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ФИТОПАТОГЕННЫЕ МИКРОМИЦЕТЫ ОВСА В УСЛОВИЯХ ИРКУТСКОЙ ОБЛАСТИ

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Представлены результаты фитопатологического обследования партий районированных сортов овса Ровесник и Егорыч урожаев 2015, 2016 гг. и 2020, 2021 гг., выращенных в разных районах Иркутской области. Зараженность микромицетами определяли методом влажной камеры по ГОСТ 12044–93. Погодные условия в годы выращивания обследуемых партий овса были теплыми и характеризовались отклонением увлажнения в период вегетации от нормы, что приводило к ослаблению растений и к усилению развития фитопатогенных микромицетов. Установлена высокая повсеместная встречаемость грибов из рода *Alternaria*. Зараженность грибами из рода *Alternaria* овса сорта Ровесник, выращенного в 2015 г., составила от 20 до 36%, в 2016 г. – от 44 до 83%. Сорт Егорыч в 2016 г. заражен от 43 до 91%. В партиях урожая 2020 г. и 2021 г. независимо от сорта зараженность составила от 70 до 100% и от 60 до 98% соответственно. *Bipolaris* spp. отмечен во всех анализируемых партиях овса сорта Ровесник в урожае 2015, 2016 гг. при варьировании зараженности 3–12 и 4–37% соответственно. Сорт Егорыч урожая 2016 г. имел зараженность от 3 до 87%. В урожае 2020 и 2021 гг. выявлены единичные партии, свободные от *Bipolaris* spp., но большинство из них независимо от сорта имели степень заражения 7–40 и 3–45% соответственно в 2020 г. и в 2021 г. Встречаемость фитопатогенов из рода *Fusarium* spp. не зависела от сорта, но сильно отличалась по годам. В зерне большинства партий урожая 2015, 2016 гг. зараженность микромицетами *Fusarium* spp. была в интервале 1–24%, а в урожае 2020, 2021 гг. преобладали партии с очень высоким заражением этим возбудителем (23–93, 20–67% соответственно). Единичные партии были свободны от *Fusarium* spp.

Ключевые слова: овес, сорта, микромицеты, фитопатогены

PHYTOPATHOGENIC MICROMYCETES OF OATS UNDER THE CONDITIONS OF THE IRKUTSK REGION

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The results of phytopathological examination of grain batches of oat zoned varieties Rovesnik and Egorych grown in different areas of the Irkutsk region and harvested in 2015-2016 and in 2020-2021 have been presented. Infestation with micromycetes was determined by the wet chamber method according to GOST 12044-93. The weather conditions during the growing years of the examined oat batches were warm and characterized by a deviation of moisture during the growing season from the norm which led to plants weakening and the reinforced development of phytopathogenic micromycetes. A high ubiquitous occurrence of fungi from the genus *Alternaria* has been established. In 2015 the infestation of oat cultivar with Rovesnik fungi from the genus *Alternaria* ranged from 20 to 36%, and that grown in 2016 – from 44 to 83%. The variety Egorych in 2016 was infested from 43 to 91%. In the batches harvested in 2020 and 2021, irrespective to a cultivar, the infestation was from 70 to 100% and from 60 to 98%, correspondingly. *Bipolaris spp*. was observed in all the analyzed batches of oat variety Rovesnik in the harvests of 2015 and 2016 with a varying infestation range of 3-12% and 4-37%, respectively. The cultivar Egorych harvested in 2016 had the infestation level from 3 to 87%. In the harvests of 2020 and 2021, single batches free from *Bipolaris spp.* were found, but most of them had a degree of infestation, regardless of a variety, of 7-40% and 3-45%,

respectively, in 2020 and 2021. The occurrence of phytopathogens of the genus *Fusarium* spp. did not depend on the variety, but it differed greatly in years. In the grain of most batches harvested in 2015-2016, the infestation with micromycetes *Fusarium spp.* was within the range of 1-24%, and in the harvest of 2020-2021 the batches with very high infestation with this pathogen prevailed – 23-93% and 20-67%, respectively. Single batches were free of *Fusarium* spp.

Keywords: oats, cultivars, micromycetes, phytopathogens

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INTRODUCTION

Oats is the most important food and forage crop in Russia. The biological potential of oat productivity is limited by different types of rust and smut, root rot, Helminthosporium leaf blotch, and the representatives of genera *Fusarium* and *Alternaria* dominate in grain mycobiota.

Many studies in different regions of our country were devoted to solving the problem of oat resistance to a number of pathogens, as a result of which the mechanisms of this crop resistance to phytopathogens were revealed [1], varieties resistant to crown and stem rust, loose and stinking smut, root rot were created [2], oat samples resistant and highly resistant to Siberian population of the Helminthosporium leaf blotch pathogen Drechslera avenae (Eidam.) Ito et Kuribay [3]. The effect of toxic metabolites of *Fusarium* fungi on the processes of morphogenesis and plant regeneration in the culture of immature embryos of spring oats was studied [4], and the efficiency of using the biomethod to protect oats from phytopathogens was studied [5].

Fusarium, *Alternaria*, *Penicillium* and *Aspergillus* fungi are the main producers of mycotoxins of economic importance. In addition to the reduced productivity of oats and other cereal crops due to the defeat of various pathogens, the infection of crops with toxigenic fungi of the *Fusarium*, *Alternaria*, *Penicillium* and *Aspergillus* genera and the accumulation of mycotoxins dangerous for human and animal health in plant products are of great importance all over the world [6-8].

In Russia, the most common mycotoxins for food oat grain are *Alternaria* toxins, T-2 and HT-2, NEOS, CIT, and DON [9, 10]. The influence of biochemical composition and some morphological characters of oat grains of different varieties on their contamination with micromycetes of genera *Alternaria* and *Fusarium* and accumulation of toxins was shown [11, 12]. Presowing seed dressing is considered as a reasonable strategy to reduce the risk of contamination of future crops with mycotoxins [13].

In the Irkutsk region, at present, the importance of oats is increasing not only as a forage crop, but also as a food crop both for domestic consumption in the region and for export. In the system of crop rotations of the region, the forecrops for wheat using oats as one of the components in the composition of annual grasses, in mixture with rape as a siderat are promising.

In this regard, the study of mycobiota of oat grain, which determines its contamination with mycotoxins, and determination of the possibility of using the grain for food and fodder purposes, is of great importance. Also, phytosanitary condition of oat seeds as a wheat forecrop in the composition of annual grasses and green manure in their absence shows the contamination of soil with root rot pathogens or contributes to the entry of the infection into the soil with contaminated seeds.

The purpose of the study was to identify the micromycete infestation of oat seeds grown in the Irkutsk region.

MATERIAL AND METHODS

The infestation of oat grain with micromycetes was determined by the wet chamber method[1]. The studies were carried out on 65 samples of released oat varieties Rovesnik and Egorych from different soil and climatic zones of the Irkutsk region with the yields of 2015, 2016, and 2020, 2021.

The agricultural enterprises of the Irkutsk region sow oats as the second or third crop after a valuable forecrop (fallow, peas, layer of perennial grasses, corn). Autumn plowing is traditional (mouldboard and non-mouldboard), and various types of non-mouldboard cultivation in autumn or spring (discing and cultivation) are also common. Farms with modern machinery (SM Kuzbass, Ob-4) carry out direct seeding of oats. Due to the difficult financial situation, farms practically do not disinfect oat seeds.

RESULTS AND DISCUSSION

Earlier, infestation of oat with the phytopathogenic micromycete *Bipolaris* spp. prevailed; at present, the structure of this crop microbiocenosis is gradually changing. In the literature, there are data on the change of phytopathogenic complex on spring wheat seeds - *Bipolaris sorokiniana* is not the predominant micromycete [14].

In our studies, all batches of oats subjected to phytopathological examination were mostly infected with a complex of micromycetes from genera *Alternaria* and *Fusarium*, and less from - *Bipolaris* sp.

Weather conditions in the years of cultivation of the examined batches of oats were warm and characterized by deviation of moisture during vegetation period from the norm, which led to weakening of plants and to strengthening of development of phytopathogenic micromycetes, mainly toxin-producing *Alternaria* spp. and *Fusarium* spp. and their accumulation on the grain (see Tables 1, 2).

High ubiquitous occurrence of fungi of the genus *Alternaria* was established. The degree of their infestation varied depending on the year of harvest. Thus, in batches of the oat variety Rovesnik grown in 2015, which was characterized as dry according to the HTC, the infection with fungi of this genus was from 20 to 36% (average - 26%). In 2016, the HTC of a wet crop, grain of the variety Rovesnik was infested from 44 to 83% (average 61%), and of the variety Egorych from 43 to 91% (average 61%). In the lots of harvests 2020 and 2021 - slightly arid and humid in different regions, regardless of the variety, the interval of contamination was, respectively, from 70 to 100% (average 78-92%) and from 60 to 98% (average 83-96%). Slightly arid and humid conditions of the vegetation periods contribute to high infection of grain by fungi of Alternaria genus 72-96%.

Bipolaris spp. was found in all analyzed batches of the oat variety Rovesnik in the 2015 and 2016 harvests, with varying infestations of 3-12, 4-37%, respectively. Egorych variety of the 2016 crop had infestation ranging from 3 to 87%. Single lots free of *Bipolaris* spp. were identified in the 2020 and 2021 harvests, but most had degrees of infestation regardless of the variety 7-40 and 3-45% in 2020 and 2021, respectively. Batch infestation with *Bipolaris* spp. also varied by district. In the variety Rovesnik, the lowest (up to 10%) in 2015 it was recorded in Kuytunsky district, in 2020 in Zalarinsky and Taishetsky districts, in 2021 in Alarsky, Bokhansky and Zalarinsky districts. Egorych variety had the least infestation in 2020 in Taishetsky district, in 2021 in Alarinsky and Bayandaevsky districts. The effect of hydrothermal conditions on the degree of *Bipolaris* spp. infestation was not found, so, in the variety Egorych with HTC 1.65 the infestation was 4%, and 1.27 - 30%, in the variety Rovesnik with HTC 1.62 the infestation was 20%, 1.65 - 4%.

The occurrence of phytopathogens of the genus *Fusarium* spp. did not depend on the vari-

[1]GOST 12044-93 Seeds of crops. Methods of determination of disease infestation. Minsk: Interstate Council for Standardization, Metrology and Certification, 33 p.

Табл. 1. Результаты фитопатологического анализа зерна овса сорта Ровесник
Table 1. Results of phytopathological analysis of Rovesnik cultivar oat grain

Variety, region, number of batches	Harvest year	HTC	Micromycetes, %			General infestation, %	Germination rate, %
			Alternaria spp.	*Bipolaris* spp.	*Fusarium* spp.		
Rovesnik, Kuytunsky, 6 batches	2015	0,99	26	8	20	49	90
Rovesnik, Zalarinsky, 8 batches	2016	1,66	61	19	31	81	76
Rovesnik (average)	2020	–	85	17	54	100	69
Including:							
Alarsky, 2 batches	2020	1,17	78	12	91	100	51
Bayandaevsky, 2 batches	2020	1,62	89	20	53	100	66
Bokhansky, 1 batch	2020	1,27	88	20	0	100	71
Zalarinsky, 2 batches	2020	1,20	80	5	55	100	57
Taishetsky, 2 batches	2020	1,65	92	4	65	100	83
Ust-Udinsky, 2 batches	2020	1,19	87	40	63	100	88
Rovesnik (average)	2021	–	92	16	28	100	68
Including:							
Alarsky, 2 batches	2021	1,39	94	8	23	100	88
Bayandaevsky, 2 batches	2021	1,70	90	45	26	100	57
Bokhansky, 3 batches	2021	1,35	92	7	19	100	68
Zalarinsky, 2 batches	2021	1,53	93	3	46	100	60

Табл. 2. Результаты фитопатологического анализа зерна овса сорта Егорыч
Table 2. Results of phytopathological analysis of Egorych cultivar oat grain

Variety, region, number of batches	Harvest year	HTC	Micromycetes, %			General infestation, %	Germination rate, %
			Alternaria spp.	*Bipolaris* spp.	*Fusarium* spp.		
Egorych, Zalarinsky, 9 batches	2016	1,66	61	28	20	82	86
Egorych (average)	2020		79	15	36	100	72
Including:							
Alarsky, 2 batches	2020	1,17	82	13	45	100	63
Bayandaevsky, 2 batches	2020	1,62	81	15	42	100	75
Bokhansky, 2 batches	2020	1,27	78	30	23	100	63
Zalarinsky, 2 batches	2020	1,20	72	11	43	100	62
Taishetsky, 2 batches	2020	1,65	90	4	35	100	80
Ust-Udinsky, 3 batches	2020	1,19	74	20	32	100	86
Egorych (average)	2021	–	90	10	27	100	57
Including:							
Alarsky, 2 batches	2021	1,39	85	8	25	100	45
Bayandaevsky, 3 batches	2021	1,70	83	7	16	96	50
Bokhansky, 3 batches	2021	1,35	96	10	37	100	65
Zalarinsky, 3 batches	2021	1,53	96	16	30	100	68

ety, but differed greatly from year to year. In the grain of most lots of the 2015, 2016 harvests, *Fusarium* spp. micromycetes infestation was in the range 1-24% (average 20-31%), while in the 2020, 2021 harvests, the lots with very high infestation with this pathogen dominated - 23-93% (average 0-91%), 20-67% (average 16-46%) respectively. Single lots were free of *Fusarium* spp. Grains of both analyzed oat varieties were most heavily infested in 2020 in all studied areas with HTC from 1.17 to 1.65, especially the variety Rovesnik - the average infestation of batches of this variety was 18% higher compared to the variety Egorych.

The wide ranges of micromycete infestation within the considered years, districts, and varieties suggest that the degree of oat batch infestation depends not only on these factors, but also on the farming practices used in the cultivation of the crop in a particular farm. Micromycetes of infected oat seeds can contribute to soil pathogenicity and negatively influence the phytosanitary situation in grain crop rotations. Currently, they are used in the Irkutsk region in grain and livestock enterprises with stabling animals, which requires the use of concentrated grain fodder, forcing farms to reduce fallow and tilled crops.

From the point of view of safety of grain use for food and fodder purposes, it is necessary to pay attention to the high contamination of oat grain in the region with toxin-producing fungi of genera *Alternaria* and *Fusarium*. The negative effect of high infestation with phytopathogenic micromycetes manifested itself in the reduction of laboratory germination of oats, which in the vast majority of batches did not exceed 87% and could not meet the quality of the Russian standard GOST R 52325-2005 (see Tables 1 and 2)[2].

In order to obtain a high yield of grain free of mycotoxins and to form a favorable situation in grain agrocenoses, when cultivating oats, preference should be given to agricultural practices that reduce the accumulation and spread of phytopathogenic micromycetes and consider the phytosanitary status of seeds. Seed batches with high infestation require obligatory presowing dressing with fungicides approved for use in the Russian Federation.

CONCLUSIONS

1. Phytopathogenic micromycetes of genera *Alternaria* and *Fusarium* are predominant in grain infestation of oat batches grown in the Irkutsk region in 2015, 2016 and 2020, 2021. *Bipolaris* spp. occurs less frequently, but in the overwhelming number of the examined batches exceeds the threshold of pest infestation of seeds.

2. Agricultural producers of the Irkutsk region should pay attention to the high contamination of oat grain in the region with toxin-producing fungi of genera *Alternaria* and *Fusarium* in order to produce safe food products.

3. Micromycetes of infected oat seeds may contribute to soil pathogenicity and play a negative role in the formation of the phytosanitary situation in grain crop rotations, which are currently widely used in the Irkutsk Region.

СПИСОК ЛИТЕРАТУРЫ

1. *Исачкова О.А.* Устойчивость голозерного овса к семенной инфекции // Сибирский вестник сельскохозяйственной науки. 2018. № 2. С. 11–16. DOI: 10.26898/0370-8799-2018-2-2.
2. *Баталова Г.А.* Селекция зерновых культур на иммунитет на Северо-Востоке Европейской территории России // Зерновое хозяйство России. 2017. № 3. С. 8–11.
3. *Нешумаева Н.А., Голубев С.С.* Оценка устойчивости овса к сибирской популяции возбудителя красно-бурой пятнистости Drechslera avenae // Достижения науки и техники АПК. 2018. № 5. С. 48–51.
4. *Зобова Н.В., Луговцева С.Ю., Нешумаева Н.А.* Исследование влияния метаболитов микомицетов рода *Fusarium* на каллусную культуру овса // Достижения науки и техники АПК. 2019. № 7. С. 24–28.
5. *Власов А.Г., Купцов В.Н., Халецкий С.П., Коломиец Э.И.* Применение биопестицида Бактавен для защиты посевов овса от болезней // Вестник защиты растений. 2017. № 2. С. 40–45.

[2]Seeds of agricultural plants. Varietal and sowing characteristics. General and technical conditions. Moscow: Standartinform, 2009. 23 p.

6. *Левитин М.М., Джавахия Г.Г.* Токсикогенные грибы и проблемы продовольственной безопасности (обзор) // Достижения науки и техники АПК. 2020. № 12. С. 5–11.
7. *Drakopoulos D., Kagi A., Alejandro G., Six J., Jenny E., Forrer H-R., Musa T., Meca G., Vogelgsang S.* Prevention of Fusarium head blight infection and mycotoxins in wheat with cut-and-carry biofumigation and botanicals. *Field Crops Research*, 2020, no. 246, P. 107681.
8. *Кононенко Г.П., Зотова А.Е., Буркин А.А.* Опыт микотоксикологического обследования зернофуражных культур // Сельскохозяйственная биология. 2021. № 5. С. 958–967. DOI: 10.15389/agrobiology.2021.5.958rus.
9. *Киселева М.Г., Седова И.Б., Чалый З.А., Захарова Л.П., Аристархова Т.Б., Тутельян В.А.* Анализ продовольственного зерна в Российской Федерации на загрязненность широким спектром микотоксинов (на примере урожая 2018 года) // Сельскохозяйственная биология. 2021. № 3. С. 559–577. DOI: 10.15389/agrobiology.2021.3.559rus.
10. *Орина А.С., Гаврилова О.П., Гагкаева Т.Ю., Гогина Н.Н.* Контаминация зерна в Западной Сибири грибами *Alternaria* и их микотоксинами // Вестник защиты растений. 2021. № 3. С. 153–162.
11. *Лоскутов И.Г., Шеленга Т.В., Конарев А.В., Хорева В.И., Шварда А.Л., Блинова Е.В., Гнутиков А.А.* Биохимические аспекты взаимоотношений грибов и растений на примере фузариоза овса // Сельскохозяйственная биология. 2019. № 3. С. 575–588.
12. *Орина А.С., Гаврилова О.П., Гагкаева Т.Ю., Лоскутов И.Г.* Симбиотические взаимоотношения грибов *Fusarium* и *Alternaria,* колонизирующих зерно овса // Сельскохозяйственная биология. 2017. № 5. С. 986–994.
13. *Sarrocco S., Vannacci G.* Preharvest application of beneficial fungi as a strategy to prevent postharvest mycotoxin contamination: A review. *Crop Protection*, 2018, no. 110, pp. 160–170.
14. *Кекало А.Ю., Заргарян Н.Ю., Филиппов А.С., Немченко В.В.* Эффективность применения фунгицидов для защиты яровой пшеницы от корневых гнилей // Сибирский вестник сельскохозяйственной науки. 2019. № 3. С. 24–30. DOI: 10.26898/0370-8799-2019-3-3.

REFERENCES

1. Isachkova O.A. Resistance of hulless oats to seed infection. *Sibirskij vestnik sel'skokhozyaistvennoy nauki = Siberian Herald of Agricultural Science,* 2018, no. 2, pp. 11–16. (In Russian). DOI: 10.26898/0370-8799-2018-2-2.
2. Batalova G.A. Grain crop breeding for immunity in the north-east of the European territory of Russia. *Zernovoe khozyaistvo Rossii = Grain economy of Russia,* 2017, no. 3, pp. 8–11. (In Russian).
3. Neshumaeva N.A., Golubev S.S. Evaluation of oat resistance to Siberian population of a pathogenic agent of leaf stripe DRECHSLERA AVENAE. *Dostizhenija nauki i tekhniki APK = Achievements of Science and Technology of AIC*, 2018, no. 5, pp. 48–51. (In Russian).
4. Zobova N.V., Lugovtsova S.Yu., Neshumaeva N.A. Study of the influence of mycomycetes' metabolites of fusarium genus on callus oat culture. *Dostizhenija nauki i tekhniki APK = Achievements of Science and Technology of AIC*, 2019, no. 7, pp. 24–28. (In Russian).
5. Vlasov A.G., Kuptsov V.N., Khaletsky S.P., Kolomiets E.I. Application of Bactaven biopesticide in oat crop protection against diseases. *Vestnik zaschity rastenij = Plant Protection News,* 2017, no. 2, pp. 40–45. (In Russian).
6. Levitin M.M., Dzhavakhiya V.G. Toxigenic fungi and food security issues (review). *Dostizhenija nauki i tekhniki APK = Achievements of Science and Technology of AIC,* 2020, no. 12, pp. 5–11. (In Russian).
7. Drakopoulos D., Kägi A., Alejandro G., Six J., Jenny E., Forrer H-R., Musa T., Meca G., Vogelgsang S. Prevention of Fusarium head blight infection and mycotoxins in wheat with cut-and-carry biofumigation and botanicals. *Field Crops Research*, 2020, no. 246, p. 107681.
8. Kononenko G.P., Zotova E.V., Burkin A.A. Advances in mycotoxicological research of forage grain crops. *Sel'skokhozyaistvennaya biologija = Agricultural Biology,* 2021, no. 5, pp. 958–967. (In Russian). DOI: 10.15389/agrobiology.2021.5.958rus.
9. Kiseleva M.G., Sedova I.B., Chalyy Z.A., Zakharova L.P., Aristarkhova T.V., Tutelyan V.A. Multimycotoxin screening of food grain produced in Russia in 2018, *Sel'skokhozyaistvennaya biologija = Agricultural Biology,* 2021, no. 3,

pp. 559–577. (In Russian). DOI: 10.15389/agrobiology.2021.3.559rus.
10. Orina A.S., Gavrilova O.P., Gagkaeva T.Yu., Gogina N.N. Contamination of grain in West Siberia by *Alternaria* fungi and their mycotoxins. *Vestnik zaschity rastenij = Plant Protection News,* 2021, no. 3, pp. 153–162. (In Russian).
11. Loskutov I.G., Shelenga T.V., Konarev A.V., Horeva V.I., Shvarda A.L., Blinova E.V., Gnutikov A.A. Biochemical aspects of interactions between fungi and plants: a case study of *Fusarium* in oats. *Sel'skokhozyaistvennaya biologija = Agricultural Biology*, 2019, no. 3, pp. 575–588. (In Russian).
12. Orina A.S., Gavrilova O.P., Gagkaeva T. Yu., Loskutov I.G. Symbiotic relationships between aggressive *Fusarium* and *Alternaria* fungi colonizing oat grain. *Sel'skokhozyaistvennaya biologija = Agricultural Biology*, 2017, no. 5, pp. 986–994. (In Russian).
13. Sarrocco S., Vannacci G. Preharvest application of beneficial fungi as a strategy to prevent postharvest mycotoxin contamination: A review. *Crop Protection*, 2018, no. 110, pp. 160–170.
14. Kekalo A.Yu., Zargaryan N.Yu., Filippov A.S., Nemchenko V.V. Efficiency of application of fungicides for spring wheat protection against root rots. *Sibirskij vestnik sel'skokhozyaistvennoy nauki = Siberian Herald of Agricultural Science,* 2019, no. 3, pp. 24–30. (In Russian). DOI: 10.26898/0370-8799-2019-3-3.

ИНФОРМАЦИЯ ОБ АВТОРАХ

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