Advanced Studies in Biology, Vol. 15, 2023, no. 1, 163 - 171
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https://doi.org/10.12988/asb.2023.91753

Characterization of the Mycobiota of Some Cultivated Plants in Azerbaijan According to Species Composition and Diseases Caused by Pathogenic Species

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Abstract

In the conducted studies, the mycobiota of various (vegetables, melons and fruits) plants cultivated in Azerbaijan were studied according to their species composition. It became clear that 216 species were distributed on the studied plants. 95.4% of recorded fungi belong to true fungi (*Mycota* or *Fungi*) and 4.6% to fungus-like organisms (*Chromista*). 17 types of recorded fungi belonged to epiphytic mycobiota, 35 to true biotrophs, and the rest were related to facultatives, which are prone to pathogenicity to one degree or another. It has been determined that the fungi

involved in the formation of pathogenic mycobiota cause rust, powdery mildew, rust, spotting, decay, wilting and other diseases, and their prevalence is not at a dangerous level today. Thus, the prevalence rate of diseases caused by them is 12.5% in total. Although this indicator is not considered a dangerous limit from the phytopathological point of view, the presence of the most dangerous species for plants among the registered disease agents makes it possible to point out that it is appropriate to focus on the situation.

Keywords: cultivated plants, mycobiota, species composition, pathogens, spread rate

Introduction

It's no secret that plant-based products are an indispensable component of people's diet. Therefore, in the studies conducted in terms of providing the population with fruits, fresh vegetables and melon products, plant varieties with high productivity have been created, and currently they are widely used in the purchase of targeted products. Nevertheless, a certain part of the products obtained every year is lost due to various reasons, among the main reasons for this, diseases caused by various living things occupy an important place [13]. It is no coincidence that today there are extensive researches on its prevention all over the world [14, 18], and today this issue is one of the tasks that cannot be solved within any specific country. Thus, the role of the border factor in the spread of diseases caused by microorganisms is not so great.

Among these types of diseases, those caused by fungi are of particular importance, at least because the loss of yield during the epiphytoty of a disease caused by this or that fungi is sufficient, [10] and sometimes even results in this product being completely useless. In general, it is estimated that at least 10% of the world's crop production is lost due to fungal diseases, which is expressed in millions of tons[2]. On the one hand, this loss cannot be considered acceptable if take into account the constant increase of the world population within a stable area, and on the other hand, the emergence of global ecological problems. Naturally, in order to prevent the diseases caused by fungi, it is very important to comprehensively study them in various aspects (cultural-morphological, ecological, physiological-biochemical, etc.), and to prepare effective measures to combat them. At the beginning of all of these are their species composition and ecological relationships.

The important place of the agricultural sector in the economy of the Republic of Azerbaijan, the extensive cultivation of vegetables, melons and fruit plants [6] allows us to note that the mentioned issues are not alien to our country either. Thus, the richness of its nature and the diversity of natural climatic conditions have led to the spread of a number of disease-causing fungi in Azerbaijan, and many studies have

been conducted on their study [1, 12], however, the conducted studies do not allow us to say that the vegetable, melon and fruit plants that are widely cultivated in Azerbaijan are fully covered in the phytopathological aspect.

Therefore, the purpose of the presented work was devoted to the study of the mycobiota of vegetables, melons and fruit plants cultivated in Azerbaijan according to the species composition and ecolotrophic characteristics of phytopathogens.

Material and mehtods

Research has been conducted since 2017 in various economic regions of the Republic of Azerbaijan (Absheron-Khizi, Guba-Khachmaz, Lankaran-Astara, Mil-Mugan, etc.). For this purpose, samples were taken from the vegetative and generative organs of vegetables (cultivated in open and covered conditions), melons and fruit plants cultivated in the mentioned areas and were analyzed according to the set goal. In taking samples, were used methods of selecting permanent areas for planned route and stationary observations, which are widely used in the course of mycological research [11]. In total, more than 1100 samples were taken and analyzed during the research.

For the taking fungi to the pure culture were used standard nutrient mediums (Suslo agar, Saburo agar, Potato agar, agarized Czapek medium). The media were prepared, sterilized and poured into Petri dishes according to known methods [11]. A sample suspected of having a fungi is transferred to a nutrient medium and placed in a thermostat (26^0C) for a certain period of time (up to 10 days) until a colony is formed. After a colony or clump of mycelium is formed, it is re-inoculated into a clean medium for visual purity, and this process is continued until a pure culture is obtained. The purity of the culture is monitored with the help of a microscope. During the whole process, the day of colony formation, shape, color, color of the back side, smell, shape of mycelia, formation of conidia and other derivatives and changes in their shapes, sizes, etc. are recorded, and identification of mushrooms is carried out based on the determinants[5, 8, 15, 17] drawn up on the basis of cultural-morphological and physiological characteristics. The characterization of fungi according to ecotrophic relationships was carried out by clarifying the observations made in the studies and the literature data.

The prevalence of diseases caused by fungi (P, %) was determined according to the following formula[]9:

$$P=(n/N)x100$$

Here, n is the number of diseased plants, N is the total number of plants sampled.

Results and discussion

From the result of the analysis of samples taken from vegetables, melons and fruit plants cultivated in different areas of Azerbaijan, became clear that the number of fungi distributed in the studied plants is equal to 216, and according to the system given on the official website of the International Mycological Association, their current taxonomic structure is as in table 1. As seen, the majority of recorded fungi, more precisely 95.8%, belong to true fungi (Mycota or Fungi), and a small number (4.2%) belong to fungus-like organisms (Chromista).

Most of the recorded true fungi, more precisely 67.0% (64.4% of total fungi) belong to Ascomycota, 26.0% (25.0%) to Basidiomycota, 6.8 % (6.5%) belongs to zygomycetes (Mycormycota).

Among the recorded fungi, a number of genera participate in the formation of the mycobiota of the studied cultivated plants with a number of 10 or more species, here includs genera *Aschochyta (11 species), Colletotrichum (14 species), Fusarium (11 species), Penicillium (12 species) and Septoria (12 species)Aschochyta (11 species), Colletotrichum (14 species), Fusarium (11 species), Penicillium (12 species)* and *Septoria (12 species*)

Table 1. Ttaxonomic structure of the fungi isolated during the research

				Class	Order	Family	Genus (species)
Chromista		Oomycota		1	1	1	3(9)
Fungi or Mycota	Mucor-myceta	Mucormycota	Mycormycotina	1	1	2	4(14)
	Dicaria	Ascomycota	Pezizomycotina	5	10	16	44(139)
		Bazidiomycota	Agaricomycotina	3	5	8	12(37)
			Puccinomycotina	1	1	2	4(15)
			Ustillagonomy-cotina	1	1	1	1(2)
Total				9	21	33	68(216)

As mentioned, samples were taken from different plants in the studies, and the distribution of recorded fungi on those plants was also different(tab.2). As seen, among the sampled vegetable plants tomatoes, melon plants melon, and almonds among the fruit plants, are characterized by a relatively rich mycobiota. This allows us to note that the constituent elements of the mentioned plants are a convenient source of food for a wider group of fungi.

Being heterotrophic organisms, fungi obtain the organic matter they need from materials belonging to organisms with different biological conditions, which has led to the formation of different relationships between them and food sources[3]. According to these relationships, which are generally characterized as ecotrophic relationships, fungi are characterized from different aspects. Depending on the

relationship between plants and fungi, fungi form either epiphytic or pathogenic mycobiota [19]. When characterizing the fungi recorded from this aspect, became clear that a total of 17 species of fungi could be attributed to the epiphytic mycobiota. These fungi belong to genera such as *Aspergillus, Cladosporium, Mucor, Penicillium, Trametes* and *Trichoderma* and there is no literature information about them causing any pathology. The remaining fungi directly or indirectly cause some pathology in plants. From an ecotrophic point of view, fungi involved in the formation of pathogenic mycobiota, belongs either true biotrophs or facultative. If we characterize the registered fungi from this point of view, becomes clear that a small part of the fungi belongs to true biotrophs. Thus, a total of 35 types of fungi recorded in the research belong to real biotrophs and it has been determined that species such as *Armillaria mellea, Fomes fomentarius, Erysiphe cichoracearum, E.communis, Gymnosporangium clobrozrakovae, G.comutum, G.sabinae, G.tremelloides, Perenospora barassicae, Phytophtora capsici, Ph.citrophtora, Ph.infenstas, Ph.melangenae, Ph.parazitica, Plazmopara cubensis, P.parasitica, P.destructor, Podosphaera fuliginea, P.leucotricha, Puccina allii, P.amygdalus-iridis, P.capsici, P.cucumeris, P.graminis, P.menthae, P.petroselini, P.porri, P.pruni, P. ribesii-caricis, Sphaerotheca pannosa, Taphrina deformans, Transchelia prunispinosae, Uromyces brassicae, Urosystis brassicae* and *U.magica belong* to them.

Table 2. Distribution of fungi on plants

Plants	Taxonomic relationship of fungi species				Total
	Oomycota	Mucormycota	Ascomycota	Bazidiomycota	
Vegetable plants					
Potato	1	0	11	2	14
Tomato	3	0	24	1	28
Cabbage	1	0	8	0	9
Eggplant	2	2	18	1	23
Pepper	1	0	12	1	14
Cucumber	2	5	17	1	25
Others (greenery)	4	4	15	4	27
Melon plants					
Water-melon	2	1	21	2	26
Melon	2	1	23	2	28
Pumpkin	1	2	12	2	17
Fruit plants					
Almond	0	4	10	17	31
Apple	0	2	12	14	28
Pear	0	1	10	12	23
Peach	0	2	9	10	21
Plum	0	1	8	11	20
Others	5	4	20	17	46
Total	10	14	138	54	216

Most fungi belonging to biotrophs have substrate specificity. For this reason, the prevalence of diseases caused by these fungi is generally not higher than 1.5% for all studied plants. The reason for its existence should be sought in their hosts.

Diseases caused by fungi, characterized as facultatives, are characterized by a wide variety both in number and in terms of the symptoms of the diseases they cause. The diseases such as spotting (white, brown, gray, black, etc.), wilting (fusarium and verticillosis), various color rots (white, brown, gray, mixed, etc.), mold, etc. One or more species are involved in the formation of these diseases.

Among the diseases caused by facultatives, the most widespread is the spotting disease, which is caused by species belonging to the genera *Alternaria, Aschochyta, Cercospora, Gloeosporium, Phyllosticta, Ramularia, Rhytisma* and *Septoria*. The prevalence of diseases caused by these fungi ranges between 7.5% in total. According to the rate of spread of diseases spot caused by fungi belonging to the genus *Alternaria* are with the highest indicator, and with the lowest indicator *Rhytisma*. In terms of the distribution of the disease on separate groups of plants, the spread of the spotting disease in the field-grown vegetable plants is characterized by a higher indicator. So, in general, the spread of the spotting disease in vegetable plants is 8.6%, in fruit plants 6.4%, and in melon plants 2.5%.

In the second place according to the distribution is the decay disease, which manifests itself in different colors, caused by fungi belonging to facultatives. İn the formation of this diseases are participates all xylotrophic macromycetes(*Fomitopsis, Phellinus, Laetiporus, Ganoderma, Inonotus*, etc. genera), fungi belongs to the genera of *Botrytis, Sclerotinia, Thanatephorus*, and ect. Although the prevalence rate of diseases caused by these fungi is 4.7% for all studied plants, while decay diseases caused by xylotrophic macromycetes have a higher prevalence (6.4%) in fruit plants, the decay caused by them is not found in vegetables or melon plants. The prevalence of diseases caused by fungi belonging to the genera *Botrytis, Sclerotinia, Thanatephorus* and others is relatively higher in vegetable plants and is 6.9% in total.

The wilt disease caused by fungi belonging to the genera *Fusarium* and *Verticillium* is in the third place according to the prevalence their overall distribution rate is 2.5% for vegetable plants, 1.2% for melon plants, and 0.1% for fruit plants.

In general, the prevalence of diseases caused by all fungi is 12.7% for vegetable plants, 9.8% for melon plants, and 14.5% for fruit plants. When these indicators are summarized for all studied plants, the prevalence of diseases is 12.5%.

It should be noted that the phytopathological assessment of the various studied plant groups is mainly based on the spread of the prevalence of registered diseases [16] and on the basis of the most decisive means of struggle in this matter is to identify it earlier. These have been confirmed in various researches[7], as well as in normative documents. Currently, if we evaluate the vegetable, melon and fruit plants studied in a phytopathological aspect according to the documents available in a number of countries, including Azerbaijan, there are no serious grounds for the situation to be dangerous, and the situation can be assessed as normal. Thus, the fact

that the prevalence of the disease is generally higher than 20% makes it necessary to take the situation seriously. This was not the case in our research. Nevertheless, the inclusion of dangerous species belonging to the genera Alternaria, Botrytis, Erysiphe, Fusarium, Phytophtora, Puccinia, Verticillium and other genera, and even the 10 most dangerous disease-causing species(Botrytis cinerea, Fusarium graminerum, F.oxysporium) for plants, gives reason to note that there are aspects of the phytopathological situation that will cause danger.

Nevertheless, the inclusion of dangerous species belonging to the genera *Alternaria, Botrytis, Erysiphe, Fusarium, Phytophtora, Puccinia, Verticillium* and other genera, and even the 10 most dangerous[4] disease-causing species(*Botrytis cinerea, Fusarium graminerum, F.oxysporium*) for plants, gives reason to note that there are aspects of the phytopathological situation that will cause danger. This, in turn, makes it necessary to continue research in the mentioned direction according to the requirements of the modern era.

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Received: September 17, 2023; Published: October 2, 2023