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Evaluation of Phytopathogenic Fungi According to the Degree of Danger

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Abstract

The increasing number of the world's population and the fact that it is happening on the Earth, which is stable against the background of the reduction of the areas used by people for food purposes, has put humanity in a position to face a number of problems. Here is food, lack of energy, raw materials for industry, etc. issues such as If we add to these the global problems of the globalized world, first of all, such as global warming and the loss of biodiversity, then it can be noted that the situation on Earth is not so encouraging. Among the mentioned problems, the problems related to the demand for food and fodder of the Earth's population, as well as other living beings, are of particular importance. Thus, for people to live and function, they must always receive the necessary substances due to the satisfaction of their demand for food and energy from the environment. Already today in this matter, that is, quality food products for people. According to various forecasts, the population of the Earth is expected to be 9.3 billion in 2050, which means that the population is expected to increase by 1.33 times. In return for this increase, people living on Earth in order to meet the demand for food products, it will be necessary to increase the current production of agricultural products by approximately 1.5 times. This forecast is calculated based on the crops grown on the Earth's land used by humans for food production today. This includes global warming, urbanization, etc. as a result of the processes, salinization, desertification, etc. if lands that lose their suitability for cultivation are added, then the yield per hectare will need to be increased more. It is known that although the basis of human food is traditionally various products obtained from plants and animals, there are always products obtained with the direct and indirect participation of microorganisms, primarily bacteria and fungi, among the food products used by people, and more and more products from the mentioned sources are also found,

ratio of microorganismschanges for the better. Despite this, plants and animals still remain the main source of human food supply, and for this reason, their research in meeting the human need for food is considered one of the urgent issues of the modern era due to the above-mentioned reasons.

Keywords: mycobiota, pathogen, phytopathogen, productivity, symptom

Introduction

As mentioned, phytopathogenic fungi are generally divided into 3 types, and their causative agents differ from each other according to the spread of the diseases they cause, the symptoms of the diseases they cause. 70 of the 105 recorded fungal species were found to be phytopathogenic , and the presence of those corresponding to the mentioned division among them was also confirmed (Abdelmalek & Salaheldin., 2016). For example, in the studies, Blumeria (1 species), Eryshiphe (6 species), Puccinia (7 species), Tilletia (1 species), Urocystis (2 species), Uromyces (3 species) and Ustilago (5 species) species belonging to the genera are fungi-biotrophs, alternaria, ascochytosis, septoriosis, anthracnose, fomosis, etc. such as Alternaria (4 species), Aschochyta (4 species), Colletotrichum (2 species), Cercospora (3 species), Phoma (4 species), Ramularia (1 species), Rhizoctonia (1 species), Septoria (5 species) , Thielaviopsis (1 species), Trichotectum (1 species) fungi are necrotrophic, fusarium, root rot, etc. disease-causing Botrytis (1 species), Claviceps (1 species), Cochliobolus (1 species), Fusarium (8 species), Gibberella (1 species), Monilia (1 species), Pyrenophora (1 species), Sclerotina (2 species), Stemphilium (1 species), Verticillium (2 species), etc. Fungal species belonging to genera belong to hemibiotrophs. If we characterize the mentioned by the number of species, it is clear that 25 (*Blumeria graminis, Eryshiphe betae, E.cichoracearum, E.communis, E.cruciferarum, E.pisi, E.trifolii, Puccinia artemisiicola, P.coronata, P.cynodontis, P. graminis, P. helianthi, P. hordei P. recondita, Tilletia caries, Urocystis cepulae, U. tritici, Uromyces fabae, U.striatus, U.trifolii-repentis, Ustilago cynodontis, U. nigra, U.hordei, U.tritici* and *U.zeae*) species of fungi-biotrophs, 26 (*Alternaria alternata, A.solani, A.tenuissima, A.tenuis, Ascochyta hordei* Hara*, Ascochyta betae, Asc.pisi, Asc.sojikota, Cercospora beticola* Sacc*, C.fabae, C. medicaginis, Colletotrichum gloesporioides* (Penz.) Penz. & Sacc., *C. trifolii, Phoma artemisiae, Ph. betae, Ph. destructiva, Ph. medicaginis, Ramularia medicaginis, Rhizoctonia solani, Septoria helianthi, S. nodorum, S. pisi, S. sojina, S. tritici , Thielaviopsis basicola, Trichothecim roseum*) species necrotrophic fungi, 19 (*Botrytis cinerea, Claviceps purpurea, Cochliobolus heterostrophus, Fusarium avenaceum* (Fr.) Sacc., *F. culmorum, F. moniliforme, F. gibbosum, F. oxysporium, F. solani, F. semitectum, F. sporotrichioides, Gibberella fujikuroi* (Sawada) Wollenw, *Monilia sitophila, Pyrenophora graminea, Sclerotina sclerotiorum, S. trifoliorum, Stemphilium botryosum, Verticillium albo-atrum* and *V.dahile*) species refers to hemibiotrophs. More precisely, 37.1% of registered phytopathogens belong to fungal-necrotrophs, 35.7% to fungal-biotrophs, and 27.1% to hemibio-

trophs. Based on this fact, it can be said that the specific gravity of hemibiotrophs is low and the specific gravity of biotrophs is relatively high, which can be evaluated as a positive situation. So, in terms of adaptation and substrate specificity, hemibiotrophs are considered more active, that is, their adaptability is higher, and substrate specificity is weak, that is, they are universal. Among the biotrophs, since there are more of those with substrate specificity, it is impossible for their plant species to be mixed, i.e., first of all, their wide spread in phytocenoses and the occurrence of their euphytoty (Pardo-Planas, O *et al*., 2017)

It would be appropriate to touch on one point here, which is related to the fact that some fungi belong to both hemibiotrophs and endophytes at the same time. Thus, some fungi, for example, fungi belonging to the genus Fusarium, can behave as both necrotrophic fungi and hemibiotrophs, as well as endophytes, causing various diseases in plants. This fact allows us to note that mushrooms are a very interesting object from a scientific and practical point of view, but a number of their properties, more precisely, their potential, should not be exceeded until the end.

It would be appropriate to touch on one point about the potential of mushrooms, which is related to the contradictory properties of a number of them.

Materials and methods

As mentioned, fungi belonging to the genus Fusarium are one of the widespread phytopathogens, both according to literature data and the results of our research, and even figuratively comparing the disease caused by fungi belonging to this genus to plants, primarily grains, with the cancer disease that spreads among humans. can Nevertheless, fungi belonging to this genus also synthesize phytohormones, which accelerate plant growth and are currently the focus of attention in terms of obtaining plant-based products (Jabraylzadeh, & *et al*., 2024). Nevertheless, in our opinion, this can also be noted as an acquired sign in terms of increasing the adaptability of fungi, that is, by causing disease in plants, the fungus causes its weakening and biological productivity, therefore, as a result of its synthesis of phytohormones, the life of the diseased plant is extended, and thus the fungus it becomes possible to satisfy the need for organic matter for a longer period of time. In other fungi, the opposite situation occurs. Thus, fungi belonging to the genus Trichoderma have antagonism towards phytopathogens, and for this reason they are used for practical purposes as biological control agents, but among those fungi there are also species that synthesize metabolites that cause allergic diseases in humans (for example, *T. viride*), which this creates additional opportunities for the expansion of their adaptation capabilities. Similar examples can be given in the example of other mushrooms (*Mucor hiemalis, Trichotectum roseum*, etc.). In a word, although this or that characteristic of mushrooms is useful or harmful in terms of practical orientation, it is more logical to characterize the characteristics of mushrooms, which are characterized in terms of being harmful or useful, as the necessary requirements of their life activity. (Mapuranga, & *et al*., 2022, Yusifova, & *et al*., 2024)

In addition, the distribution of phytopathogenic fungi, both in general and on individual fodder plants, is characterized by different quantitative indicators, which allows us to note that they differ both in terms of the degree of danger and the damage they cause to the productivity of plants. For this reason, it was considered appropriate to systematize the phytopathogenic fungi recorded in fodder plants according to the degree of danger, for which the results obtained in the research and the literature information about the damage to the productivity of plants caused by the disease caused by phytopathogenic fungi were also used. In conclusion, the phytopathogenic fungi recorded in our studies were systematized according to the frequency of occurrence and the degree of spread of the diseases caused by them, and according to their effect on the productivity of plants, they were divided into 3 places - those that are a source of serious danger, those that are a source of potential danger, and species that are not known to be dangerous. Apparently, the first group mainly includes species belonging to the genera Alternaria, Fusarium and Verticillium, which are more widespread than others and species without substrate specificity, that is, they are not specific to a specific plant species or a few species, but to almost all forage plants. and have the ability to cause disease.

Finally, it would be appropriate to touch on one issue, which is related to whether or not the outbreak of this or that disease occurred during the research period. First of all, it should be noted that during the years 2020-2024, when the research was carried out, there was no such case, or more precisely, the case of the spread of this or that disease covering several hectares of a specific natural or agrocenosis area was not observed. This gives reason to note that epitotia does not occur. This case is one of the points to be evaluated in a positive sense, and it is also characterized as an indicator that the phytosanitary condition of the area where fodder plants are spread is not dangerous. To this Finally, it would be appropriate to touch on one issue, which is related to whether or not the outbreak of this or that disease occurred during the research period.

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Table 1. Characterization of phytopathogenic fungi recorded in the studied fodder plants according to the degree of danger

	Sources of serious danger	Sources of potential danger	Unknown danger
Distribution in forage crops (%)	52-88	12-48	4-8
Matching species	*A.alternata, A.solani, B.cinerea, F.oxysporium, F.moniliforme F.solani, T.roseum, V.albo-atrum, V.dahile*	*A.tenuissima,* A.*solani, A.tenuis E.communis F.avenaceum, F.gibbosum F.semitectum, F.sporotrichioides Rh.solani S.sclerotiorum St.botryosum, Th.basicola*	*Ascochyta hordei* Hara, *Asc.betae, Asc.pisi, Asc.sojikota, B.graminis, C.beticola, C.fabae, C.medicaginis, C.trifolii, C.gloesporioides, E.betae, E.cichoracearum, E.communis, E.cruciferarum, E.pisi, E.trifolii, Monilia sitophila, Ph.artemisiae, Ph.betae, Ph.destructiva, Ph.medicaginis, Ph.leptostromiforme, P.artemisiicola, P.coronata, P.cynodontis, P.graminis, P.helianthi, P.hordei* Schwein., *P.recondita, P.graminea, R.betae, R.medicaginis, S.libertiana, S.trifoliorum, S.helianthi, S.nodorum, S.pisi, S.sojina, S.tritici, T.caries, Urm. nigra U.cepulae, Uro.tritici,U.fabae, U.striatus, U.trifolii-repentis, Ust.cynodontis, U.hordei, U.tritici və U.zeae,*
Total	*9*	21	40

According to one such research, the 10 most dangerous among phytopathogenic fungi are *Botrytis cinerea*, *Manaporthe oryzae*, *Puccinia spp*., *Fusarium graminearum* Schwabe, *F.oxysporum*, *Blumeria qraminis* (DC.) Speer, *Mycosphaerella graminicola, Colletotrichum spp, Ustilago mayds* and *Melampsora lini*. By clarifying the information about some of these fungi (*Colletotrichum spp., Mycosphaerella graminicola, Puccinia sp*.), it would be appropriate to try to estimate the specific weight of phytopathogenic species of the mycobiota of fodder plants that are spread or cultivated in Azerbaijan, or rather, the current situation.

First Colletotrichum spp. It can be noted that the fungi of this genus cause anthracnose disease in the host plant, and the analysis of literature data shows that one or more of the cultivated plants in the world are sensitive to the fungi of this genus. These fungi become more active after harvest and can even cause 100% spoilage of the stored product. They are hemibiotrophs, their sexual reproduction is unknown, and plant pathogenic species include *C. capsici, C. gloeosporioides, C. graminicola, C. trifoli,* etc. some are also included.

The fungus *Mycosphaerella graminicola* is a telemoron, and its anamorphic form is the fungus *Septoria tritici*. The name of the disease caused by these two

fungi is called septroiose spot, and in the course of research, it has been found to spread in a number of areas where cereal crops are grown.

Puccinia spp. Fungi cause rust disease in cereals, 3 forms of which are considered particularly dangerous: stem rust (caused by *P. graminis*), striped (yellow) rust (*P. striiformis*) and brown (leaf) rust (*P.triticina*). The participation of *P.graminis* fungus in the formation of phytopathogenic mycobiota of Azerbaijan's fodder plants has been confirmed in the course of research. found.

Taking into account the last mentioned data, when comparing with the phytopathogenic fungi recorded in the fodder plants of Azerbaijan, it is clear that 4 species of the 10 most dangerous fungi (*Botrytis cinerea, F.oxysporum, Blumeria graminis* and *Ustilago mayds*) have been recorded in the course of the research and according to are disease-causing species. The remaining *Colletotrichum spp., Mycosphaerella graminicola* and *Puccinia sp*. In the course of studies, the participation of the pathogenic mycobiota of Azerbaijan's fodder plants in the formation of the pathogenic mycobiota of Azerbaijan's fodder plants has been confirmed in the course of research on species such as *C.gloeosporioides, C.trifoli, P.graminis and Septoria tritici*. In a word, 7 of the 10 most dangerous fungi in the world are involved in the formation of the pathogenic mycobiota of Azerbaijan's fodder plants to one degree or another.

On the other hand, *Alternaria alternata, A. solani, Erysiphe pisi, Rhizoctonis solani, Tilletia caries, Trichothecim roseum, Verticillium dahile*, etc., which participate in the formation of the mycobiota of Azerbaijan's fodder plants. The presence of fungi such as this and the fact that they are dangerous disease-causing agents has also been experimentally confirmed in other studies (Gurbanov., 2009, Mapuranga & *et al*., 2022). It is interesting that recent studies (Yusifova, & *et al.*, 2024) also show that both the number of fungi of this type and their degree of danger continue to increase.

Here, it would be appropriate to touch on one fact, which is related to the fungi belonging to the Fusarium genus recorded in the research. As mentioned, in the studies, 8 belonging to the genus *Fusarium (Fusarium avenaceum, F. culmorum, F. gibbosum (= F. equiseti), F. moniliforme (= Fusarium verticillioides), F. oxysporium, F. solani, F. semitectum (= F. incarnatum) and F. sporotrichioides,)* distribution of the species was determined . All of these fungi, as well as their telemorphic form, the fungus *Gibberella fujikuroi*, are involved in the pathogenesis of Fusarium wilt, the most dangerous disease of the century in fodder crops, especially cereals and legumes, either individually or in various combinations.

In other studies conducted on fungi of this genus, it was determined that 12 of its species (*Fusarium acuminatum* Ellis və Everh., *F.avenasum, F.equiseti, F.falciforme, F.incarnatum, F.oxysporium, F.proliferatum, F.redolens, F. solani, F.tricinctum, F.verticilliodes and F.virguliforme*) have pathogenicity activity and they cause Fusarium root rot in separately and co-sown alfalfa. 7 of the mentioned fungi are found in cultivated or wild fodder plants in Azerbaijan, which gives a serious reason for keeping those fungi in the center of attention and preparing preventive measures against them.

It is true that today it would not be correct to mention that the situation regarding the phytopathogenic mycobiota of fodder plants is so sad, at least because none of the fungi that are the causative agents of dangerous diseases are included in the dominant core of the mycobiota of fodder plants today, and most of them are in the frequency of occurrence. according to it has indicators characteristic of random and rare species. Nevertheless, it is necessary to always keep in mind the situation as a potentially dangerous situation, and it is advisable to implement preventive and ecologically based preventive measures to prevent the spread of fungal diseases. Special attention should be paid to the last issue, i.e. the environmental justification of the prepared measures, which is based on the following considerations.

Firstly, the changes in nature due to the increasing anthropogenic impact on the environment in modern times do not bypass the living things, including plants and fungi, which also cause changes in the interactions formed in plant-fungi relations. To clarify this, it is necessary to pay special attention to the changes in the habitat of plants and fungi, especially to its ecobiological aspects.

Second, there is figuratively speaking an inverse relationship between the flexibility of living things to adapt to changing conditions and the level of development of living things in accordance with changes in the environment. In this regard, fungi are at a lower level of development compared to plants, therefore they adapt to changed conditions faster, that is, the adaptability of the pathogen is higher than that of the host. This also determines the occurrence of resistance events in the end.

Thirdly, a number of fungi are universal due to the characteristics they carry, that is, they are characterized by a wide variety (hemibiotroph and necrotroph) according to the symptoms of the diseases they cause, they can act as endophytes in their interactions with plants, and they can lead the same lifestyle as typical soil saprotrophs. This makes it necessary to develop newer approaches in their study, more specifically, those that allow to determine which of these features are used.

Finally, the last one is based on the use of physical-mechanical, chemical and biological control methods separately, or on the basis of their joint use in different combinations, in the preparation of measures against diseases observed in plants. Although each of the above has its advantages and disadvantages, the control measures based on biological methods and approaches are considered more favorable. Thus, physical and mechanical control measures do not allow obtaining results that will compete with either chemical or biological control methods. Control measures based on chemical and biological control are currently widely used.

Results and discussion

In relation to the above mentioned, in one of the points observed in the research and which will be paid attention to in the future, it should be noted that with the control methods applied during the cultivation of fodder plants, biological and systemic control measures are currently used in the control measures against fungal diseases in the territory of the country. It is not used in a way and it would not be

correct to comment on the effectiveness of those used in episodic cases. In addition, despite the fact that the sources used in biological control are obtained, primarily fungi that are antagonistic to phytopathogens are widespread in Azerbaijan, they are not found in the organization of any product production. Solving all of these should be the main task of future research to solve the problems that arise according to the principles of sustainable development of the country. It can be specially noted that the high-level resolution of the mentioned issues and the preparation of comprehensive measures to combat fungal diseases, as well as the organization of the production of biological agents at the expense of local sources, are among the issues of great importance in terms of the development of the non-oil sector for Azerbaijan, a traditional oil country.

Finally, it would be appropriate to touch on one of the issues to be paid attention to in the future, which is related to the assessment of the danger of natural and agrosenoses due to fungal diseases. So, currently, in the conditions of Azerbaijan, there was no evaluation system that was used or proposed based on serious scientific research. True, in some studies, such attempts are found, albeit for local areas, and according to those evaluation systems, the degree of spread of the disease caused by this or that fungus is taken as a basis. This approach is correct, because the degree of spread of the disease is one of the main indicators in terms of evaluating the phytosanitary status of the senoses, but the research materials used in those works cover specific areas, not all of Azerbaijan, and are useful from the point of view of the general impression. For this reason, it is also appropriate to continue research aimed at developing a more perfect evaluation system in the future.

Thus, from the results obtained at this stage of the research, it became clear that phytopathogenic fungi actively participate in the formation of fodder plants and are characterized by a wide variety both in terms of their frequency of occurrence on individual plants, as well as the names and symptoms of the diseases they cause, and among the recorded phytopathogenic fungi, fungi biotrophs, necrotrophs, and hemibiotrophs are also found, and a more sophisticated evaluation system should be developed in the future to determine their vulnerability.

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