premature slaughter of animals, which causes big losses to businesses. The carcasses of animals subjected to forced slaughter are thin and therefore have poor meat quality and the liver cannot be used, so we suffer significant economic losses (European Parliament and Council of European Union, 2016; Howell A., et al. 2015).

As a result of studies conducted around the world, it was found that the annual damage from Fasciolosis amounted to \$3 million (Chai, J. Y., 2019).

Thus, every year there is a decrease in the number of cattle and small ruminants due to the aggregated pathological effect of helminth infections, which cause large economic losses to livestock breeding.

The purpose of our study was to learn the dynamics of the epizootic process of cattle Fasciolosis by analyzing and comparing data from 2021 to 2023 in Ukraine.

Methods and materials. The material for the statistical analysis was the annual reporting form No. 2-Vet "Report on the Work of the State Service of Ukraine for Food Safety and Consumer Protection Laboratories".

The State Service of Ukraine on Food Safety and Consumer Protection controls and supervises the epizootic situation in Ukraine by conducting scheduled epizootic inspections. In 2021-2023, samples of slaughtered cattle of different ages and breeds from 24 different regions of Ukraine were collected and inspected against Fasciolosis (Vinnytsia, Volyn, Dnipropetrovs'k, Donetsk, Zhytomyr, Zakarpattia, Zaporizhzhia, Ivano-Frankivsk, Kyiv, Kirovohrad, Lviv, Luhansk, Mykolaiv, Odesa, Poltava, Rivne, Sumy, Ternopil, Kharkiv, Kherson, Khmelnytskyi, Cherkasy, Chernivtsi, Chernihiv). We researched cattle, considering both their age and the conditions they were kept in. Diagnostic tests have been conducted with microscopy methods in regional laboratories of the State Service of Ukraine for Food Safety and Consumer Protection, which are authorized and accredited in the ISO-17025 system.

Results. Cattle Fasciolosis is widespread in Ukraine. In the total of 474209 conducted tests, 6967 cases had positive results, the average infection rate of cattle with *Fasciola* from 2021 to 2023 was 1.5 %.

In 2021, the State Service of Ukraine for Food Safety and Consumer Protection laboratories conducted 201688 tests, 2957 cases had positive results, which totaled 1.5% of the infection rate. In 2022, 155319 tests were conducted, and 2017 cases had positive results, which totaled 1.3 %, in 2023, out of 117202 conducted tests 1993 cases were positive, which gave 1.7% (Fig. 1).

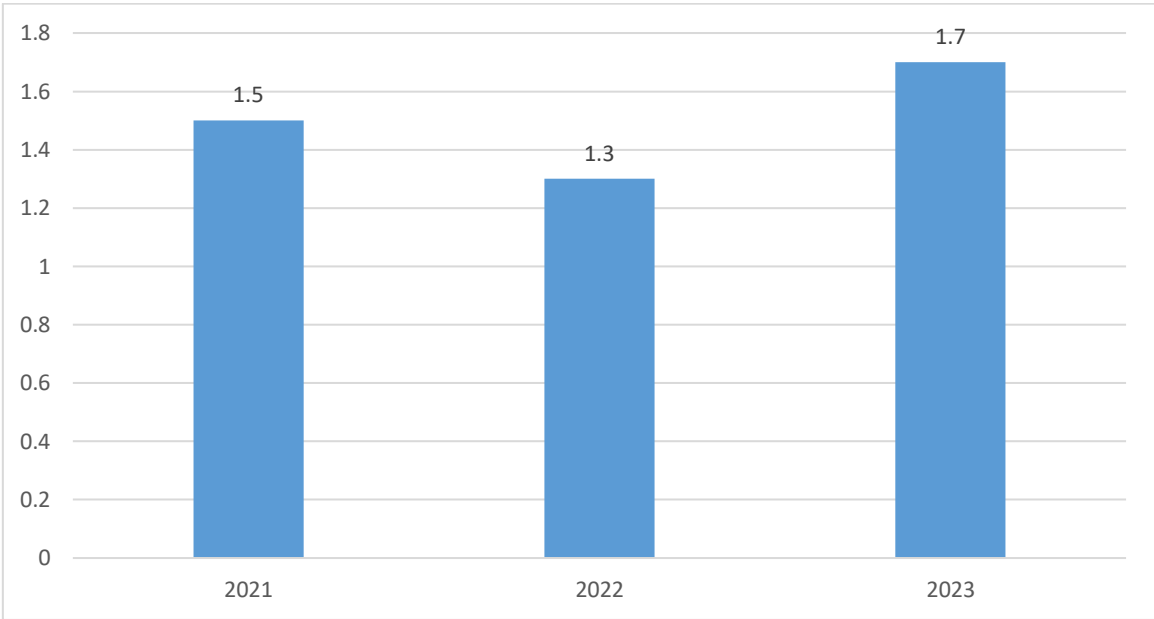


Fig. 1. Infection of cattle with Fasciolosis in Ukraine from 2021 to 2023

According to the development of the Fasciolosis epidemic, Ukraine can be divided into three risk areas: dangerous – with an infestation rate of 1 to 4.5%, threatening – with an infestation rate of 0 to 1%, temporarily not-dangerous – with an infestation rate of 0%.

The statistics analysis shows that from 2021 to 2023, 10 regions were included in the dangerous area: Volyn - 1.5%, Rivne - 4.5%, Odesa - 1%, Kirovohrad - 1.5%, Kharkiv - 1.6%, Chernihiv - 2%, Sumy - 3.1%, Lviv - 3.4%, Khmelnytskyi - 1.2%, Zhytomyr - 2% (Fig. 2).

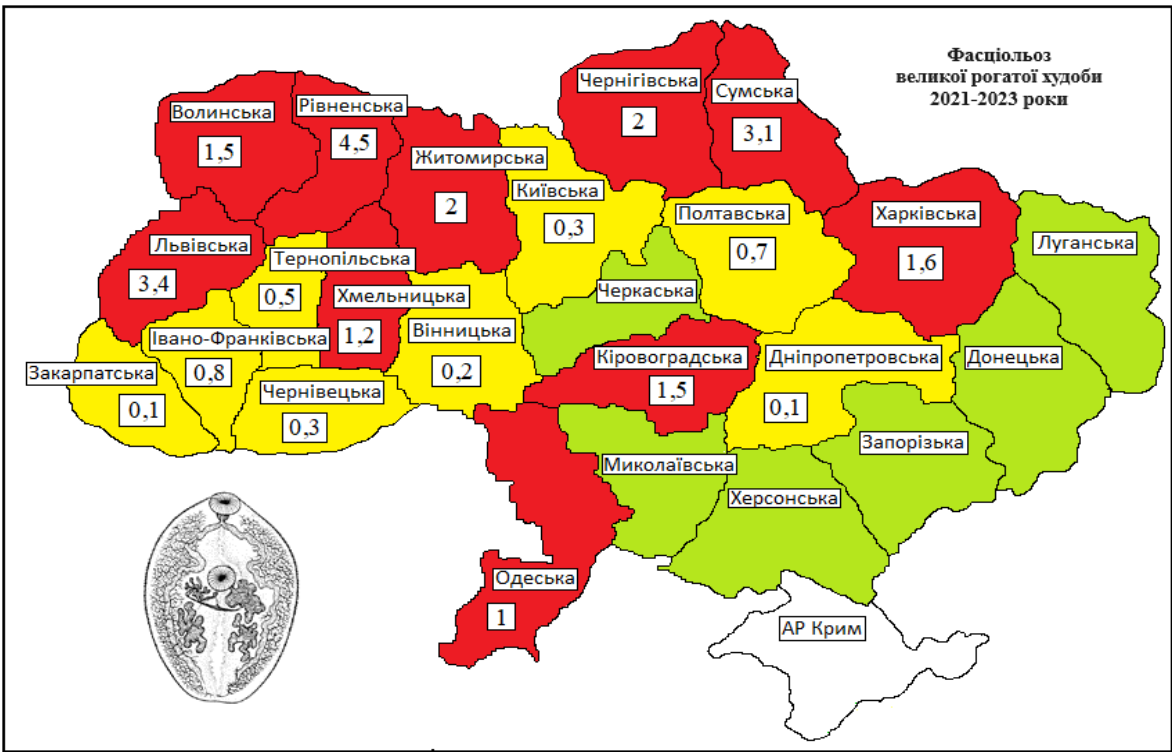


Fig. 2 Infection of cattle with Fasciolosis in Ukraine from 2021 to 2023

8 regions were included in the threatened risk area: Zakarpattia - 0.1%, Ivano-Frankivsk - 0.8%, Ternopil - 0.5%, Chernivtsi - 0.3%, Vinnytsia - 0.2%, Kyiv - 0.3%, Poltava - 0.7%, and Dnipropetrovsk - 0.1%,

6 regions had temporarily not-dangerous areas: Mykolaiv, Zaporizhzhia, Cherkasy, Kherson, Donetsk, and Luhansk.

It was found that the farms had different terrain. Most farms are located on uplands, with small reservoirs and wetlands along the edges. The habitats of mollusks ponds are very diverse and are divided into permanent and temporary ones. Permanent habitats include small rivers with low flow rates and small ponds. Temporary ones include puddles, ditches, and indentations from animal hooves filled with rainwater (Доврій Ю.Ю., 2006; Lyngdoh D, et al. 2016; Lotfy, W. M., et al. 2013).

Based on registrations at slaughterhouses, the distribution of liver fluke *Fasciola hepatica* is more concentrated in the northwestern regions of Ukraine, with 1.7% positive registrations in 2023. The climate in this part of Ukraine is relatively mild with many precipitations. This is favorable for the parasite life cycle, in which the intermediate host, *Galba truncatula*, is common in small ponds in pasture. The effect of *F. hepatica* on cattle productivity and anthelmintic treatment procedures has not been studied (Ducheyne E, et al. 2015; Novobilský A, et al., 2015; Dube A, et al., 2023).

The spread of Fasciolosis agents from one area to another, from one region to another, or even from one country to another, depends on various environmental factors, including the movement of Fasciolosis-affected animals, as well as hay and other collected feedstock from dangerous to not-dangerous areas. The spread of Fasciolosis to other areas can also be caused by the water flow. Cercariae long-distance migration and mollusks infected with them lead to the emergence of new foci of Fasciolosis. Mollusks are also moved by flood waters to habitats in other regions. (Selemetas N, et al., 2015; Zárate-Rendón DA, et al., 2023)

Like many other trematodes, the *Fasciola* population is considered a free, complex, self-regulating, and dynamic system. The water factor plays an important role in the transmission of *Fasciola* during the spillage of rivers and water reservoirs, for both the conservation of flukes and their transmission.

The size of the *Fasciola* population depends on the regional differences and treatment frequency. The coastal zone, which is relatively warm and humid, is a more favorable environment for the development and survival of parasite larvae, and the grazing season is longer than in northern or highland areas. Many precipitations and marshy pastures are associated with an increased risk of exposure to *F. hepatica* (Howell A, et al., 2015; Доврій Ю.Ю., 2006). The homogeneity at the country level in the distribution and occurrence of *O. ostertagi* and *F. hepatica* may indicate that the two helminth infections share a common dependence on pastures as well as climate conditions (Bennema SC, et al., 2010), which is reflected in the responses of dairy farmers in our study (Charlier J, et al., 2014; Suleyman, Y., et al., 2006).

Thus, even though trematodes have existed for centuries, their complex life cycles still retain a huge reproduction potential that has not yet been fully explored. Therefore, monitoring studies in the field of trematode epidemiology, particularly *Fasciolas* should be conducted regularly.

Conclusions. It has been found that late detection of the disease in cattle suspected of having Fasciolosis and delayed treatment measures may lead to the occurrence of severe complications, on the one hand, and to other diseases, on the other. This finally ends in poor forecasts and even excessive additional costs and time spent on treating the disease.

REFERENCES

1. Gasbarre L. C. (2014). Anthelmintic resistance in cattle nematodes in the US. *Veterinary parasitology*, 204(1-2), 3–11. <https://doi.org/10.1016/j.vetpar.2014.03.017>.
2. Rose, H., Rinaldi, L., Bosco, A., Mavrot, F., de Waal, T., Skuce, P., Charlier, J., Torgerson, P. R., Hertzberg, H., Hendrickx, G., Vercruysse, J., & Morgan, E. R. (2015). Widespread anthelmintic resistance in European farmed ruminants: a systematic review. *The Veterinary record*, 176(21), 546. <https://doi.org/10.1136/vr.102982>.
3. Vande Velde, F., Claerebout, E., Cauberghe, V., Hudders, L., Van Loo, H., Vercruysse, J., & Charlier, J. (2015). Diagnosis before treatment: Identifying dairy farmers' determinants for the adoption of sustainable practices in gastrointestinal nematode control. *Veterinary parasitology*, 212(3-4), 308–317. <https://doi.org/10.1016/j.vetpar.2015.07.013>.
4. Sutherland, I. A., & Leathwick, D. M. (2011). Anthelmintic resistance in nematode parasites of cattle: a global issue?. *Trends in parasitology*, 27(4), 176–181. <https://doi.org/10.1016/j.pt.2010.11.008>.
5. Vercruysse, J., Charlier, J., Van Dijk, J., Morgan, E. R., Geary, T., von Samson-Himmelstjerna, G., & Claerebout, E. (2018). Control of helminth ruminant infections by 2030. *Parasitology*, 145(13), 1655–1664. <https://doi.org/10.1017/S003118201700227X>.
6. Matthews, K., Melville, S., Turner, M., & Chappell, L. H. (2004). The application of genomic technology to combat parasitic disease. *Parasitology*, 128(S1), 1-2. <https://doi.org/10.1017/S0031182004007061>.
7. European Parliament and Council of European Union (2016) Regulation (EU) 2016/679. <https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32016R0679&from=EN>).
8. Howell, A., Baylis, M., Smith, R., Pinchbeck, G., & Williams, D. (2015). Epidemiology and impact of *Fasciola hepatica* exposure in high-yielding dairy herds. *Preventive veterinary medicine*, 121(1-2), 41–48. <https://doi.org/10.1016/j.prevetmed.2015.05.013>.
9. Chai, J. Y. (2019). Fasciolids. In *Human Intestinal Flukes* (pp. 397-416). Springer, Dordrecht. https://doi.org/10.1007/978-94-024-1704-3_5.
10. Lyngdoh D., Sharma S., Roy B., Tandon V. (2016) Animal Fascioliasis: perspectives from high altitudinal regions. *Vet Par* 232:21–31. <https://doi.org/10.1016/j.vetpar.2016.11.007>.
11. Ducheyne, E., Charlier, J., Vercruysse, J., Rinaldi, L., Biggeri, A., Demeler, J., Brandt, C., De Waal, T., Selemetas, N., Höglund, J., Kaba, J., Kowalczyk, S. J., & Hendrickx, G. (2015). Modelling the spatial distribution of *Fasciola hepatica* in dairy cattle in Europe. *Geospatial health*, 9(2), 261–270. <https://doi.org/10.4081/gh.2015.348>.
12. Novobilský, A., Sollenberg, S., & Höglund, J. (2015). Distribution of *Fasciola hepatica* in Swedish dairy cattle and associations with pasture management factors. *Geospatial health*, 9(2), 293–300. <https://doi.org/10.4081/gh.2015.351>.
13. Charlier, J., van der Voort, M., Kenyon, F., Skuce, P., & Vercruysse, J. (2014). Chasing helminths and their economic impact on farmed ruminants. *Trends in parasitology*, 30(7), 361–367. <https://doi.org/10.1016/j.pt.2014.04.009>.
14. Phelan P., Morgan E., Vineer H., Grant J., O'Kiely P. (2015) Predictions of future grazing season length for European dairy, beef and sheep farms based on regression with bioclimatic variables. *J Agr Sci.*; 154:1–17. doi:10.1017/S0021859615000830.
15. Dube A, Kalinda C, Manyangadze T, Mindu T, Chimbari MJ. Effects of temperature on the life history traits of intermediate host snails of fascioliasis: A systematic review. *PLoS Negl Trop Dis*. 2023 Dec 4;17(12):e0011812. doi: 10.1371/journal.pntd.0011812. PMID: 38048345; PMCID: PMC10721167.

16. Selemetas, N., Ducheyne, E., Phelan, P., O'Kiely, P., Hendrickx, G., & de Waal, T. (2015). Spatial analysis and risk mapping of *Fasciola hepatica* infection in dairy herds in Ireland. *Geospatial health*, 9(2), 281–291. <https://doi.org/10.4081/gh.2015.350>.
17. Zárate-Rendón, D. A., Padilla, D. G., Carcausto, S. P., Del Águila, A., Wetzel, E., & Vásquez, J. Ñ. (2023). Spatial analysis and risk mapping of *Fasciola hepatica* infection in dairy cattle at the Peruvian central highlands. *Parasite epidemiology and control*, 23, e00329. <https://doi.org/10.1016/j.parepi.2023.e00329>.
18. Smolynets, I.B., Guttyj, B.V., Khariv, I.I., Petryshak, O.Y., Lytvyn, R.I. (2016). Pharmaceutical marketing: objectives and types. Scientific Messenger LNUVMBT named after S.Z. Gzhytskyj. 18, 2(69), 151-154. doi:10.15421/nvlvet6929.
19. Lotfy, W. M., Mohsen, E. A., & Ali Moustafa, H. A. (2013). Bioaccumulation of some heavy metals in the liver flukes *Fasciola hepatica* and *F. gigantica*. *Iranian Journal of Parasitology*, 8(4), 552-558. PMID: 25516736.
20. Suleyman, Y., Eser, K., Recep, S., & Musret, M. U. A. (2006). Essential elements levels in *Fasciola hepatica* and *Dicrocoelium dendriticum*. *Indian Veterinary Journal*, 12, 1322-1323.
21. Dovhii Yu.Yu. (2006) Poshyrennia ta terapiia fastsiolozu zhuinykh tvaryn u Zhytomyrskii oblasti. VMU., № 7, S. 19–20 (in Ukrainian).
22. van Dijk, J., Sargison, N. D., Kenyon, F., & Skuce, P. J. (2010). Climate change and infectious disease: helminthological challenges to farmed ruminants in temperate regions. *Animal : an international journal of animal bioscience*, 4(3), 377–392. <https://doi.org/10.1017/S1751731109990991>.
23. Bennema, S. C., Ducheyne, E., Vercruysse, J., Claerebout, E., Hendrickx, G., & Charlier, J. (2011). Relative importance of management, meteorological and environmental factors in the spatial distribution of *Fasciola hepatica* in dairy cattle in a temperate climate zone. *International journal for parasitology*, 41(2), 225–233. <https://doi.org/10.1016/j.ijpara.2010.09.003>.
24. Howell, A., Baylis, M., Smith, R., Pinchbeck, G., & Williams, D. (2015). Epidemiology and impact of *Fasciola hepatica* exposure in high-yielding dairy herds. *Preventive veterinary medicine*, 121(1-2), 41–48. <https://doi.org/10.1016/j.prevetmed.2015.05.013>.
25. Bennema, S. C., Vercruysse, J., Morgan, E., Stafford, K., Höglund, J., Demeler, J., von Samson-Himmelstjerna, G., & Charlier, J. (2010). Epidemiology and risk factors for exposure to gastrointestinal nematodes in dairy herds in northwestern Europe. *Veterinary parasitology*, 173(3-4), 247–254. <https://doi.org/10.1016/j.vetpar.2010.07.002>.
26. Charlier, J., Vercruysse, J., Morgan, E., van Dijk, J., & Williams, D. J. (2014). Recent advances in the diagnosis, impact on production and prediction of *Fasciola hepatica* in cattle. *Parasitology*, 141(3), 326–335. <https://doi.org/10.1017/S0031182013001662>.

ПРОБЛЕМИ ПОШИРЕННЯ ФАСЦІОЛЬОЗУ ВЕЛИКОЇ РОГАТОЇ ХУДОБИ НА ТЕРИТОРІЇ УКРАЇНИ ЗА 2021-2023 РОКИ

Литвиненко О. П.¹ (ORCID ID 0009-0003-0682-8917), **Мірошніченко О. І.**¹ (ORCID ID 0009-0001-0445-1963), **Піщанський О. В.**¹, **Коваленко В. Л.**¹ (ORCID ID 0000-0002-2416-5219), **Герілович А.П.**² (ORCID ID 0000-0002-3280-4172).

¹ - Державний науково-дослідний інститут лабораторної діагностики та ветеринарно-санітарної експертизи, м. Київ, Україна, e-mail: 2431519@ukr.net.

² - ГО «Інститут Єдиного Здоров'я», м. Харків, Україна.

Резюме. У статті проведено порівняльний аналіз динаміки епізоотичного процесу щодо ураження великої рогатої худоби фасціольозом в Україні з 2021 по 2023

рр. Наведено дані в розрізі областей. Визначено зони ризику з умовним поділом України на неблагополучну, загрозливу та тимчасово благополучну територію.

Гельмінти жуйних тварин, які випасаються, дуже поширені в усьому світі та негативно впливають на продуктивність тварин і продовольчу безпеку. Зростає занепокоєння, що зміна клімату збільшує частоту та інтенсивність гельмінтозів. В Україні ці занепокоєння впливають із звітів про випадки та теоретичних моделей життєвого циклу, що дає можливість оцінити впливу зміни клімату на епідеміологію гельмінтів. Ми вважаємо, що це дослідження є першим у дослідженні географічних та кліматичних тенденцій гельмінтозних інфекцій великої рогатої худоби в розрізі областей. Було проведено 474209 досліджень, з яких позитивний результат було отримано в 6967 випадках, середня інвазованість ВРХ фасціолами за період з 2021 по 2023 роки склала 1,5 відсотка у регіонах з помірним кліматом.

Зараження фасціольозом змінювалося залежно від висоти та сільськогосподарського регіону господарства. Ці дослідження показують, що метеорологічні зміни можуть значно сприяти розумінню впливу клімату на динаміку інфекційного захворювання. Якщо взяти до уваги місцеві умови навколишнього середовища, вплив зміни клімату на динаміку захворювань можна зрозуміти в більш локальних масштабах. Ми рекомендуємо створити стратегію широкого відбору проб по всій Україні, щоб відстежувати зміни ризику гельмінтозних захворювань та інформувати про стратегії адаптації для сприяння продуктивності тварин і захисту їх здоров'я.

Ключові слова: фасціольоз, поширення, епізоотичний процес, територія.

DOI: 10.31073/onehealthjournal2024-III-04