https://doi.org/10.15407/microbiolj87.01.036

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EFFECTIVENESS OF NEW ANTIFUNGAL DRUGS AGAINST MICROSCOPIC FUNGI ISOLATED FROM AGRICULTURAL CROPS

Guanidines are nitrogen-rich organic compounds that have been frequently associated with a wide range of biological activities, such as antibacterial, antiviral, antifungal, and antiprotozoal activities. Guanidinium-containing oligomers based on aliphatic and aromatic oligoepoxides are newly synthesized substances with antifungal activity, providing prospects for their use as agricultural fungicides. ***Aim.*** *The aim of the study was to investigate the effectiveness of new antifungal drugs against microscopic fungi isolated from agricultural crops and to determine the antagonistic activity of Trichoderma koningii and Trichoderma viride.* ***Methods.*** *The guanidine-containing alkyl-substituted oligomer was obtained through the reaction of the aromatic DER-331 or aliphatic DEG-1 oligoepoxide with guanidine, followed by interaction with alkyl bromides. The fungicidal activity was determined using the agar diffusion method on nutrient media with the following fungal strains: Alternaria alternata F-41618, Alternaria infectoria F-416121, Aspergillus niger F-41611, Aspergillus flavus F-41612, Acremonium strictum F-41615, Chaetomium globosum F-41617, Cladosporium sphaerospermum F-41623, Botrytis cinerea F-41603, Fusarium poae F-41610, and Fusarium moniliforme F-41605. To compare the effectiveness of the newly synthesized antifungal drugs with existing agents for treating agricultural crops, the following preparations were selected: «ROYALFLO», «MEDIAN EXTRA», and «STROBI». The determination of interspecies interactions among microscopic fungi was conducted using the agar block method with antagonist cultures isolated from soil, namely Trichoderma viride F-41256 and Trichoderma koningii F-41246.* ***Results.*** *The research results indicate that the newly synthesized fungicidal preparations from the group of guanidine-containing derivatives exhibit moderate fungicidal and fungistatic properties against these representatives of microscopic fungi. Our tests have demonstrated that the most effective biocide is a preparation of tetraalkyl-substituted oligomers based on an aromatic oligoepoxide. The strains of Alternaria infectoria, Aspergillus flavus, Acremonium strictum, Chaetomium globosum,*

Citation: Pysmenna Yu.B., Vortman M.Ya., Lemeshko V.N., Shevchenko V.V. Effectiveness of New Antifungal Drugs against Microscopic Fungi Isolated from Agricultural Crops. *Microbiological journal.* 2025 (1). P. 36—46. https://doi.org/10.15407/microbiolj87.01.036

Cladosporium sphaerospermum, and Fusarium moniliforme showed high sensitivity to it, while Alternaria alternata exhibits — medium sensitivity. The strains of Aspergillus niger, Botrytis cinerea, and Fusarium poae displayed low sensitivity. The fungicide «STROBI» demonstrated the highest effectiveness among the biocidal preparations: the size of the growth retardation zone on the 14th day of cultivation decreased insignificantly compared to the other studied preparations. According to the experimental results, Trichoderma koningi exhibited superior antagonistic properties compared to Trichoderma viride. Acremonium strictum was nearly completely suppressed by the block culture Trichoderma viride. Significant fungicidal action with large zones of growth retardation was observed in the test cultures of Alternaria alternata and Cladosporium sphaerospermum. ***Conclusions.*** *It was found that newly synthesized guanidine-containing preparations exhibited moderate fungicidal and fungistatic properties. Although some drugs available on the market demonstrate much higher efficiency, the investigated compounds show promise due to their specific selectivity of action, especially in cases of resistance formation to other fungicidal drugs. Furthermore, the study demonstrates that the Trichoderma koningii strain exhibits a stronger antagonistic effect on fungi isolated from agricultural crops, offering the potential for the development of an effective antifungal agent.*

Keywords*: microscopic fungi, guanidine derivatives, antifungal drugs, antagonistic properties****.***

Guanidine derivatives are widely utilized as biocides and disinfectants due to their broad spectrum of antimicrobial activity against both gram-positive and gram-negative bacteria, viruses, and fungi. The mechanism of the fungicidal action of polyguanidines is associated with the sorption of the biocidal polycation on the negatively charged cell membrane of microorganisms, leading to its destruction and cell lysis. In small concentrations, quaternary ammonium salts and polyguanidines disrupt membrane functions, causing alterations in osmotic pressure, permeability, and the rate of transfer of molecules and ions through the membrane. This disruption also inhibits metabolic processes and biological oxidation, leading to the inhibition of cell division (Brzezinska et al., 2018; Gomes et al., 2023; Lysytsya et al., 2023).

Fungal diseases are a significant cause of crop yield losses and a decline in product quality. Consequently, the search for new antifungal drugs is a highly urgent task. Filamentous fungi are responsible for many postharvest losses of fruits and vegetables, posing a substantial challenge to quality preservation, particularly after harvesting. Fungal activity can lead to contamination with mycotoxins, posing potential health risks to consumers (Peng et al., 2021).

Currently, the market offers a wide range of fungicidal preparations, both for treating crops and preserving finished products for long-term storage. With a strong biocidal effect against many microorganisms, polyguanidines are considered safe for humans and animals. They belong to the IV class of substances slightly harmful when in contact with the skin and the III class of moderately harmful compounds when ingested. Aqueous solutions of polyguanidines are stable, retaining biocidal activity for an extended period. They have no odor, do not cause discoloration of fabrics, and do not corrode equipment. Additionally, they exhibit surface-active properties (Koffi-Nevryet al., 2011; Peng et al., 2021).

However, the prolonged use of the same fungicides leads to the development of resistance in fungi against their action. Therefore, the task of finding new drugs, including those based on natural antagonists of phytopathogenic fungi, is urgent. It is known from the literature that species of the genus *Trichoderma* can not only inhibit the growth of phytopathogens of the genus *Fusarium* but also use the pathogen as a substrate (hyperparasitism). Moreover, the development of *Trichoderma* fungi is not harmful to human health, making them promising candidates for the creation of biological preparations. (Yassin et al., 2021).

The **aim** of this work was to investigate the effectiveness of new antifungal drugs against microscopic fungi isolated from agricultural crops

and to determine the antagonistic activity of *Trichoderma koningii* and *Trichoderma viride*.

Materials and Methods. The following types of microscopic fungi were used as objects of research to determine the fungicidal activity of biocidal preparations and their antagonistic activity (Table 1).

The fungicidal activity was determined using the agar diffusion method on nutrient media (Vortman et al., 2020). The sensitivity of fungi isolated from crops to the investigated compounds was assessed by measuring the diameter of the zone of growth retardation of micromycetes: > 25 mm — high; 25—15 mm — moderate; < 15 mm — low; 0 mm — absent. To compare the effectiveness of newly synthesized antifungal drugs with existing agents for treating crops, the following preparations were selected: «ROYAL-FLO», «MEDIAN EXTRA,» and «STROBI».

The determination of interspecies interactions of microscopic fungi was carried out using the agar block method (Pysmenna et al., 2016), which allows us to reveal the nature of the interaction between the test culture and the block culture.

Table 1. **Types of microscopic fungi used for research**

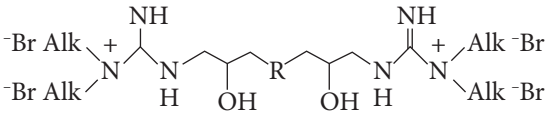
N	Type of microscopic fungus	Strain number	Source of isolation
Micromycetes isolated from agricultural crops and granary premises			
1	*Alternaria alternata*	F-41618	Tomato
2	*Alternaria infectoria*	F-416121	Tomato
3	*Aspergillus niger*	F-41611	Granary premises
4	*Aspergillus flavus*	F-41612	Wheat
5	*Acremonium strictum*	F-41615	Granary premises
6	*Chaetomium globosum*	F-41617	Wheat
7	*Cladosporium sphaerospermum*	F-41623	Tomato
8	*Botrytis cinerea*	F-41603	Grape
9	*Fusarium poae*	F-41610	Wheat
10	*Fusarium moniliforme*	F-41605	Wheat
Antagonist cultures			
11	*Trichoderma viride*	F-41256	Soil
12	*Trichoderma koningii*	F-41246	Soil

The experiment was conducted in three repetitions over 14 days. Interactions among species of microscopic fungi were assessed based on a set of criteria, including the diameter of the zone of growth retardation, its change during the study, and comparison with the development of control blocks. This assessment followed a system with the following categories (Pysmenna et al., 2016): I — inhibition by the culture block, II — fungicidality of the block, III — fungistatic action of the culture block, IV — interaction of the culture-block with absent or weakly expressed antagonistic properties, V — fungistatic action of the test culture, and VI — neutral interaction of two cultures which develop evenly.

Synthesis of oligomers. Diane epoxy oligomer DER-331 (DOW Chemical Company, Germany), MM 365 g/mol, mass fraction of epoxy groups 23.5%, hydroxyl groups 0.6%, and aliphatic epoxy oligomer DEG-1 (ToV «Spetskontrakt»), mass fraction 28.6% of epoxy groups, 1.3% of hydroxyl groups, were dehydrated by heating in a vacuum for 2—6 hours at 80—90 °C and a final pressure of 2 mm Hg. Guanidine hydrochloride (GD) (Aldrich, 99.9% purity) was used without additional purification. Alkyl bromides, namely heptyl-(C_7H_{15}) and decyl-($C_{10}H_{21}$) bromides (Aldrich, 99.9% purity), were used without additional purification. Methanol was purified by distillation. ChDA brand dimethylformamide was used without further purification.

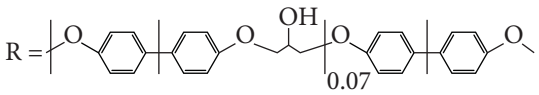
The synthesis of tetraalkyl-substituted guanidinium-containing oligomers was conducted in two stages. At the first stage, guanidine-containing oligomers with terminal guanidine fragments were obtained by reacting guanidine, previously converted with the help of alkali from the salt form to the base, with aromatic DER-331 or aliphatic DEG-1 oligoepoxide in dimethylformamide at a temperature of 70°C for 4 hours, with a molar ratio of components of 2:1 (Feiertag et al., 2003; Palátet al., 2007).

At the second stage, the reaction between guanidinium-containing oligomers and alkyl bromides (Alk= -C_3H_7,- C_7H1_5, $C_{10}H_{21}$) was carried out in methanol at 50 ^{0}C for 2—3 hours and a molar ratio of components of 1:4. The obtained products were reprecipitated from methanol into diethyl ether. To remove the solvent residues, the product was kept in a vacuum at a 60 °C for 5 hours. Product yield was 93—95%. Therefore, the following tetraalkyl-substituted guanidine-containing oligomers were obtained:



Alk = C_7H_{15}, $C_{10}H_{21}$

- based on aromatic oligoepoxide

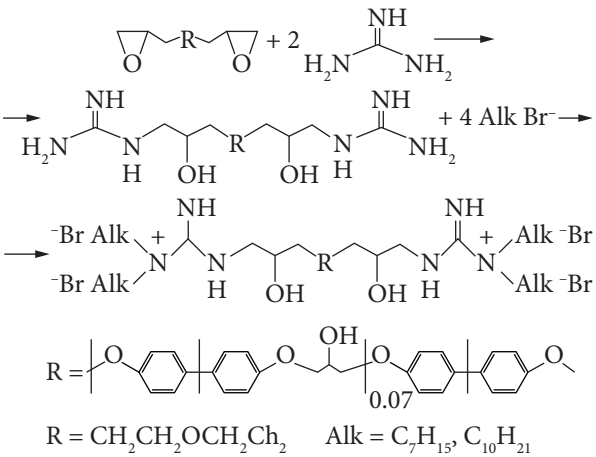


- based on aliphatic oligoepoxide

R = CH_2CH_2 O CH_2CH_2

Results. The antifungal properties of three biocidal preparations belonging to the group of guanidine-containing derivatives synthesized by the Institute of High Technologies (Ukraine) and preparations «ROYAFLO», «MEDIAN EXTRA», and «STROBI» were studied.

The scheme for obtaining alkyl-substituted guanidinium oligomers can be presented as follows:



R = $CH_2CH_2OCH_2Ch_2$ Alk = C_7H_{15}, $C_{10}H_{21}$

Control over the completion of the reaction was carried out by IR spectroscopy. The IR spectra bands: 3200—3550 cm^{-1} and bands of valence vibrations of OH and NH groups; 2869 cm^{-1}, 2926 cm^{-1}, and 2964 cm^{-1} — absorption bands of -CH, -CH2, and -CH3 groups, 1460 cm^{-1} — deformation vibrations of the C—H bond, 1640 cm_{-1} — valence vibrations of C=N guanidine fragments and deformation vibrations of NH groups. 1450—1650 cm^{-1} — absorption bands of C=C bonds of the benzene ring for an oligomer based on an aromatic oligoepoxide, 1640 cm^{-1} — deformation vibrations of NH groups, and 1100—1300 cm^{-1} — vibrations of C—O—C bonds of ether groups (Fig. 1).

The structure of the obtained oligomers was confirmed by the method of ^{1}H-NMR spectrometry. In the ^{1}H NMR ($CDCI_3$) spectrum of tetraalkyl-substituted guanidinium-containing oligomers, proton signals are present at 1.72 ppm (t, 3H, -CH_3), 2.73 ppm -NH (NH CH_2), 2.58 ppm -CH_2 (CH_2CHOH), 3.58 ppm -OH (CH-OH)), 3.96 ppm -CH (CH-OH), 6.8 ppm and 7.2 ppm -CH of the benzene ring for the oligomer based on the aromatic oligoepoxide, and 7.8 ppm and 8.2 ppm -NH (NH_{20}) groups (Fig. 2).

The effect of fungicides on the studied micromycetes is shown in Fig. 3

According to the obtained results, it can be concluded that the fungicide «STROBI» exhibits the greatest effectiveness among the biocidal preparations studied. The size of the zone of growth retardation on the 14th day of cultivation decreased insignificantly compared to the other preparations. The lowest efficiency was observed in the following species: *Aspergillus niger, Botrytis cinerea,* and *Fusarium poae*; on the other hand, it caused complete inhibition of growth in other species.

The composition of the fungicide «STROBI» includes the active substance of the class of strobilurins — kresoxim-methyl, which is a fungicide with protective, curative, eradication, and long-term residual control of the disease. The mechanism of its action consists in inhibiting the

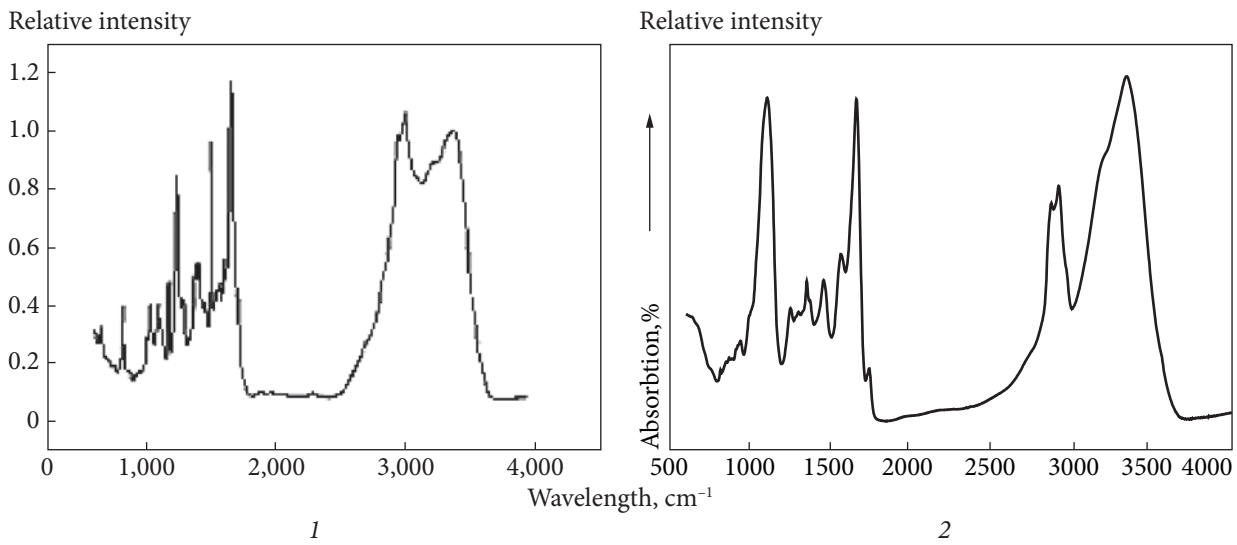


Fig. 1. IR spectra of tetraalkyl-substituted oligomers: *1* — based on aromatic oligoepoxide (Alk= $C_{10}H_{21}$), *2* — based on aliphatic oligoepoxide (Alk= C_7H_{15})

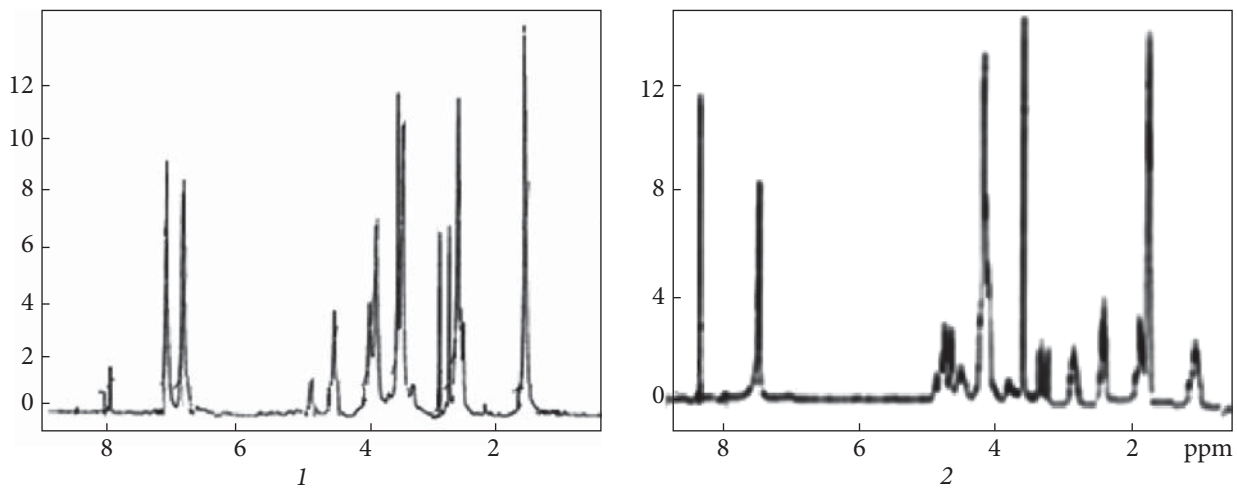


Fig. 2. ^{1}H NMR spectra of tetraalkyl-substituted oligomers: *1* — based on aromatic oligoepoxide (Alk= $C_{10}H_{21}$), *2* — based on aliphatic oligoepoxide (Alk= C_7H_{15})

germination of spores due to blocking the transport of electrons in the mitochondria of cells, thus preventing the formation of ATP, necessary for the normal metabolic process of the microscopic fungi. Kresoxim-methyl has low toxicity for mammals, invertebrates, and arthropods and medium toxicity for birds. It is classified as very toxic to aquatic organisms (fish, algae, and aquatic invertebrates).

The second most effective fungicide is «ROYALFLO», the maximum effectiveness of which can be observed for the following species: *Alternaria infectoria, Aspergillus flavus, Acremonium strictum, Chaetomium globosum,* and *Cladosporium sphaerospermum,* moderate effectiveness — for *Alternaria alternata* and *Botrytis cinerea*, and poor one — for *Aspergillus niger, Fusarium poae,* and *Fusarium moniliforme.* It

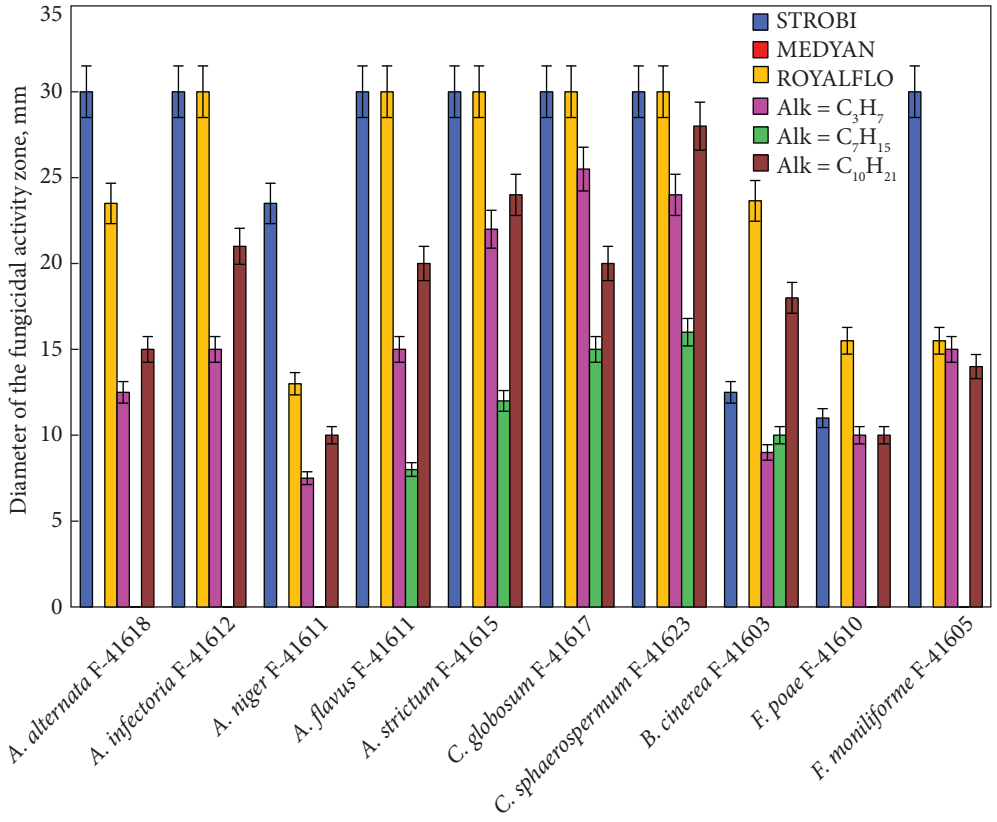


Fig. 3. Effectiveness of anitifungal drugs against micromycetes-contaminants of agricultural crops

should be also noted a slight correlation in the sizes of growth retardation zones on the 7th and 14th day of cultivation. «ROYALFLO» is a contact, highly effective fungicide, whose main active ingredient is thiram.

The drug «MEDIAN EXTRA» showed the least effectiveness against the studied species of micromycetes, since the use of the drug did not delay the process of culture development on some studied cups, and even the development of symbiotic representatives was observed. This fungicide showed low effectiveness against the representative of *Fusarium moniliforme*: an insignificant zone of growth retardation was observed only on the 7th day of cultivation, and on the 14th day, the drug did not show antifungal properties (Figs. 3 and 4).

«MEDIAN EXTRA» is a broad-spectrum contact fungicide with copper as an active substance. Due to its strong affinity for amino acids and carboxyl groups, copper reacts with proteins and acts as an inhibitor of enzymes in target organisms.

The research results indicate that the newly synthesized fungicidal preparations from the group of guanidine-containing derivatives exhibit moderate fungicidal and fungistatic properties toward these representatives of microscopic fungi (Fig. 5).

Our tests showed that the most effective biocide is a preparation of tetraalkyl-substituted oligomers based on an aromatic oligoepoxide, the sensitivity to which of the strains *Alternaria infectoria, Aspergillus flavus, Acremonium strictum, Chaetomium globosum, Cladosporium sphaerospermum, and Fusarium moniliforme* is high, *Alternaria alternata* — medium, and *Aspergillus* spp. *niger*, *Botrytis cinerea,* and *Fusarium poae* — low. This fungicide was most effective against the

species *Cladosporium sphaerospermum* and the lowest against *Botrytis cinerea* (Figs. 3 and 5). It is important to note that this drug worked against all types of microscopic fungi tested.

In general, the drug Alk=C_3H_7 showed worse fungicidal and fungistatic qualities compared to the previous one. *Alternaria infectoria, Aspergillus flavus, Acremonium strictum, Chaetomium globosum,* and *Cladosporium sphaerospermum* showed high sensitivity to it; *Botrytis cinerea* and *Fusarium moniliforme* — medium sensitivity, and *Alternaria alternata, Aspergillus niger*, and *Fusarium poae* — low sensitivity. Among fungicides derived from guanidine, this drug proved to be the most effective toward test cultures of *Alternaria infectoria, Aspergillus flavus,* and *Cladosporium sphaerospermum*.

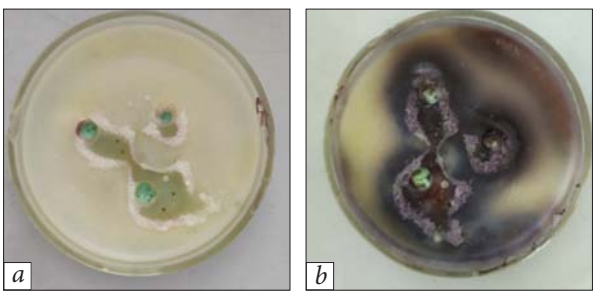


Fig. 4. Effectiveness of the drug «MEDIAN EXTRA» against the representative of *Fusarium moniliforme*: *a* — zone of growth retardation on the 7th day of cultivation, *b* — the complete absence of action on the 14th day of cultivation

Biocidal drug Alk=C_7H_{15} was not sensitive to test cultures *Alternaria alternata, Alternaria infectoria, Aspergillus niger, Aspergillus flavus, Fusarium poae,* and *Fusarium moniliforme*. As for *Aspergillus flavus*, its sensitivity was lower compared to *Acremonium strictum, Chaetomium globosum, Cladosporium sphaerospermum*, and *Botrytis cinerea* in the growth retardation zone up to 25 mm, so the sensitivity (as a whole) to the drug was average.

To determine the effectiveness of using *Trichoderma koningii* and *Trichoderma viride* cultures as biological preparations to reduce the number of phytopathogenic fungi, their antagonistic properties were assessed. According to the results obtained on the Chapek-Dox medium, interaction category V was most frequently detected — the lawn culture exhibited a fungistatic effect on the antagonist culture. Interaction categories II — fungicidal effect of the block, and VI — neutral interaction of two cultures — occurred with the same frequency. The categories of interactions between test crop lawns and antagonist blocks are listed in Table 2.

The antagonistic activity of the *Trichoderma viride* test culture, according to our data, demonstrated a fungicidal effect on *Acremonium strictum* and *Cladosporium sphaerospermum*, and a fungistatic effect on *Alternaria alternata*. In general, *Trichoderma viride* was fungistatically affected by most of the test cultures, including

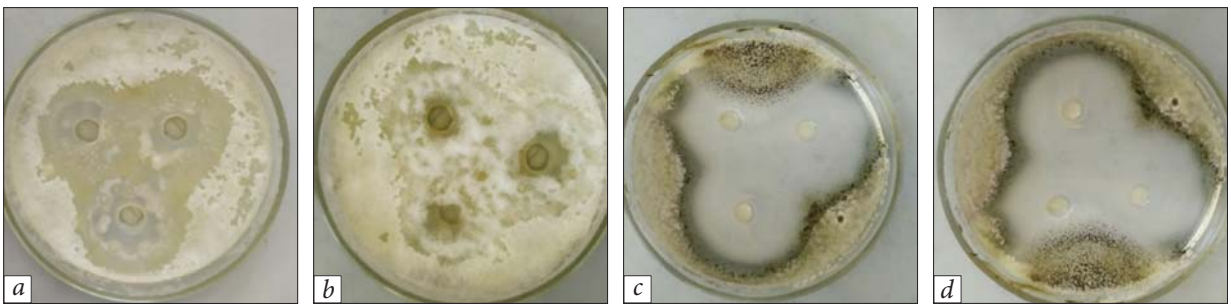


Fig. 5. Representatives with the lowest and highest sensitivity to the fungicide Alk= $C_{10}H_{21}$: A — growth retardation zones on the 7th day of cultivation in the *Botrytis cinerea* strain, B — growth retardation zones on the 14th day of cultivation in the *Botrytis cinerea* strain, C — zones of growth retardation on the 7th day of cultivation in the *Botrytis cinerea* strain, D — zones of growth retardation on the 14th day of cultivation in the *Cladosporium sphaerospermum* strain

Alternaria infectoria, Aspergillus niger, Chaetomium globosum, Botrytis cinerea, Fusarium poae, and *Fusarium moniliforme*. A neutral interaction between the two cultures was observed only with *Aspergillus flavus* (Fig. 6).

According to the results of the experiment, *Trichoderma koningi* has better antagonistic properties compared to *Trichoderma viride*. *Acremonium strictum* was almost completely suppressed by the block culture. Bright fungicidal action with large zones of growth retardation was observed on test cultures *of Alternaria alternata* and *Cladosporium sphaerospermum*. Weakly expressed antagonistic properties were observed against the *Botrytis cinerea* species. Uniformly and independently, lawn and block developed with test cultures of *Aspergillus flavus* and *Chaetomium globosum*. *Alternaria infectoria, Aspergillus niger, Fusarium poae,* and *Fusarium moniliforme* completely blocked the development of the block culture (Fig. 7).

Discussion. Our tests showed that the most effective biocide is a preparation of tetraalkyl-substituted oligomers based on an aromatic oligoepoxide. In comparison with our earlier studies, it was established that alkyl-substituted (Alk=$C_7H_{15}Br$, $C_{10}H_{21}Br$) guanidinium-containing oligomers at a concentration of 1% exhibited fungicidal activity against almost all tested isolates. Conversely, the oligomer with a heptyl radical did not show fungicidal activity at all, and this pattern was confirmed in the conducted experiment. It is important to note that the zones of growth retardation for isolates such as *A. flavus* and *A. niger* were 26.6 mm and 14.6 mm, respectively, which significantly exceed the previously obtained indicators (Vortman et al., 2020).

The obtained data indicate the selectivity of the fungicidal action of the solutions on different types of microscopic fungi, which may be associated with differences in their metabolic processes and adaptation mechanisms. According to the results of microbiological studies, alkyl-substituted guanidinium-containing oligomers show

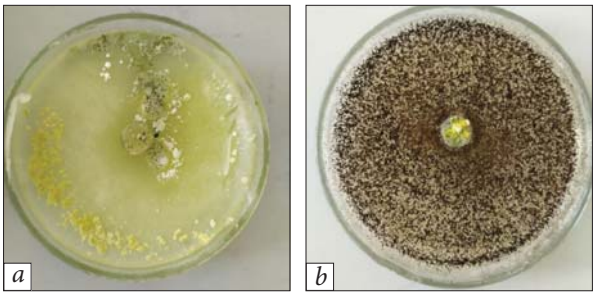


Fig. 6. Categories of interaction of *Trichoderma viride* with cultures of the block: A — II — fungicidal effect of the block on *Acremonium strictum*; B — V — fungistatic action of *Aspergillus niger*

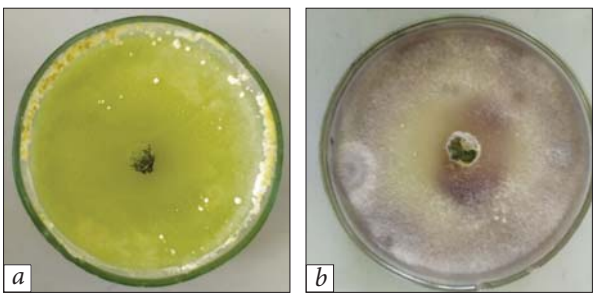


Fig. 7. Categories of the interaction of *Trichoderma koningii* with block cultures: A — I — suppression of *Acremonium strictum* by the block culture; B — V — fungistatic effect of *Fusarium moniliforme*

Table 2. **Interspecies interaction of antagonistic fungi and test cultures**

Test culture	*Trichoderma viride*	*Trichoderma koningii*
Alternaria alternata	III	II
Alternaria infectoria	V	V
Aspergillus niger	V	V
Aspergillus flavus	VI	VI
Acremonium strictum	II	I
Chaetomium globosum	V	VI
Cladosporium sphaerospermum	II	II
Botrytis cinerea	V	IV
Fusarium poae	V	V
Fusarium moniliforme	V	V

I — oppression by the block culture of the lawn; II — fungicidal action of the block; III — fungistatic action of the block culture k; IV — culture-block interaction with absent or weakly expressed antagonistic properties; V — fungistatic action of the lawn culture on the block culture; VI — neutral interaction of two cultures.

fungicidal activity against microscopic fungi and antimicrobial activity against the test cultures, recommended for commercial disinfectants. By the literature, the mechanism of fungicidal action of guanidine polymers is associated with adsorption on the negatively charged cell surface and blocking the transport of metabolites through the cell wall and cytoplasmic membrane. It can be assumed that the compounds studied by us exhibit antifungal activity by a similar mechanism. It is worth noting the low toxicity of such compounds for humans and warm-blooded animals (Peng et al., 2021; Gomes et al., 2023).

By our data, micromycetes *Trichoderma koningii* and *Trichoderma viride* have a fairly high antagonistic activity (fungicidal and fungistatic effects) against micromycetes isolated from crops, that is, they are promising species for creating biological preparations based on them.

Several antagonistic mechanisms are used against plant pathogens. These include antibiosis, mycoparasitism, competition for nutrients and space, plant growth stimulation, inducible plant defense mechanisms, and modification of environmental conditions. Mycoparasitism is a direct mechanism of biological control that works by parasitizing, detecting, growing, and colonizing the pathogen. The ability to mycoparasitize other fungi is widely used for biological control of agricultural pests (mainly against pathogenic fungi and parasitic nematodes) (Peng et al., 2021; Yassin et al., 2021).

Antimicrobial activity may result from several secondary metabolites such as terpenes, polyketides, gliotoxin, and gliovirin produced by fungi. Other metabolites include tricholine, garzianic acid, viridian, gliosoprinins, heptelic acid, 6-pentyl-α-pyrone, and massoylactone.

The obtained data indicate that micromycetes of the genus *Trichoderma* spp. are potentially effective biological control agents and can be used as active ingredients in biopesticides, biofertilizers, growth enhancers, and natural resistance promoters. This is due to their ability to protect plants, enhance vegetative growth, and maintain pathogen populations in numerous agricultural conditions, as well as act as soil inoculant additives to improve nutrient properties, decomposition, and biodegradation (Al-Ani, 2018; Pysmenna et al., 2016).

Conclusions. It was found that newly synthesized guanidine-containing preparations exhibit average fungicidal and fungistatic properties against microscopic fungi isolated from agricultural plants. Although some drugs available on the market demonstrate much higher efficiency, the investigated compounds are promising for use due to their specific selectivity of action, especially in cases of the formation of resistance to fungicidal drugs.

When investigating the potential use of *Trichoderma koningii* and *Trichoderma viride* strains for the production of biological preparations, it was determined that *Trichoderma koningii* had better antagonistic properties compared to *Trichoderma viride. Acremonium strictum, Alternaria alternata,* and *Cladosporium sphaerospermum* cultures had the largest zones of growth retardation.

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Received 08.12.2023

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ЕФЕКТИВНІСТЬ НОВИХ АНТИФУНГАЛЬНИХ ПРЕПАРАТІВ ЩОДО МІКРОСКОПІЧНИХ ГРИБІВ, ВИДІЛЕНИХ З СІЛЬСЬКОГОСПОДАРСЬКИХ КУЛЬТУР

Гуанідини — азотисті органічні сполуки, які мають різноманітні біологічні активності, такі як антибактеріальна, антивірусна, антигрибкова та антипротозойна дія. Олігомери на основі гуанідину, що містять аліфатичні та ароматичні олігоепоксиди, є новосинтезованими речовинами з антифунгальною активністю, що відкриває перспективи їх використання як фунгіцидних засобів для сільськогосподарських культур. **Метою** дослідження було вивчити ефективність нових антифунгальних препаратів проти мікроскопічних грибів, виділених із сільськогосподарських культур та визначити антагоністичну дію *Trichoderma koningii* і *Trichoderma viride*. **Методи.** Гуанідинвмісний алкільно-заміщений олігомер було отримано реакцією ароматичного DER-331 або аліфатичного DEG-1 олігоепоксиду з гуанідином, за якою відбувалася взаємодія з алкільними бромідами. Антифунгальну активність визначали методом дифузії в агар на поживних середовищах зі штамами грибів: *Alternaria alternata* F-41618, *Alternaria infectoria* F-416121, *Aspergillus niger* F-41611, *Aspergillus flavus* F-41612, *Acremonium strictum* F-41615, *Chaetomium globosum* F-41617, *Cladosporium sphaerospermum* F-41623, *Botrytis cinerea* F-41603, *Fusarium poae* F-41610, *Fusarium moniliforme* F-41605. Для порівняння ефективності новосинтезованих препаратів із наявними засобами для обробки сільськогосподарських культур обрано препарати «ROYALFLO», «МЕДЯН ЕКСТРА» та «СТРОБІ». Визначення міжвидових взаємодій між мікроскопічними грибами проводилося методом агарових блоків з антагоністичними культурами, ізольованими з ґрунту — *Trichoderma viride* F-41256, *Trichoderma koningii* F-41246. **Результати.** Результати дослідження показали, що новосинтезовані фунгіцидні гуанідинвмісні препарати показали середню фунгіцидну та фунгістатичну дію на мікроскопічні гриби. Показано, що найефективніший біоцид — препарат на основі тетраалкіл-заміщених олігомерів на основі ароматичного олігоепоксиду. Висока чутливість спостерігається у штамів *Alternaria infectoria*, *Aspergillus flavus*, *Acremonium strictum*, *Chaetomium globosum*, *Cladosporium sphaerospermum*, *Fusarium moniliforme*, тоді як *Alternaria alternata* має середню чутливість. Штами *Aspergillus niger, Botrytis cinerea* та *Fusarium poae* проявляють низьку чутливість. Фунгіцид «STROBI» продемонстрував найвищу ефективність серед біоцидних препаратів. Розмір зони затримки росту на 14-й день культивування зменшився незначно у порівнянні з іншими вивченими препаратами. Виявлено, що *Trichoderma koningi* має більш виражені антагоністичні властивості порівняно з *Trichoderma viride*. Ріст *Acremonium strictum* практично повністю був пригнічений культурою блоку *Trichoderma viride*, фунгіцидна дія з великими зонами затримки росту спостерігалась на тестових культурах *Alternaria alternata* та *Cladosporium sphaerospermum*. **Висновки.** Новосинтезовані гуанідинвмісні препарати виявили середню фунгіцидну та фунгістатичну дію. Незважаючи на те, що деякі препарати, які доступні на ринку, демонструють набагато вищу ефективність, вивчені сполуки є перспективними з огляду на селективність їхньої дії, особливо в разі формування стійкості до дії фунгіцидних препаратів. Крім того, дослідження показало, що штам *Trichoderma koningii* виявляє сильнішу антагоністичну дію на гриби, ізольовані із сільськогосподарських культур, що відкриває можливості для розробки ефективного антифунгального засобу.

Ключові слова: *мікроскопічні гриби, гуанідінові похідні, антифунгальні препарати, антагоністичні властивості.*