Characteristics of mycobiota in some cultivated plants by species composition and frequency of occurence in the conditions of Azerbaijan

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Abstract. The mycobiota of various plants used for food and fodder purposes in Azerbaijan was studied in the presented paper. It was shown that 127 species of fungi participate in formation of the mycobiota from 19 species of the studied plants, 115 species of which belong to fungi (mycota) and 12 species belong to mushroom-like organisms (chromistan fungi). 38 species of reported mushrooms can spread throughout the territory of Azerbaijan, and their frequency of occurrence ranges from 3.4 to 54.3%. Among the fungi characterizing by distribution on a certain plant, as well as by various indicators of the frequency of occurrence, there are species (Botrytis cinerea, Erysiphe communis, Fuzarium oxysporum F.moniliforme, F.solani, Uromyces pisi, Vertisillium dahlias and others) that cause dangerous diseases in cultivated plants. The results obtained during the research are important from the point of view of taking preventive measures to limit the activity of phytopathogenic fungi in the future.

1 Introduction

Plants are an indispensable source of nutrition for all living beings, including humans. Therefore, regardless of the goal, obtaining a sufficient amount of vegetable products is one of the important tasks of the modern era [1]. As a logical result of this, both fundamental and practical research is being carried out in this area.

High-yielding plant varieties have been developed in the studies carried out so far. At present, food and feed are primarily obtained from them, and thus efforts are being made to solve the food shortages that are clearly felt today in some parts of the world. Despite this, some of the products received every year are either directly lost or unusable for various reasons [2, 3]. There are different reasons for this. Diseases caused by various organisms occupy an important place among them [4, 5] and it is no coincidence that extensive research is being carried out around the world to prevent this [6, 7]. It is considered an obvious reality that this issue cannot be resolved by any particular country. Among this type of pathologies, diseases caused by fungi are of particular importance. Firstly, because today the proportion of fungi is the highest among all living things, that causes various pathologies on plants[8].

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Secondly, the yield loss during the euphotia of a disease caused by one or another fungus can reach 100%.

In order to prevent diseases caused by fungi, it is very important to carefully study them, study their growth and development, the laws of their distribution, and develop effective measures to combat them.

Much attention is paid to cultivation of agricultural crops, including food, fodder and medicinal plants, in the Republic of Azerbaijan. For this reason, the aforementioned problems are not new for our country, and studies conducted to research them confirm this [9]. Most of the research was devoted to the study of pathogenic fungi that cause diseases in fruit trees and tree species that are main for medicinal plants. Despite this, no systematic study of the mycobiota of plants widely grown in Azerbaijan for food and fodder purposes has been found.

Therefore, the goal of the presented paper was to study the mycobiota of some plants grown in Azerbaijan for food and fodder purposes, in terms of species composition, frequency of occurrence, and ecologotrophic relationships.

2 Materials and methods

To achieve this goal, samples of vegetative and generative organs of some plants (19 species) grown in the economic regions of Azerbaijan, such as Absheron, Aran, Ganja-Gazakh, Guba-Khachmaz, Lankaran and Zagatala-Sheki and which were assumed to be fungi were taken and analyzed according to the intended purpose in 2015-2020. For sampling, both the planned route method (widely used in the course of mycological studies) and methods for selecting permanent sites for stationary observations were used [10]. Sampling was also carried out according to the seasons of year. During the study, about 1,000 samples were taken and analyzed. During sampling, there were taken samples of plants belonging to the same species (more precisely, to the same variety belonging to this species), but grown in different areas.

Standard media (malt juice, rice agar, starch agar, potato agar and Czapek agar) prepared in accordance with the appropriate methods used in mycological studies were applied to breed fungi in pure cultures. Samples that probably contained fungi were transferred to a nutrient medium, placed in a thermostat (260°C) for a certain period of time (up to 10 days) and stored until a colony formed. After formation of a colony or heap of mycelium, due to visual purity, they were again transferred to a clean medium, and this process continued until a pure culture was obtained. The purity of a culture was controlled using a microscope. During the whole process, the date of colony formation, shape, color, color of back side, smell, shape of mycelium, formation of conidia and other derivatives, as well as their shapes, sizes, etc. were noted, and identification of the fungi was carried out mainly according to the determinants compiled based on cultural, morphological and biological features.

The frequency of occurrence of fungi was calculated using the following formula: $P=(n/N)x100$

Here, P is the frequency of occurrence; n is the number of fungi recorded; N is the number of samples.

3 Results and discussion

As a result of the analysis of the samples taken from some cultivated plants grown in the territory of the above-mentioned economic regions of Azerbaijan, it was found that the number of species of fungi and mushroom-like organisms distributed on the studied plants is 127.

Such genera as Aspergillus (8 species), Fusarium (8 species), Penicillium (10 species), Puccinia (9 species) and Septoria (8 species) are represented by the most common species among the fungi recorded. The number of species of other genera involved in formation of the mycobiota of the studied plants ranges from 1 to 6. When determining the proportion of fungi in formation of the mycobiota of certain plants, it became clear that the M.sativa plant is characterized by a richer mycobiota. Thus, the fungi included in the mycobiota of this plant make up 21.3% of the total number of recorded species, i.e. this plant is a more "tasty" food source for fungi, as well as their pathogenic representatives. The mycobiota of tomatoes and melons can also be considered rich, since their share in the total mycobiota is 18.1% and 17.3%. Soybeans are characterized by a poor (6.3%) mycobiota, the reason for this lies in the small number of cultivations of this plant in Azerbaijan, and also in the fact that its cultivation period is short. The genera represented by the majority of species was mentioned above.

It should be noted that both anamorphs and teleomorphs of sac fungi have been found in the studies. Thus, it was found that 70.4% of registered fungi belong to anamorphs (44.9% of the total mycobiota), and 29.6% belong to teleomorphs (18.9%) of sac fungi.

The frequency of occurrence is considered one of the important indicators for clarifying the functions performed by fungi in a particular cenosis. For this reason, there was also considered appropriate to define it during the study.

Only 38 species (Alternaria alternata, A.radicina, A.solani, Ascochyta cucumeris, Asc. lycopersici, Asc.pisi, Asc.trifolii, Aspergillus fumigatus, A.niger, Grass bloomeria, Botrytis synerea, Cladosporium herbarium, Colletotrichum trifoliy, Common erysipelas, Fusarium oxysporum, F.moniliform, F.solani, Mucor mucedo, M.racemosus, Penicillium marten, P.chrysogenum, P.notatum, Phoma destructive, Phytophthora infestans, Pythium debarianum, Rhisopus nigricans, Rhizoctonia solani, Sclerotina libertiana, Septoria pumpkin, S.glycines, S.lucopersici, S.nodorum, Trichoderma virid, Trichothecime pink, Uromyces pisi, U.trifolii-repentis, Vertisillium dahliae and V.lycopersici) of the fungi recorded during the study were distributed in all areas of research in Azerbaijan, of which 5.3% belong to the division of Oomycota, 7.9% belong to Zygomycota, 7.9% belong to Basidiomycota, and the rest (78.9%) belong to Ascomycota. The frequency of occurrence of these fungi in the study areas ranges from 7.8-54.7%.

According to some researchers, for the frequency of occurrence, 40-50% or higher are considered the dominant species, from 10 to 40% are considered the most common ones, and less than 10% are considered occasional or rare species for the studied biotope. Considering that this idea more accurately characterizes the distribution of fungi in a biotope, its use in this study was also considered appropriate. Accordingly, only 5 species of fungi recorded during the research and included in the mycobiota of the studied plants, A.niger (54.3%), B.cinerea (41.3%), F.oxysporum (41.6%), P.martensii (43.5%) and V.dahlias (44.7%), can be considered dominant.

17 species of nominal mushrooms can be characterized as common species, which became possible due to the frequency of their occurrence: collodion (19.3%), A. radicina (16.7%), fungus (31.7%), ASA.lycopersici (15.4%), A. fumigatus fungus (24.5%), Cladosporium herbarum (16.7%), F. moniliforme fungus (29.8%), F. solani (14.3%), M. mucedo (21.4%), M. racemosus (18.2%), P. chrysogenum (30.6%), notatum P. (23.7%), phomosis destructiva (4.8%), humidity (22.9%), T. viride (32.4%), B. Lycopersici (23.5%).

The number of random species is 16, and their frequency of occurrence is characterized as follows: Ascochyta cucumeris (7.9%), Asc.pisi (8.6%), Asc.trifolii (8.7%), Blumeria graminis (5.3%), Colletotrichum trifolii (5.1%), Erysiphe communis (6.1%), Phytophtora infestans (8.6%), Pythium debarianum (5.8%), Rhizoctonia solani (3.6%), Scl.libertiana (8.9%), Septoria cucurbitacearum (6.3%), S.glycines (8.4%), S.lucopersici (5.4%), S.nodorum (3.4%), Trichothecime pink (4.5%) and U.trifolii-repentis (9.3%).

It should be noted that only 38 of the 127 species recorded during the study were found in all areas where the studied plants were grown. Among these fungi, there are dangerous phytopathogens, such as Asc.lycopersici (ascochyta-leaf spot), A.alternata (blackspot), B.cinerea (gray rot), Erysiphe communis (powdery mildew), F.moniliforme (fusarium), F.oxysporum (fusarium), F.solani (fusarium), Phoma destructiva (phoma), Ph.infestans (phytophthora), V.dahlias (wilt), V.lycopersich, U. pisi (rust) and others. In addition, other pathogenic microorganisms not found in all areas were recorded as well. Fungi such as Erysiphe cichoracearum, Fusarium gibbosum, Olpidium brassicae, Puccinia recondita, Sclerotinia sclerotiorum, Uromyces pisi and others can be shown as an example of this. According to the literature, the productivity of host plants can be reduced by 10-50% as a result of diseases caused by these fungi. In the current situation, this is an undesirable crop loss. Although their frequency of occurrence is characterized by a specific indicator (12-28%) of the species frequently occurring in different economic regions (12-28%), today their frequency of occurrence in Azerbaijan is characterized as random species (0.02-5.7%). Although this indicator allows us to note that the general phytosanitary situation in the country is not yet dangerous, taking of preventive measures to limit the activity of phytopathogenic fungi should be considered a necessary condition today.

4 Conclusions

Thus, it was found from the studies carried out that during formation of mycobiota in 19 plant species grown in Azerbaijan for food, fodder and medical purposes, there were recorded 127 species of fungi, of which 90.5% belong to true fungi (Mykota or fungi) and 9.5% belong to mushroom-like organisms. Only 38 species of recorded fungi can be distributed in all areas where the studied plants were grown. Among the fungi which are characterized by different indicators both in their distribution on individual host plants and in the frequency of occurrence, there are also species that cause dangerous diseases in plants. Along with creating a certain impression about the mycobiota of plants grown in Azerbaijan, the results obtained during the research are also important for taking preventive measures in this direction in the future.

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