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Structure of Micromycete Complex in Agrocenosis of Field Crops on Leached Chernozem of Western Ciscaucasia

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Abstract:

Monitoring of soils demonstrates that the state of agricultural lands reached the limit beyond which irreversible degradation could occur. The reasons for degradation are a systematic violation of agricultural methods and removal of a high amount of organic and mineral substances with harvest without their adequate recycling into the soil. Soils lose more than 40% of humus, the agricultural harvest is formed due to depletion of soils. At present in Krasnodar krai about 210 thousand hectares of arable lands should be conserved due to exhaustion and degradation. This article presents data on long-term monitoring of mycological state of plants and rhizosphere of each culture of typical grain, grass and hoed crop rotation per one cycle growing, herewith, species composition, trophic and phylogenetic specialization, abundance, spatial and time frequency of occurrence, toxicity of micromycetes have been considered as an integrated index of phytopathologic state of a given agrocenosis.

Keywords: phytosanitary situation, phytocenosis, phytopathological microorganisms, micromycetes, humus, monitoring.

Introduction

According to the data of the state land registry, the capacity of agricultural and arable lands in Krasnodar krai is the highest in Russia. However, incomplete studies in the scope of the land monitoring program demonstrate that the state of agricultural lands reached the limit beyond which irreversible degradation could occur. The reasons for degradation are a systematic violation of agricultural methods and removal of a high amount of organic and mineral substances with harvest without their adequate recycling into the soil. Soils lose more than 40% of humus, the agricultural harvest is formed due to depletion of soils. At present in Krasnodar krai about 210 thousand hectares of arable lands should be conserved due to exhaustion and degradation (www.priroda.ru/regions/earth/).

Degraded soils lost their native microflora, their peculiar structure and functions, they lost the self-cleaning ability. Violation of microbiological processes led to a decrease in anti-phytopathogenic potential, soils started to accumulate actively toxicogenic microorganisms, mainly phytopathogenic ones. After being accumulated in economically valuable crop seeds, pathogens stared to prevail and periodically cause epiphytotics. At present activity of *Fusarium* fungi in Krasnodar krai has increased, they provoke tracheomycosis, root rot, the affection of generative organs and leaf apparatus of grain and hoed crops at all vegetation stages. Micromycete *Microdochium nivale* is a major challenge, in winter wheat it excites snow mold, root and near-root rot, fusarial leaf burn and Fusarium head blight. Injuriousness of leaf mycosis increased: Septoria blight, a tan spot of winter wheat, rhynchosporium, net and stripe notch of winter barley, phomopsis and Embellisia blotch of sunflower, the charcoal rot of hoed crops. Previously economically insignificant fungi were spread and became harmful, for instance, Gibellina excitant of winter wheat - *Gibellina cerealis*, injuriousness of *Alternaria* species increased [1, 2].

The strategy of plant cultivation in Krasnodar krai is aimed at an increased yield of agricultural crops, one approach to the solution of this issue is control of the phytosanitary situation of agrocenosis. The applied protective measures are based on studies of injuriousness and bioecological properties of individual types of harmful organisms and improved protection against their development [3, 4]. We considered this problem in another way: we performed long-term monitoring of mycological state of growing and rhizosphere of each crop of typical grain, grass, and hoed crop rotation per one cycle, herewith, species composition, trophic and phylogenetic specialization, abundance, spatial and time-frequency of occurrence, toxicity of micromycetes were considered as an integrated index of phytopathological state of this agrocenosis.

Materials And Methods

The studies were performed in 1992-2016 on the basis of long-term multifactor stationary experiment, Kuban SAU. The experiment is included into the Registry of certificates of long-term experiments with fertilizers and other agrochemical substances of Russian Federation (2002). 11-field grain, grass, and hoed crop rotation was established in 1992, located at three fields with the addition of a new crop every year according to the crop rotation layout. The first rotation (1992-2002) included alternation of winter wheat with hoed crops and was terminated with the three-year cultivation of medick, the second rotation (2001-2011) was started with the following alternation: winter wheat, winter barley, and then – winter wheat with hoed crops and three-year medick. The third rotation was started in 2010 also with alternation of grain and hoed crops. The studies were performed in variants with natural fertility status without mineral fertilizers and crop protection agents. Recommended soil cultivation system was applied: moldboard plowing for hoed crops and medick, depth 30-32 cm, and boardless plowing, depth 8-12 cm, for winter cereals. Relief of the experimental field was smooth. The soils were presented by chernozem, leached, super deep, slightly humic, slightly clayey, humus content was 2.7-2.9%. Total surface area of the experimental field was 105 m^2, registration plot for hoed crops and medick was 47.6 m^2, for cereals - 34.0 m^2. Triple experiment replication, variant placement: random blocks. Phytosanitary state of crops was estimated by conventional phytopathological procedures, micromycetes were extracted from plants and soil using starvation alcohol agar, soil agar, potato sucrose agar, and Czapek's medium. *Fusarium* genus was identified according to W. Gerlach et H. Nirenberg, [5], with consideration of current modifications [6-10]; *Bipolaris, Drechslera, Exserohilum, Curvularia* geni - according to B.A. Khasanov [11], with consideration of modification in their taxonomy [12], *Alternaria Stemphylium* and *Ulocladium* - according to E.G. Simmons [13-20] and [21]. The other types were identified according to Russian and foreign manuals of identification [22-39]. Quantitative and qualitative characterization of micromycete complex of the rhizospheric area of plants was based on procedures of soil mycology [40-44].

RESULTS

As a consequence of long-term monitoring, 125 types of micromycetes were isolated and identified in roots, root crops, leaves, stems, and generative organs of plants, including: 71 in winter wheat, 57 in winter barley, 47 in sugar beet, 50 in grain maize, 44 in sunflower, and 50 in medick. The table with species composition of pathogenic micromycetes presents the titles of holomorphs with regard to the most injurious sporulation stage, anamorpha as a rule, with an indication of teleomorph, if any (Table 1).

Taxonomic status of the isolated micromycetes was presented by two kingdoms: fungus-like organisms (*Chromista*) and true fungi (*Fungi*), four Phylums: *Oomycota, Zygomycota, Ascomycota, Basidiomycota,* and *Anamorpha fungi* group. All existing types of parasitic specialization were present: from bio- to hemi- and necrotrophs.

The group with mono- and olygophag phylogenetic specialization was comprised of bio- and hemibiotrophs: excitants of false and true mildew, pitch strikes, certain types of spot diseases. Depending on biological capabilities during the off-season, fungi of this group remained in/on seeds, after-harvest residues in the form of teleomorphs, teliospores, mycelium in leaves of winter crops, in live tissues of intermediate crops and medick of the second and third years. In pathogenic complex mono- and olygophages were in minority, their fraction in seeds of winter cereals was 35-40%, in other crops - 10-15% (Fig. 1).

Polyphage group of micromycetes with wide phylogenetic specialization was comprised of hemi- and necrotroph types: excitants of root borer, root rots, root crops and heads, necrosis of leaves and stems, fusariosis and dark mildew of spike, rot. In pathogenic complex polyphages dominated: in cenosis of winter cereals, their fraction was in average 60-65%, in remaining crops - 85-90%.

Polyphages, occupying plants during vegetation as pathogens, during off-season changed to saprotroph feed. Upon optimum ambient conditions due to the ability to use after-harvest residues as feed, they developed intensively in anamorphic stage accumulating a high reserve of soil infections. Moreover, polyphages according to biological cycle during off-season formed teleomorphs and resting structures which performed not only the function of long-term preservation but also subsequent spreading in cenosis. Infected seeds served as an additional source of infections of this group.

Polyphage phytopathogens were of particular concern since they could infect all crops of rotation at once, their portion in the pathogenic complex was determined by the type of host plant and was in average 25-40% (Fig. 2). This complex was comprised mainly of *Fusarium* and *Alternaria* (Table 1).

In addition to monitoring of species composition of pathogenic fungi, infecting plants during vegetation, more than 200 mycological analyses (3-4 per crop vegetation) of plant rhizosphere were carried out in the course of two crop rotations. On the basis of obtained results general species composition of micromycetes in crop rotation was determined, it was established that mitospore fungi (*Anamorpha fungi*) constituted about 90% of the total amount of isolated species. They were easily isolated from soil and served as indicators for characterization of soil mycological status. On the basis of time and spatial frequency of occurrence, the significance of each fungi type was established, its typical pattern and status in domination structure were evaluated. Differentiation of fungi complex in terms of trophic specialization and quantitative ratio of pathogenic and saprotrophic fungi is the index which allows judging relative health of the soil.

In this regard, we tried to differentiate the set of isolated fungi in terms of food confinement and highlighted three relatively conventional groups: pathogenic. saprotrophic, and mixed. The first group was comprised of micromycetes causing a pathologic process in all crops of rotation. The saprotrophic group was comprised of typical native types of fungi participating in the transformation of organic residues and forming soil suppressive properties. The mixed group was comprised of species which, due to biological peculiarities, were pathogens in agrocenosis of one crop and saprotrophs in agrocenosis of another group.

In rhizosphere of winter cereals, hoed crops and medick, a set of fungi was formed with high species variety: it was presented by 74 species, among which more than one half (58.1%) were toxigenic.

The core of the pathogenic complex was comprised of dominating or frequently occurring species: *Fusarium* (*F. culmorum** (* - hereinafter toxigenic species were shown), *F. graminearum**, *F. poae**), *Alternaria* (*A. alternata**, *A. tenuissima**), *Cladosporium* (*C. herbarum**), *Cephalosporium* (*C. acremonium*), *Verticillium* (*V nigrescens, V. kubanicum*), *Microdochium nivale**. Time and particularly spatial frequency of occurrence of *Fusarium* (*F. solani**, *F. oxysporum**, *F. verticillioides**), *Pythium* (*P. ultimum*), *Verticillium* (*V. dahliae, V. lateritium**, *V. tr1icorpus*) varied, hence, their quantitative status was unstable and caused periodical transfer from dominating group to that of frequently occurring or typical species and vice versa. The pathogenic set was supplemented by frequently occurring or typical species: *Bipolaris sorokiniana, Botrytis cinerea**, *Fusarium avenaceum**, *Curvularia lunata, Fumago vagans, Harzia verrucos, Nigrospora maydis**, *Pythium graminicola, Oedocephalum glomerulosum, Rhizoctonia solani, Stemphylium botryosum.*

In the saprotrophic group, dominating or frequently occurring types were native fungi: *Trichoderma* (*T. viridi** Pers., *T. koningii** Oudem.) *Stahybotrys* (*S. alternans** Bonorden), *Humicola* (*H. grisea* Traaen). Frequently occurring or typical species were: *Trichoderma album** Preuss, *T. aureoviride** Rifai, *Chaetomium seminudum** Ames, *Ch. thermophile** La Touche. Typical (in the rhizosphere of sugar beet, medick) or rare species (winter cereals, grain maize, sunflower) were as follows: *Trichoderma glaucum** Abbott, *T. hamatum** (Bon.) Bainer, *T. harzianum** Rifai, *Arthrobotrys oligospora* Fres., *Dendrochion nanum* (Nees et Grad) Hughes and *Stysanus* (*S. stemonites* (Pers. et Steud.) Morton et G. Sm.).

The mixed group was comprised of *Aspergillus* (*As. candidus**, *As. flavus**, *As. glaucus, As. fumigatus** Fres., *As. niger**, *As. oryzae**, *As. tamari*), *Mucor (M. hiemalis, M. mucedo, M. plumbeus*), *Penicillium* (*P.atramentosum* Thom, *P. labrum, P. glaucum, P. freguentans**, *P. funiculosum** Thom, *P. canescens** Sopp, *P. citrinum**, *P. claviforme**, *P. corymbiferum, P. commune** Thom, *P. cyclopium, P. luteum**, *P. notatum** Westl., *P. purpurogenum**, *P. rubrum**, *P. rugulosum**, *P. roqueforti** Thom, *P. variabile**) and *Rhizopus* (*Rh. microsporus, Rh. nodosus, Rh. nigricans**, *Rh. oryzae*). The obtained results did not permit to characterize them quantitatively since their spatial and time occurrence varied from high to low level.

Penicillium fungi being cosmopolitans are widely spread in leached chernozem. Herewith, their role in agrocenosis is not unique. On the one hand, they are capable to this or that extent to expose pathogenic properties with regard to agricultural crops, to synthesize phytotoxins and to be a reason of soil exhaustion, on the other hand, in combination *Trichoderma*, they are capable to form soil suppressive properties

Table 1. Species composition, the taxonomic status of phytopathogenic micromycetes in cenosis of field crop rotation, the experimental field of Kuban SAU, 1992-2016.

Excitant, taxonomic status	Crops					
	winter wheat	winter barley	sugar beet	grain maize	sunflower	medick
Kingdom *Chromista*						
Phylum *Oomycota*						
Class *Oomycetes*						
Order *Saprolegniales:*						
Aphanomyces cochlioides Drechsl.			+			
Order *Pythiales:*						
Pythium ultimum Trow.	+	+	+	+		+
Pythium graminicola Subraman	+					
Order *Peronosporales:*						
Albugo tragopogonis Schroet					+	
Peronospora aestivalis Syd.						+
Peronospora schachtii Fuckel			+			
Plasmopara halstedtii Berl. et De Toni					+	
Kingdom *Fungi*						
Phylum *Zygomycota*						
Class *Zygomycetes*						
Order *Mucorales:*						
Mucor hiemalis Wehmer			+	+		
Mucor mucedo Fres.	+	+	+	+	+	+
Mucor plumbeus Bon.			+	+		
Rhizopus microsporus Tiegh.					+	
Rhizopus nodosus Namyslawski			+	+	+	+
Rhizopus nigricans Ehrnb.	+	+	+	+	+	+
Rhizopus oryzae Went et Prin.	+	+	+	+	+	
Phylum *Ascomycota*						
Class *Euascomycetes*						
Order *Erysiphales:*						
Blumeria graminis (DC) Speer. Syn.: *Erysiphe graminis* DC. f. sp. *tritici* Em. Marchal (anamorpha *Oidium monilioides* (Nees) Link.)	+					
Erysiphe communis (Wallr.) Grev. f. *betae* Jacz.			+			
Erysiphe graminis DC. f. *hordei* Em. March.		+				
Erysiphe communis (Wallr.) Grev. f. *medicaginis* Diets.						+
Order *Helotiales:*						
Pseudopeziza medicaginis Sacc.						+
Sclerotinia sclerotiorum (Lib.) de Bary			+	+	+	
Order *Hypocreales:*						
Gibellina cerialis Pass.	+					
Order *Pleosporales:*						
Gaeumannomyces graminis (Sacc.) Arx et Olivier. Syn.: *Ophiobolus graminis* (Sacc.) Sacc. (anamorpha *Phialophora radicicola* Cain)	+	+				
Phylum *Basidiomycota*						
Class *Teliomycetes*						
Order *Uredinales:*						
Puccinia helianthi Schwein.					+	
Puccinia hordei G.H.Otth		+				
Puccinia hordeina Lovtov		+				
Puccinia graminis Pers.	+					
Puccinia maydis Bereng				+		
Puccinia recondita Roberge:Desm f. sp. *tritici* (Erikss.) C. O. Johnston	+					
Puccinia striiformis Westend	+					
Uromyces striatus Schroter						+
Uromyces betae (Pers.) Lev.			+			
Order *Ustilaginales:*						
Tilletia caries (DC.) Tul. Syn.: *T. tritici* (Bjerk.) R. Wolff.	+					
Tilletia controversa Kuhn Syn.:*T. nanifica* (Wagn.) Săvul.	+					
Tilletia levis Kuehn Syn.: *T. foetens* (Berk. et Curt) Trel.	+					
Ustilago hordei (Pers.) Lagerh.		+				
Ustilago nuda (Jens.) Rostr.		+				
Ustilago tritici (Pers.) Jens.	+					
Sorosporium reilianum (Kuehn) McApl.				+		
Ustilago zeae (Beckm.) Ung. Syn.: *U. Maydis* (DC.) Cda.				+		
Group *Anamorpha fungi*						
Class *Hyphomycetes:*						
Alternaria alternata (Fr.) Keissl.	+	+	+	+	+	+
Alternaria tenuissima (Fr.) Wiltshire.	+	+	+	+	+	+
Alternaria zinniae Pape; Neergard					+	
Alternaria sp.	+	+	+	+	+	+
Aspergillus candidus Link. (teleomorph unknown)	+	+				
Aspergillus flavus Link (teleomorph *Petromyces* Malloch et Cain)	+	+	+	+	+	+
Aspergillus glaucus Fr. (teleomorph *Eurotium* Link: Fr.)	+	+	+	+	+	+
Aspergillus niger van Tieghem (teleomorph unknown)	+	+	+	+	+	+
Aspergillus tamarii Kita	+	+		+	+	+
Aspergillus oryzae (Ahlburg) Cohn			+			
Auerobasidium pallulans (Weir) M.L. Lohman et Cash.	+	+				
Bipolaris sorokiniana (Sacc.) Shoem. (teleomorph *Cochliobolus sativus* (Ito et Kurib.) Drechs.)	+	+		+		
Botrytis cinerea Pers (teleomorph *Botryotinia fuckeliana* (de Bary) Whetzel)	+	+	+	+	+	+
Cephalosporium acremonium Cda.	+	+	+	+	+	+
Cercosporella herpotrichoides (Ellis et Everh.) Deighton	+					
Cladosporium herbarum (Pers.) Link. (teleomorph *Mycosphaerella tassiana* (deN) Joh.	+	+	+	+	+	+
Cladosporium macrocarpus Preuss.	+	+	+	+	+	+
Cercospora medicaginis Ell. et Hol.						+
Curvularia lunata (Wakker) Boed. (teleomorph *Cochliobolus lunatus* Nelson et Haasis)	+	+		+		

Excitant, taxonomic status	Crops					
	winter wheat	winter barley	sugar beet	grain maize	sunflower	medick
Curvularia pallescens Boeudijn (teleomorph *Cochliobolus pallescens* (Tsuda, Ueyama) Sivan.)	+	+				
Drechslera dematioidea (Bub. et Wrobl.) Subr. et Iain.	+					
Drechslera graminea (Rabenh.) Shoemaker, (teleomorph *Pyrenohpora graminea* Ito et Kurib.)		+				
Drechslera teres (Saccardo) Shoemaker(teleomorph *Pyrenohpora teres* Drechsler.)		+				
Drechslera tritici-repentis (Died.) Shoemaker. (teleomorph *Pyrenophora triticirepentis* (Died.) Shoemaker)	+					
Embellisia helianthi (Hansf.) Pidopl.				+		
Epicoccum neglectum Desm.	+	+		+		
Exserohilum rostratum (Drechs.) Leonard et Suggs. (teleomorph *Setesphaeria rostrata* Leonard)	+	+		+		
Fusarium avenaceum (Fr.) Sacc. (teleomorph *Gibberella avenaceum* R. J. Cook.	+	+		+		+
Fusarium culmorum (Sm.) Sacc. (teleomorph unknown)	+	+		+		
Fusarium equiseti (Corda) Sacc. Syn.:*Fusarium gibbosum* Appel., Wollnw. (teleomorph *Gibberella intricans* Wollenw.)	+		+			
Fusarium graminearum Schwabe. (teleomorph *Gibberella zeae* (Schw.) Petch	+	+		+		
Fusarium heterosporium Nees. (teleomorph *Gibberella gordonii* spec. nov. Booth)	+	+				
Fusarium oxysporum Schlecht.			+	+	+	+
Fusarium poae (Peck.) Wollenw. in Levis (teleomorph unknown)	+	+			+	
Fusarium proliferatum (Mats.) Nirenberg Syn.: *F. moniliforme* var. *intermedium* Neish, Leggett (teleomorph *Gibberella intermedia* (Kuhlmann) Samuels, Nirenberg, Seifert)	+	+				
Fusarium sambucinum Fuckel (teleomorph *Gibberella pulicaris* (Fries) Sacc.)	+			+		+
Fusarium semitectum Berk. et Rav. In Berkeley (teleomorph unknown)	+					+
Fusarium solani (Mart) App. et Wr. (teleomorph *Nectria haematococca* Berk et Br.)	+	+	+	+		+
Fusarium sporotrichiella Swerb.	+	+				+
Fusarium verticillioides (Sacc.) Nirenberg Syn.: *F. moniliforme* Sheldon. (teleomorph *Gibberella fulikuroi* (Sawada) Wollenw.)	+	+	+	+	+	
Fusarium tritcinctum Corda Sacc.(teleomorph *Gibberella tricincta* El-Gholl, McRitchie, Schoulties, Ridings)	+					
Fumago vagans Pers (teleomorph *Apiosporium salicinum* Kunze)	+	+		+		+
Harzia verricosa Harz Costantin.Syn: *Acremoniella verricosa* Tagnini; Ellis.	+					
Heterosporium graminis Rostr.	+	+				
Oedocephalum glomerulosum (Bull.) Sacc.	+					
Microdochium nivale (Fr.) Sumuels et Hallet. Syn.: *Fusarium nivale* (Fr.) Ces (teleomorph *Monographella nivales* (Schaffnit) Muller)	+	+	+	+	+	+
Nigrospora oryzae (Berk. et Broome) Petch. Syn.: *N. maydis* (Garov.) Jechova. (teleomorph *Khuskia oryzae* H.J. Huds.)	+	+		+		
Penicillium glabrum (Wehmer) Westling	+	+	+	+	+	+
Penicillium glaucum Link.	+	+	+	+	+	+
Penicillium freguentans West.	+	+		+	+	+
Penicillium citrinum Thorn			+			
Penicillium claviforme Bain.			+		+	+
Penicillium corymbiferum Westl.			+		+	+
Penicillium cyclopium Westend			+			
Penicillium luteum Zukal			+		+	+
Penicillium rugulosum Thorn			+			
Penicillium variabile Sopp					+	+
Periconia macrospinosa Lefebv. et John	+					
Rhynchosporium secalis (Oudem.) J. J. Davis Syn.: *Marssonia secalis* Oudem.		+				
Scolecotrichum graminis Fusk	+	+				
Stemphylium botryosum Wallr.	+	+	+	+	+	+
Ulocladium botrytis Preuss.	+	+	+	+	+	+
Verticillium alboatrum Reinke et Berthold						+
Verticillium dahliae Kleb.			+	+	+	+
Verticillium lateritium Berk.			+	+	+	+
Verticillium nigrescens Ehrend.			+	+	+	+
Verticillium tricorpus Isaac.			+	+	+	+
Verticillium kubanicum Scczerbin-Parfenenko			+	+	+	+
Trichocladium opacum (Corda.) S.	+	+				
Trichothecium roseum Fr.	+	+	+	+	+	+
Rotula graminis (Desm.) J.L.Crane et Schokn. Syn.: *Torula graminis* Desm., *T. herbarum* (Pers.) Link ex S.F. Gray var. *affinis* Sacc.	+	+				+
Thielaviopsis basicola (Berk. Et Br) Feir.				+	+	
Class *Coelomycetes:*						
Phoma betae Frank.			+			
Phoma oleraceae var. *helianthi* Hansf.					+	
Phomopsis helianthi Michal. Petrov.					+	
Septoria helianthi Ell. et Kell.					+	
Septoria nodorum (Berk.) Berk. Syn.: *Stagonospora nodorum* (Berk) Castell. et Germano. (teleomorph *Leptoshparia nodorum* E.Müll.)	+					
Septoria tritici Roberge ex Desm. (teleomorph *Mycosphaerella graminicola* (Fuckel) J. Schroet.)	+					
Septoria triticicola Lobic.	+					
Sporonema phacidiodes Desm.						+
Wojnowicia graminis (McApl.) Sacc. et D. Sacc.	+	+				
Class *Agonomycetes:*						
Rhizoctonia cerealis E.P.Hoeven. (teleomorph *Ceratobasidium cereale* D.I. Murray et Burpee)	+	+				
Rhizoctonia solani Kuehn. (teleomorph *Thanatephorus cucumeris* (A.B.Frank) Donk.)	+	+	+	+		+
Rhizocrtonia violaceae Tul. (teleomorph *Helicobasidium purpureum* (Tul) Pat.						+
Sclerotium bataticola Taubenh. Syn.: *Rhizoctonia bataticola* (Taubenhaus) E.J.Butler(anamorpha *Macrophomina phaseolina* (Tassi) Goidanich)			+	+	+	+

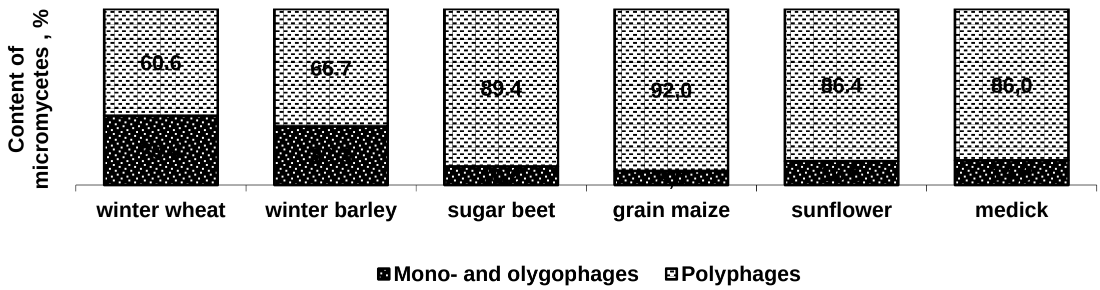

Fig. 1. Structure of pathogenic complex of micromycetes of grain, grass, and hoed crop rotation in terms of phylogenetic specialization, experimental field of Kuban SAU, 1992-2016.

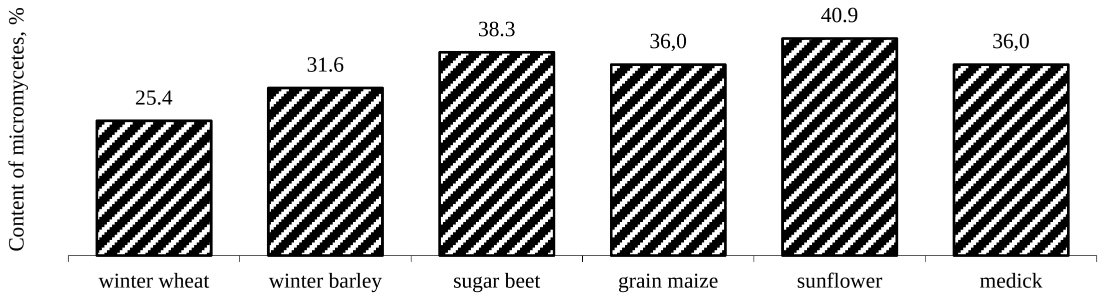

Fig. 2. Fraction of polyphage micromycetes in pathogenic complex infecting all rotation crops, experimental field of Kuban SAU, 1992-2016.

DISCUSSION

Study of abundance dynamics and interrelation of micromycete types with various trophic specialization in the rhizospheric area of plants during vegetation evidence that the main predictors effecting on these indices are crop type, the phase of its development, and ambient conditions: temperature and available moisture. During the study weather conditions were different: more or less favorable. the obtained results made it possible to estimate more exactly the state of soil fungi population both under optimum and critical conditions of their development.

In early spring period (March – early April), with sufficient moisture in the soil, a restricting factor for mesophyll fungi was low temperature. During this time mainly the pathogenic species dominated, the saprotrophic group was comprised mainly of *Penicillium*, more rarely – of *Trichoderma*. During heading, blooming, milky stage of winter cereals and active growth of hoed crops and medick (Mat - early June) the micromycete complex was rearranged: an abundance of saprotrophic fungi increased presented by *Trichderma*, and in medick rhizosphere of sugar beet roots – presented by *Stahybotrys alternans, Humicola grisea.* During yellow and complete ripeness of cereals, various ripening stages of hoed crops (sunflower and grain maize), growth of sugar beet roots, aftergrowth of vegetative bulk of the first-year medick (July - August) in certain years (1996, 1998, 2000, 2001, 2002, 2005, 2006) the surface temperature increased to 60-67ºC, in top soil - to 30-40ºC. Prolonged dry seasons decreased the content of productive moisture to critical values: 10-15% and lower (in 2006 – to ecologically dangerous level). Dominating position in fungi population of the rhizospheric zone was occupied by thermophilic species of *Aspergillus* and *Penicillium*.

Peculiar role of medick in the formation of micromycete complex should be mentioned. On the one hand, as a biological species it was affected by numerous fungi, thus, in the studied crop rotation it could not be considered as a phytosanitary crop. On the other hand, improving physical and chemical properties of soil at the second and especially the third year, it structured soil and increased its water permeability by 71-89%. Buffer effects of soil bulks smoothed variations of temperature and moisture content. Positive variations in soil increased variety of saprotrophic fungi, including *Trichoderma, Humicola, Stahybotrys. Trichoderma* fungi, possessing such unique properties as high competitiveness with regard to feeding substrate, tolerance to stresses, antibiosis, solubilization, mycorhizal formation, the capability to inactivate pathogen ferments and to absorb inorganic feed substances, formed a biological constituent of soil suppressive properties.

In vitro screening of 114 strains of *Trichoderma viridi* and 6 strains of *T. koningii* to pathogenic test subjects of *Fusarium* (*F. culmorum, F. graminearum, F. poae, F. solani, F. tritcinctum, F. verticillioides*) demonstrated that nearly in 90% cases the strains of *T. viridi* exposed hyperparasitism to *Fusarium*, *T. koningii* exposed antagonistic properties. *Trichoderma* fungi inactivated growth and development of pathogenic micromycete *Gibellina cerealis* [2].

CONCLUSION

Therefore, the long-term monitoring of excitants of plant mycosis during vegetation and analysis of a fungal population of rhizosphere zone made it possible to determine general species reserve of micromycetes in typical grain, grass and hoed crop rotation and significance of each culture in its formation. Ranking of fungi in terms of phylogenetic specialization, spatial and time-frequency of occurrence, abundance made it possible to determine the significance of each fungi type, to estimate its uniformity and position in domination structure. On the basis of the obtained results, it is possible to estimate the suppressive capacity of the soil, to make short- and long-term forecasts, to select correct protective measures.

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