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FORMATION OF THE NUMBER OF PHYTOPATHOGENIC MICROMYCETE POPULATIONS IN AGROCENOSES OF OAT

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The formation of the number of the phytopathogenic micromycete populations as a factor in biological pollution of oat agrocenoses is an important research field, the study of which will make it possible to create some sustainable agroecosystems. Therefore, the influence of the environmental factors (abiotic, biotic, anthropogenic, etc.) on the formation of micromycete populations on the vegetative organs of oat plants using different plant cultivation technologies was studied. This article presents the results of the ecological assessment of oat plant varieties based on the indicators of its their influence on the population number, the frequency of its occurrence, and the intensity of micromycete sporulation. Vegetative organs of oat plants of Parliamentsky and Tembre varieties were selected by BBCH scale for cereals in the phases: 5 tillers detectable (25), node 5 at least 2 cm above node 4 (35), end of heading: inflorescence fully emerged (39). It was determined that certain climatic conditions like an abiotic factor (namely an increase in air temperature), frequent droughts, or rare but abundant rains, significantly influenced the formation of micromycete populations in the oat leaf microbiome. Plant growing technologies, as an anthropogenic factor, influenced the spectrum of species and their frequency of the occurrence on the vegetative organs of oats of different kinds of the varieties. Using the organic technology of plant cultivation led to diversification of the spectrum of micromycete populations, but with a lower frequency of occurrence of species compared to the traditional technology of plant cultivation. Also, the varieties of oat plants, as a biotic factor, in terms of some physiological substances of plants, are able to restrain the spread of micromycete populations on the vegetative organs of plants or stimulate them. It was found out that using the traditional and organic technologies of plant cultivation on the vegetative organs of Tembre oat variety, the population density, the frequency of micromycete species occurrence, and the intensity of sporulation were significantly lower compared to the indexes of Parliamentsky oat variety plants. This points to the fact that the cultivation of oat varieties capable of resisting the formation of micromycete populations on an ecologically safe level will ensure a decrease in the level of biological pollution of agrocenoses and at the same time increase the biosafety of plant raw materials.

Key words: *micromycetes, biosafety, vegetative organs of plants, cultivation technologies.*

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Introduction. A significant part of agricultural products, including oat raw materials, does not always meet current global quality and safety standards (Mostovyak et al., 2020). Oats is one of the most important grain crops grown in Ukraine, mainly in the Polissia and Forest-Steppe zones (the gross harvest is 499,000 tons of grain, yield is 2,4 tons/ha). The largest areas of crop growing are in Volyn (39,5 thousand ha), Zhytomyr (30,4 thousand ha), Chernihiv (28,0 thousand ha), Rivne (21,2 thousand ha), and Lviv (16,2 thousand ha) regions. The potential yield of this crop can reach up to 5,0–6,0 t/ha (Van Montagu, 2020). With the changes in the soil and climatic conditions of Ukraine, and with the predominance of drought, the micromycetes of different spectrum of activity are increasingly found in oat agrocenoses, which have the greatest harmful effect on the weakened plants suffering from a lack of nutrients (O'Brien, 2017). This caused the excessive use of chemical pesticides and the use of resistant, genetically homogeneous varieties, which increased the harmfulness of phytopathogenic microorganisms, the formation of their resistant forms with increased aggressiveness, which contributed to the emergence of ecological risks in agro-ecosystems and a decrease in the biosafety of oat raw material production. Therefore, in the world, more and more attention is being paid to identifying the reasons for the disruption of the natural ties between the plant and the pathogen and to studying the mechanisms and factors that restrain the formation of the number of phytopathogenic microorganisms in the agrocenoses of cereal grain crops, including oats (Köhl et al., 2019).

Many kinds of research are aimed at studying of soil and climatic conditions during the growing season, which is an important factor in regulating the number of populations of harmful organisms based on the wide use of natural resources (Shvartau et al., 2017). The changes in soil and climatic conditions as well as the intensive use of chemical protection agents led to the spread of micromycete populations and accumulation of their infectious structures on the vegetative organs of plants (Beznosko et al., 2022; Lamichhane, 2017). After all, it is known that a resistant variety, especially created by genetic modification, is a powerful factor of directed selection in populations of microorganisms, and a susceptible variety is a factor in the growth of their populations (Ngoune et al., 2020; Beznosko et al., 2022). They substantially influence qualitative and quantitative indicators of the phytopathogenic background, which significantly worsens the conditions of agrophytocenoses and, to some extent, the biological safety of agroecosystems (Dermenko, 2016). Therefore, it is important to study the formation of micromycete populations on the vegetative organs of oat plants in the conditions of various cultivation technologies, taking into account soil and climatic conditions.

It is a known that the size of the population, the frequency of the species occurrence, and their sporulation intensity are important indicators of the characteristics of the microorganism population. Change in the number of the original population or a delay in its growth can play a role of an indicator of the variety assessment as a factor of the environmental risk. The intensity of the formation of propagative and resting spores of phytopathogenic micromycetes on the plant vegetative organs of cereal grain crops is an ecological indicator of the varieties culling that are able to stimulate the development of pathogens or the selection of those that are able to restrain their development (Barratt et al., 2018; Ternovy et al., 2018; Hardoim et al., 2015). Therefore, the study of the formation of micromycete populations in oat agrocenoses is a priority area of scientific research, which will ensure a decrease in the level of biological pollution and increase the quality and safety of oat products.

The purpose of this study is to conduct an ecological assessment of the formation of micromycete populations on the vegetative organs (leaves) of oats in terms of using different cultivation technologies.

Materials and Methods. The research was conducted on the basis of the Laboratory of Biocontrol of Agroecosystems and Organic Production of the Institute of Agroecology and Nature Management of the National Academy of Sciences for 2020–2022. The formation of the micromycete population on the oats vegetative organs of Parliamentsky and Tembre varieties was studied under the conditions of the traditional and organic plant cultivation technologies.

The vegetative organs of oat plants were selected by BBCH scale for cereals in the phases: 5 tillers detectable (25), node 5 at least 2 cm above node 4 (35), end of heading: inflorescence fully emerged (39) in the fields of the Skvirsk Research Station of Organic Production of the National Academy of Sciences of the Russian Academy of Sciences in accordance with generally accepted methods.

It is known that the ontogenesis of oat plants, the spread and development of diseases are significantly influenced by the temperature and the amount of rainfall. The integrated indicator of these factors is the hydrothermal coefficient (HTC), the average value of which was determined during the growing season of the plant: HTC=1.0 (2020); HTC =1.3 (2021); HTC =0.7 (2022). If HTC ≥1 is sufficient hydration; HTC 0.8-1.0 is moderate hydration; HTC 0.6-0.7 is insufficient hydration.

In the conditions of using the traditional technology of oat plant growing, the following chemical preparations were used: Vitavax 200 FF (fungicide) with the active substance Carboxin (200 g/l) and Thiram (200 g/l) and Granstar Gold 75 (FMC) (herbicide) with the active substance Tribenuron-methyl (562.5 g/kg) and Thifensulfuron-methyl (187.5 g/kg). At the same time, in the conditions of using the organic technology, no means of crop protection of were used.

The number of the micromycete population on the vegetative organs of oat plants was determined by the method of dilution and surface sowing of the suspension on Chapek's nutrient medium. The number of micromycetes was recorded in colony-forming units (CFU) per 1 g of dry leaf and determined according to DSTU 7847:2015 (DSTU, 2016). The frequency of occurrence (%) of micromycete species was determined by the following formula (Sessitsch et al., 2021):

$$A= (B\times 100\%)/C, \qquad (1)$$

where A is the frequency of the occurrence of the species;

B is the number of the samples in which this species was detected;

C is the total number of selected species.

The identification of isolates of microscopic fungi to genus and species was carried out on a biological microscope DN-200D according to the determinants (Ruytinx et al., 2021) and using the online MycoBank database.

The indicator of the intensity of micromycete sporulation was determined by counting macro- and microconidia in the Goryaev-Tom chamber according to the following formula:

$$N = (a \times 1000/(h\times S) \times n), \qquad (2)$$

where

N is the number of cells in one ml of suspension;

a is the average number of cells in a grid square;

h is camera depth (0.1 mm);

S is the area of the grid square (0,04 mm^2);

n is the dilution of the initial suspension.

A one-way analysis of variance (ANOVA, Tukey's test) was used for statistical processing of the received experimental data. The difference between control and experimental indicators was considered significant when the probability of the difference was $P<0.05$.

Results. According to the research carried out under the conditions of using the traditional technology of plant cultivation, it was found that on the vegetative organs of oat plants, the number of micromycete population ranged from 0,45 to 5,6 thousand CFU/g of green mass of plants (Table 1).

The studied indicator varied significantly depending on the climatic conditions of the relevant year of the study,

Table 1

The number of micromycete populations on the oats vegetative organs under traditional technology of plant cultivation

The variety oats	Phases of oat plants	The number of micromycete populations, thousand CFU/g of green plant mass		
		2020	2021	2022
Tembre	5 tillers detectable (25)	c (0,98)	b (1,1)	c (0,88)
	node 5 at least 2 cm above node 4 (35)	c (0,75)	b (1,8)	c (0,45)
	end of heading: inflorescence fully emerged (39)	b (2,2)	ab (3,3)	b (1,94)
Parliamentsky	5 tillers detectable (25)	b (1,6)	b (2,1)	b (1,55)
	node 5 at least 2 cm above node 4 (35)	b (1,2)	ab (2,9)	c (1,01)
	end of heading: inflorescence fully emerged (39)	ab (3,01)	a (5,6)	b (2,01)

Note: *(x ± SD, Tukey's test, n = 5 replicates); a, b, c – statistically significant differences in the number of microorganisms (P < 0,05)*

Table 2

The number of micromycete populations on the oats vegetative organs using organic technology of cultivation

The variety oats	Phases of oat plants	The number of micromycete populations, thousand CFU/g of green plant mass		
		2020	2021	2022
Tembre	5 tillers detectable (25)	c (0,98)	c (1,1)	c (0,88)
	node 5 at least 2 cm above node 4 (35)	c (0,75)	b (1,8)	c (0,45)
	end of heading: inflorescence fully emerged (39)	b (2,2)	ab (3,3)	c (1,94)
Parliamentsky	5 tillers detectable (25)	c (1,6)	b (2,1)	c (1,55)
	node 5 at least 2 cm above node 4 (35)	b (1,2)	a (2,9)	b (1,01)
	end of heading: inflorescence fully emerged (39)	ab (3,01)	a (5,6)	ab (2,01)

Note: *(x ± SD, Tukey's test, n = 5 replicates); a, b, c – statistically significant differences in the number of microorgan isms (P < 0,05)*

namely: high air temperature and a significant amount of precipitation.

In the phase: 5 tillers detectable, the number of populations on the vegetative organs of the Tembre variety ranged from 0,9 to 1,2 thousand CFU/g of green plant mass. At the same time, for the vegetative organs of Parliamentsky variety, this indicator was within the range of 1,6 to 2,2 thousand CFU/g of green plant mass. In the phase: node 5 at least 2 cm above node 4, the population number of micromycetes increased and ranged from 1,8 to 2,9 on oat leaves of both varieties. During the phase: end of heading: inflorescence fully emerge, the population of micromycetes increased by 2–2,5 times, which indicates a change in weather conditions at the end of the growing season during the years of the study. Also, the introduction of chemical plant protection agents, which contributed to the rapid reproduction of micromycetes, had a significant impact on the growth of the micromycete population. It should be noted that Parliamentsky variety, due to using of some physiological biochemical substances, is able to stimulate the formation of micromycete populations and is able to accumulate infectious structures on the vegetative organs of oats.

Compared with using the traditional technology of cultivation, using the organic technology of oat growing, the population of micromycetes on vegetative organs increased as the crop aged and ranged from 0,5 to 3,6 thousand CFU/g of green plant mass (Table 2).

During phase: 5 tillers detectable, the population of micromycetes on the vegetative organs of Tembre variety ranged from 0,8 to 1,1 thousand CFU/g of green plant mass. At the same time, this very indicator for Parliamentsky variety was in the range from 1,5 to 2,1 thousand CFU/g of green plant mass. In the phase: node 5 at least 2 cm above node 4, the population of micromycetes increased significantly on the leaves of Parliamentsky variety and reached 2,9 thousand CFU/g of green plant mass, while on the leaves of Tembre oat variety, this indicator was 2 times lower. The highest population size was characterized by the phase: end of heading: inflorescence fully emerged, during which it increased 1,5 times on the vegetative organs of Tembre and Parliament varieties and ranged from 1,9 to 5,6 thousand CFU/g of green plant mass. It should be noted that on the vegetative organs of Tembre variety, the population size is almost 2 times lower than on the leaves of Parliamentsky variety. This shows that the plants are able to influence the formation of micromycete populations on the vegetative organs of oats in different ways.

According to the laboratory studies, it was found out that, 5 types of micromycetes: *Drechslera avenae, Alternaria alternata, Alternaria infectoria, Fusarium oxysporum, Fusarium incarnatum* dominated in terms of using the traditional technology of plant cultivation on the vegetative organs (leaves) of Parliamentsky variety. The frequency of their occurrence varied from 55 to 70%. Common species included micromycetes: *Fusarium verticillioides, Fusarium culmorum, Fusarium graminearum, Cladosporim herbarum, Septoria avenae, Rhizopus nigricans, Ascochyta avenae, Heterosporium avenae,* with the frequency of occurrence

Table 3

The intensity of sporulation on the oats vegetative organs in traditional cultivation technology

	The intensity of sporulation, million units/ml						
The variety oats		Tembre			Parliamentsky		
The Phases of ontogenesis		5 tillers detectable (25)	node 5 at least 2 cm above node 4 (35)	end of heading: inflorescence fully emerged (39)	5 tillers detectable (25)	node 5 at least 2 cm above node 4 (35)	end of heading: inflorescence fully emerged (39)
The micromycetes	*Fusarium* spp.	ab (3,1)	b (2,6)	ab (4,2)	ab (4,1)	b (3,4)	a (6,3)
	Alternaria spp.	b (2,1)	b (1,5)	ab (4,8)	ab (4,4)	b (2,2)	a (7,2)
	Drechslera spp.	b (1,9)	c (0,7)	ab (3,8)	b (3,1)	b (2,6)	a (6,7)
	Rhizopus spp.	c (0,9)	c (0,4)	b (1,9)	b (1,9)	c (0,8)	ab (3,9)
	Cladosporium spp.	b (1,1)	c (0,9)	b (1,9)	b (2,1)	c (0,3)	ab (4,4)
	Trichoderma spp.	-	-	-	b (1,2)	c (0,8)	b (3,1)
	Aspergillus spp.	b (1,9)	b (1,4)	b (2,2)	b (1,6)	c (0,9)	ab (4,4)
	Ascochyta spp.	b (1,2)	c (0,7)	b (2,8)	b (1,1)	c (0,8)	ab (3,8)
	Heterosporium spp.	b (1)	c (0,9)	b (1,1)	b (1,7)	b (1)	ab (4,1)
	Septoria spp.	b (1,1)	c (0,6)	b (2,8)	b (1,4)	b (1,2)	ab (4,2)
	Pyrenophora spp.	b (1,9)	c (0,3)	b (2,9)	b (1,2)	b (0,9)	ab (2,8)
	Penicillinum spp.	-	-	-	b (1,4)	c (0,2)	b (1,9)

Note: *(x ± SD, Tukey's test, n = 5 replicates); a, b, c – statistically significant differences in the number of microorganisms (P < 0,05)*

ranging from 23 to 45%. Rare species included micromycetes *Pyrenophora avenae, Penicillium notatum, Aspergillus flavus, Trichothecium roseum* with the frequency of up to 18%. At the same time, 4 types of micromycetes, *D. avenae, A. alternata, F. oxysporum, F. incarnatum*, dominated on the vegetative organs (leaves) of Tembre variety, and their frequency of occurrence reached 60%. Common species included micromycetes: *R. nigricans, S. avenae, F. verticillioides, A. avenae.* Their frequency of occurrence ranged from 22 to 28%. Four rare species of micromycetes were also identified: *H. avenae, A. flavus, C. herbarum, P. avenae*, and their frequency of occurrence reached 20%.

In comparison with the traditional technology of plant cultivation using the organic technology of growing, common species such as *D. avenae, A. alternata, A. infectoria, R. nigricans, F. graminerum, F. oxysporum* were found on the vegetative organs of Parliamentsky variety with the frequency of occurrence varied from 35 to 45%. Other identified micromycetes belonged to such rare species as *F. sporotrichiella, F. incarnatum, F. culmorum, F. verticillioides, A. flavus, A. niger, C. herbarum, T. roseum, H. avenae, S. avenae, A. avenae, P. avenae, P. notatum*, with the frequency of up to 18%. At the same time, in the leaf microbiome of Tembre variety, the common species included micromycetes like *T. harzianum, T. viride, R. nigricans, H. avenae, D. avenae, A. alternate, F. incarnatum, F. verticillioides, F. culmorum, F. oxysporum.* Their frequency of occurrence ranged from 25 to 45%. Also, other 5 rare species of micromycetes were identified, namely *F. culmorum, P. avenae, S. avenae, A. flavus, C. herbarum*, with their frequency of occurrence reaching to 20%. It should be noted that in the organic technology of cultivation on vegetative organs (plants), in addition to phytopathogenic micromycetes, antagonistic fungi of the genus *Trichoderma* spp. (*T. harzianum and T.* viride) were characterized by a high frequency of occurrence, which reached up to 45%.

In the course of the laboratory studies, it was found out that using of traditional cultivation technology, the spectrum of micromycetes on the vegetative organs of various oats varieties was characterized by the high sporulation, especially in the earing phase, which ranged from 1,1 to 7,2 million units/ml (Table 3).

As it is indicated in Table 3, micromycetes of *Fusarium* spp., *Alternaria* spp., *Drechslera* spp. genera were characterized by the highest intensity of sporulation on the vegetative organs of Parliamentsky variety, which ranged from 6,3 to 7,2 million units/ml. At the same time, the indicator of Tembre variety was 2 times lower. This proves the role of the variety as a biotic factor in the regulation of phytopathogenic micromycetes in plant agrocenoses.

In terms of using the organic technology of plant cultivation, micromycetes of *Fusarium* spp., *Alternaria* spp., *Drechslera* spp genera were characterized by high intensity of sporulation on the vegetative organs of Parliamentsky variety, which ranged from 1,8 to 2,1 million units/ml (Table 4).

This is 1,5 times less compared to the results of using traditional growing technology. At the same time, on the vegetative organs (leaves) of Tembre variety, the intensity of micromycetes sporulation in the earing phase ranged from 0,6 to 1,7 million units/ml. This gives reason to believe that oat plants of different breeding origins are able to significantly influence the intensity of sporulation of dominant micromycetes. Antagonist fungi of the *Trichoderm*a spp. genus were characterized by the high intensity of sporulation on the vegetative organs of Tembre variety, which amounted to 3,9 million units/ml. These micromycetes are able to quickly spread and occupy the entire habitat, displacing other pathogens.

Therefore, study the intensity of sporulation of micromycetes in oat agrocenoses under the influence of different cultivation

Table 4

The intensity of sporulation on the oats vegetative organs using of organic cultivation technology

	The intensity of sporulation, million units/ml						
The variety oats		**Tembre**			**Parliamentsky**		
The Phases of ontogenesis		**5 tillers detectable (25)**	**node 5 at least 2 cm above node 4 (35)**	**end of heading: inflorescence fully emerged (39)**	**5 tillers detectable (25)**	**node 5 at least 2 cm above node 4 (35)**	**end of heading: inflorescence fully emerged (39)**
The micromycetes	*Fusarium* spp.	c (0,7)	c (0,9)	b (1,1)	c (0,6)	c (0,8)	ab (2,2)
	Alternaria spp.	c (0,9)	b (1,1)	b (1,7)	c (0,2)	c (0,4)	a (2,1)
	Drechslera spp.	c (0,9)	b (1)	b (1,2)	c (0,4)	c (0,7)	b (1,1)
	Rhizopus spp.	c (0,8)	c (0,9)	b (1,1)	c (0,3)	c (0,4)	c (0,8)
	Cladosporium spp.	c (0,1)	c (0,8)	b (1,3)	c (0,4)	c (0,9)	b (1,1)
	Trichoderma spp.	b (1,1)	b (1,8)	a (3,9)	c (0,2)	c (0,8)	b (1,3)
	Heterosporium spp.	c (0,2)	c (0,4)	c (0,6)	c (0,5)	c (0,6)	b (1,8)
	Septoria spp.	c (0,8)	c (0,9)	b (1,1)	c (0,4)	c (0,6)	b (1,7)
	Pyrenophora spp.	c (0,7)	c (0,9)	b (1,4)	c (0,1)	c (0,9)	b (1,1)
	Penicillinum spp.	-	-	-	c (0,4)	c (0,8)	b (1,4)

Note: *(x ± SD, Tukey's test, n = 5 replicates); a, b, c – statistically significant differences in the number of microorganisms (P < 0,05)*

technologies demonstrated that not all dominant micromycetes intensively sporulated, but is due to varietal characteristics of plants. It should be noted that the diversity of micromycete species was significantly higher under organic cultivation technology than under traditional cultivation. At the same time, the frequency of occurrence and intensity of micromycetes sporulation under conditions of organic technology significantly decreased (2–3,5 times) compared to the traditional technology. This shows that crop cultivation technology is one of the influential factors on the population formation in the agrocenoses of cereal grain crops.

Discussion. One of the factors to reduce biological pollution in agrocenoses is the use of biological preparations of different spectrum of action. Pre-sowing seed inoculation and spraying on the oat leaf surface is an effective and ecologically safe means of improving the conditions of mineral nutrition, plant growth and development, and the phytosanitary state of crops (Buga et al., 2015; Kaminska et al., 2014; Aipova et al., 2020). Practical importance is attached by some foreign authors to the study of genetic variability (gene mutations, recombinations) and their use in breeding, which open up the possibility of obtaining plants with complex resistance to harmful organisms and various agro-climatic conditions (Ternovy, 2018; Sammauria et al, 2020; Ngoune & Shelton, 2020).

At the same time, the advantages of many resistant varieties are short-lived, because during their production, new types of phytopathogenic microorganisms appear that overcome the established resistance. Varieties with lost resistance become the reservoirs of highly pathogenic strains of phytopathogenic microorganisms, which can multiply and cause epiphytotia (Bruinsma et al, 2003; Lapin et al, 2013; Hardoim et al, 2015). The above-mentioned research results are aimed at determining indicators such as the population size, the frequency of species occurrence and their sporulation intensity for ecological assessment of oat varieties for interactions with phytopathogenic micromycetes. This will allow to characterize the variety as a factor in regulating the number of phytopathogenic micromycetes in oat agrocenoses. The varieties of oat plants, in terms of applying some physiological biochemical substances, are able to stimulate or restrain the formation of micromycete populations and accumulate infectious structures on the vegetative organs of oats. Therefore, the identification of varieties that restrain the formation of the population number will help to reduce the biological contamination of agrocenoses by infectious structures of the phytopathogen.

Conclusions. The analysis of the occurrence frequency of certain species on the vegetative organs of oat plants in the conditions of using different technologies of plant cultivation allows to single out the dominant species and to reveal the intensity of their distribution in the agrocenoses of cereal grain crops. Phytopathogenic fungi like *F. oxysporum, A. alternata* were characterized by high occurrence frequency of micromycetes in oats growing under the traditional cultivation technology. At the same time, using the organic cultivation technology, antagonistic fungi of *T. harzianum, T. viride* species which competed among the phytopathogenic microbiota, prevailed.

The indicators such as the population size and the micromycete sporulation intensity characterize the ability to form and accumulate infectious structures on the vegetative organs of plants. Regardless of the abiotic (temperature, humidity, etc.) and anthropogenic (cultivation technologies) factors, the population size and sporulation intensity of micromycetes was significantly lower on the vegetative organs of oat plants of Tembre variety compared to Parliamentsky oats variety, which was found out to be increased by 2–4 times.

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Формування чисельності популяцій фітопатогенних мікроміцетів в агроценозах вівса

У статті представлені результати екологічного оцінювання сортів вівса за показниками впливу на чисельність популяції, частоту трапляння та інтенсивність споруляції мікроміцетів. Вегетативні органи рослин вівса сортів Парламентський та Тембр відбирали у фази: кущення, виходу у трубки та колосіння. Визначено, що кліматичні умови, як абіотичний чинник, а саме: підвищення температури повітря, часті засухи, рідкісні, але рясні дощі істотно впливали на формування популяцій мікроміцетів в мікробіомі вегетативних органів вівса. Технології вирощування рослин, як антропогенний чинник, впливали на спектр видів та їхню частоту трапляння на вегетативних органах вівса різних сортів. За органічної технології вирощування рослин спектр популяцій мікроміцетів був різноманітніший, але із нижчою частотою трапляння видів порівняно з традиційною технологію вирощування рослин. Також сорти рослин вівса, як біотичний чинник, здатні стримувати поширення популяцій мікроміцетів на вегетативних органах рослин або стимулювати їх. З’ясовано, що за традиційної та органічної технології вирощування рослин на вегетативних органах вівса сорту Тембр чисельність популяції, частота трапляння видів мікроміцетів та інтенсивність споруляції була істотно нижчою у порівнянні із рослинами сорту вівса Парламентський. Це свідчить, що вирощування сортів вівса, які здатні стримувати формування популяцій мікроміцетів на екологічно безпечному рівні, забезпечить зниження рівня біологічного забруднення агроценозів та підвищить біобезпеку рослинної сировини.

Ключові слова: *мікроміцети, біобезпека, вегетативні органи рослин, технології вирощування.*