



The obligat parasites which spread in the micobiota of the tomato plant in the open condition in the western region of Azerbaijan

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Abstract

The study noted the biological characteristics of *Phytophthora* and powdery mildew, the main diseases of the tomato plant belonging to the family Solanaceae in the open field, and their development on the basis of route studies. Under the influence of abiotic and biotic stress factors in this region, *Phytophthora* disease is formed and develops in plantations and causes 30-40% of crop loss. Powder dew, which used to be rare, has recently become more widespread. This includes the amount of precipitation, the optimal temperature and others can cause. As a result of the research, it was determined that the conidia of the fungus form under cover conditions, conidia and cleistotes are formed in the open field.

Keywords: pathogen, open ground, fungus, obligat, tomato, *Phytophthora*, parasite

Introduction

The growing demand of the Azerbaijani population for vegetable products has created a need to expand their cultivation. Therefore, along with other vegetable crops, measures are being taken to increase the volume of tomato plantations in the country. In order to get a rich harvest from tomato crops, it is important to take measures to control its diseases, pests and weeds. During the research, it was determined that the productivity of tomato crops of vegetable farms of the republic decreases by 55-60% annually in the areas where pest control is not carried out. This has a negative impact on the economy of farms. Studies of tomato crops have shown that pests play an important role in reducing productivity. Since the tomato plant produces with constant flowering during the growing season, its pathogens can be observed at all stages of plant development. Therefore, the use of various elements of integrated pest control measures in tomato crops is considered more appropriate. On the other hand, since tomatoes are a food product, the fight against fungal diseases needs to be environmentally and economically efficient.

The purpose of the Research

Due to the study of widespread obligate parasites in tomato plants grown in open fields in different areas of the region, the biological characteristics of these fungi were also studied in detail.

Materials and Methods

All inpatient and laboratory experiments related to the study of the main diseases of the growing season of tomatoes grown in the open field in 2020-2021 were studied at the experimental base and plant clinic of the Department of Plant Protection of Azerbaijan State Agrarian University. According to the methodology of K.M. Stepanov and A.E. Chumakov, observations in the field of stationary experiments were carried out systematically not later than every 10 days during the entire vegetation period of the

plant. As a result, the initial stage of the disease and the subsequent stages of its development are clearly defined.

Tomatoes are one of the main vegetable crops in Azerbaijan, as well as all over the world. Tomato (*Lycopersicon esculentum* L.) H. Karst belongs to the family of eggplants (Solanaceae) and it is a household vegetable which has a wide range of applications. His homeland is Chile, Peru and Ecuador, which cover a narrow strip of the Galapagos Islands and the Pacific coast of South America. The first mention of tomatoes by European botanists dates back to 1553-1554. Today, tomatoes are grown in covered and open ground condition on almost all continents and countries. Tomato plants are infected with *Phytophthora*, alternariosis, septoriosis, powdery dew and bacterial-viral diseases in different regions of Azerbaijan, depending on soil and climatic conditions, from the minimum level to epiphytosis. As a result of the research, 15 non-infectious, 6 viral, 4 bacterial, 5 false fungal and 16 fungal diseases were registered on the tomato plant. The prevalence of *Phytophthora*, alternariosis, powdery dew, cladosporiosis, hill rot, mosaic virus diseases has increased. These indicators show that pathogens are becoming more aggressive breeds and specialize in cultivated plants.

It should be noted that *Phytophthora* was the first source of danger for potato crops. Russian scientist Y.T. Dyakov writes that *Phytophthora* is a global problem and a real source of problems for plants of the Solanaceae family. In 1995, a major international scientific conference called *Phytophthora-150* was held in Dublin, Ireland. The genius German botanist Anton de Bari, who first described the causative agent of *Phytophthora*, named it *Phytophthora infestans* - an infecting the plant. Phytopathologist A.K. Akhatov notes that *Phytophthora infestans*, the causative agent of *Phytophthora* in tomatoes, was first described in 1847. It is an extremely harmful disease in the humid years in the open air. Not only leaves and stems rot, but also fruits, they lose their marketable appearance. Infected plants are destroyed immediately. In the case of early infection of plants, the crop can be completely lost. A group of Russian scientists V.V. Grisenko, Y.M. Stroykov, N.N. Tretyakov,

V.A. Shkalikov, O.O. Beloshapkina, D.D. Bukreev and others, Alison E. Robertson, O.O. Beloshapkina write that fungi, including those that cause *Phytophthora* in tomatoes, and its development depends on its parasitic activity, temperature, humidity and oxygen supply from the environment. Speaking about *Phytophthora* in tomatoes grown in the open, the authors note that the disease is more dangerous for late-maturing varieties grown in the second half of summer and autumn. One of the most widespread and dangerous diseases for tomato plants in the western part of Azerbaijan is *Phytophthora*. As a result of the research, it was determined that *Phytophthora* is in a different position in the tomato plantations of the western part of the country due to the prevalence and damage. In some cultivated plants of the family Solanaceae, *Phytophthora* disease is caused by Chromista, Oomycota department, Oomycetes class, Peronosporales, Pythiaceae and infestans which belong to family *Phytophthora*. In order to determine the prevalence of *Phytophthora* on tomato plants, both inpatient experiments were conducted on the relevant methodology during the research years, and route inspections were conducted on tomato plantations of various farms in Samukh, Goranboy, Shamkir and Tovuz regions. According to the methodology, during the research, observations were made in 10% of the cultivated areas in the villages, and the prevalence of *Phytophthora* was determined. It should be noted that the spread of the disease is its quantitative analysis, when determining the spread of the disease, only sick and healthy plants are recorded, thus this indicator does not include the degree of infection. Of the plants under general observation during the spread of the disease, only diseased plants are generalized. It is impossible not to mention the 4 stages in the process of pathogenesis, thus the formation and development of the disease: the transmission of the pathogen, plant infection, incubation, the onset of the disease and its development. In order to properly assess these 4 stages, route inspections were conducted 3 times in tomato plantations of Ganja-Gazakh region according to the relevant methodology. Taking into account the nature of each disease at a certain stage of development of the plant, in order to determine the infection of *Phytophthora*, route inspections are carried out one month after the transfer of seedlings to the field, ie on May 18-20. The flowering period of plants is approximately the last of June and the harvest period is in the beginning of the second decade of July. Route inspections and inpatient experiments show that in order for *Phytophthora* disease to occur in tomato plantations, the host plant-tomato and the pathogen-*Phytophthora* infestans de Bary must be in contact. Its occurrence and significant development depends to some extent on the source of infection, the size of the inoculum, the ability to cause the disease. The source of the primary infection should not be overlooked when maintaining the primary infection from one season to the next. Because our many years of research have confirmed that any disease, including *Phytophthora*, occurs with the initial supply of infection and its germination. When *Phytophthora* infection of plants belonging to the family Solanaceae was studied, it was confirmed that 3 components are involved in the occurrence of infection: the pathogen - *Phytophthora* infestans, the host plant- the environmental conditions which tomato disease occurs. The process of infection itself ends with certain stages; the period before the pathogen enters the plant; entry period; the period after entry. Our

observations and research show that the nature of the passage of each period depends on the pathogenic characteristics of the fungus *Phytophthora* infestans, the protective reaction of the tomato plant and its physiological state. Among the environmental factors, the average daily air temperature, precipitation, and relative humidity play a major role. The presence of dew and dripping water on the surface of the plant is the basis for the infection of plants belonging to the family Solanaceae with *Phytophthora*. They germinate in drops of water. Our experiments show that without a drop of water, even in 100% relative humidity, the spores of such a pathogen cannot germinate. However, the adequacy of the conditions in the region is characterized by the strong prevalence of *Phytophthora* in seasonal crops. It should be noted that the process of infection begins with the entry of the pathogen into the plant, because the pathogen begins to spread in the body of the plant and the host plant (tomato, etc.) interacts, initiates the pathological process, but the process goes secretly. After a certain period of time after infection, the initial symptoms of the disease appear. Therefore, the period from the moment of infection of the plant with the pathogen to the appearance of the initial symptoms is called the incubation period. The length of the incubation period is of great importance in the general course of the disease. The shorter it is, the faster the disease spreads. Thus, the initial symptoms of the disease are formed at the end of the incubation period. At the end of the initial symptoms, the diseased plants become a source of infection. The causative agent of the disease begins to infect healthy plants, they become infected. In 2020-2021, while conducting research in the laboratories of the Plant Clinic of the Department of Plant Protection of the Azerbaijan State Agrarian University, using numerous biological methods, it was determined that the species belonging to the genus *Phytophthora* have a well-developed multinucleated mycel. Studies of certain species have shown that sympodial branching zoosporangia differ from vegetative myceli in appearance.



Fig 1: Conidia carriers and conidia of the fungus *Phytophthora* infestans

The genus *Phytophthora* infestans, which causes *Phytophthora* in tomatoes, has a parasitic lifestyle and belongs to the group of biotrophic organisms, being obligate parasites. *Phytophthora* infects various organs of the tomato plant. However, before infection, it should be noted that the technology of cultivation of tomato plantations grown in the open ground should be more advanced, everything can be regulated in a greenhouse, especially in greenhouse-controlled greenhouses, even weather and climatic factors. However, as with all plants grown in the open, it seems impossible to regulate the conditions for growing tomatoes. In particular, it is impossible to regulate wind, rain, frost, air and soil dryness due to climatic factors. In the field, the

average daily temperature often rises above 25°C and the relative humidity decreases accordingly, and global warming elements create conditions for the tomato plant to be under constant stress. At this time, the plant's resistance elements are weakened, the immune mechanism does not work, the biotrophic organism *Phytophthora infestans*, which lives a parasitic lifestyle and is sensitive to feeding on various organs of the plant, is formed, spreads quickly and causes high damage. Therefore, it should be noted that the technology of cultivation in many cases depends on the variety. Tomatoes grown in the open field are superior to any variety and hybrid in greenhouse in terms of aroma and other taste qualities, but lag behind in terms of commodity. If the commodity damages the appearance, then it is possible to understand how great the damage of this disease is. Any disease begins with a change in metabolism, followed by anatomical and morphological transformation of plants. For a while, the signs and symptoms of the disease do not appear. This feature is due to the limited response reaction of the plant to adverse factors. In addition, the issue of plant resistance to disease should be highlighted. Immunity is understood as complete insensitivity to the disease under any favorable conditions, with sufficient inoculum care and the presence of the pathogen. However, phytopathologists use the concept of sustainability more. This is a relative concept. Sustainability, like immunity, is determined by heredity, and there are genes of resistance not only against pathogens, but also against adverse environmental factors. The plant may be resistant to the disease or it may acquire an individual developmental cycle. However, it should be noted that the plant's resistance to pathogens and stressors is not absolute.

Experimental Part

The prevalence of *Phytophthora* and powdery dew, which are obligate parasites of tomato plants in open and greenhouse conditions, was studied by route examinations and experiments in different purpose farms of Samukh, Goy-Gol, Shamkir, Goranboy regions located in Ganja-Gazakh region in 2020-2021. The results are given in the following tables.

Table 1: Prevalence of *Phytophthora* and powdery dew in tomato plants

Examination area	<i>Phytophthora</i> Spread%	Powder dew
Samux	44,3	46,7
Goy-gol	51,7	47,5
Shamkir	52,5	48,9
Goranboy	48,9	54,7

During the research as can be seen from the table, 44.3% of *Phytophthora* infection in Samukh region, 46.7% of powder dew, 51.7% of *Phytophthora* infection in Goy-Gol region, 47.5% of powder dew, 52.5% of *Phytophthora* infection in Shamkir region %, powder dew 48.9%, *Phytophthora* infection in Goranboy region 48.9%, powder dew 54.7%.

Route examinations and stationary experiments conducted during the research years (2020-2021) show that large necrotic, scattered, brown spots of various shapes appear on the leaves, stems and fruits of tomato plant. Under favorable conditions, the infected tissue develops a weak white coating consisting of mycelium and zoospores of the fungus. During the years of research, the formation of the

initial symptoms of *Phytophthora* and the development of white coating constantly varies within a certain range, depending on climatic factors. This date falls on June 15, 2020, and June 5, 2021. Of course, this fundamental difference in the development of initial symptoms, as well as the dynamics of *Phytophthora* development in the research years is directly related to weather conditions, especially the average daily air temperature, the amount of precipitation and relative humidity. In this case, the physiological condition of the plant should not be forgotten. For example, in 2020, the symptoms of the disease were registered in the first decade of June, and specifically in the 5th, due to the weather conditions that formed in late May, the first decade of June. Spring rains in the region of 10 mm on 25 May with intervals of 2 days, fluctuations in the average daily temperature between 160-200°C should be considered as the main cause of infection. Without deviating from the main idea, it should be noted that the white coating formed during the above-mentioned infection is formed on the underside of the leaves and on the surface of the fruit. Two years of experience have shown that the stem form of *Phytophthora* is less contagious than that of fruits, but research shows that this idea, which has been formed for many years, is also divided. Recently, in the western part of the country, the infection of plants grown in the open ground has intensified, and the infection is growing according to the dynamics of growth in the form of stems.

For most of the plants belonging to the family Solanaceae, *Phytophthora*, alternariosis, septoriosis, etc. In addition to being equally dangerous, the causative agents of these diseases are oligophagous, but researchers have shown that pathogens such as powder dew can be an exception.

There are favorable conditions for the spread and development of powdery mildew in almost all regions of the country, including the western region. From April to the end of autumn, when the weather cools sharply, some plants of the Solanaceae family develop the disease. At various stages of the growing season, plants can be completely destroyed by depression and peak disease. From this point of view, powdery mildew of tomato plant in the conditions of the Western region has been studied in depth, the biological development characteristics of the pathogen have been studied. *Leveillula taurica* is the sac stage of the fungus that causes powdery mildew in tomato plants belonging to the family Solanaceae. This is because about 30,000 Ascomycota fungi have sac and conidia stages in their developmental cycle. Usually, the fungal bladder stage overwinters, sometimes fulfilling its condition by causing an initial infection in the spring of next year. The functions of the fungus in the conidia stage are a more complex process, in fact the conidia are harmful and allow the spread of the pathogen. The fungus that causes powdery mildew gives 15-20 incubations during one growing season, only the first of these incubations falls on the sac stage, and the others all fall on the conidia stage, regardless of the number. According to the literature, the tomato plant has conidial stages of the fungus that causes powdery mildew, such as *Oidium lycopersicum*, *Oidiopsis taurica*. How powder dew is developed in tomato plants, how the biological development characteristics of the pathogen differ from those described in the literature, certain experiments and researches have been conducted during the research years to find answers to these and other questions. A typical tomato farmer in Ganja-Gazakh region, route inspections in family

farms, stationary experiments in experimental farms of Azerbaijan State Agrarian University show that the fungus that causes powdery mildew in tomatoes is a biotrophic parasite, lives only on living tissue. Studies show that powder dew is more characteristic of summer tomato crops, as powder dew predominates in crops grown in September-October. The reason is that climatic factors are more reliable in this period. Although the first symptoms of powdery mildew appear in spring crops in the second decade of May, the conditions in June are ideal for the parasite, with relative humidity of 65-70%, average daily temperature of 22-24°C, occasional summer rains. It is very important for development. Later, with the intensification of July-August temperatures, reaching 32-35°C on some days, the fungus descends, becomes depressed, and from September onwards, the second summer crops begin to grow in the tomato plantations. Samples of white coating removed from the surface of infected leaves under a microscope in the laboratory show the formation of a conidia chain, along with a thin delicate mitseli. The conidia are cylindrical, elongated, measuring 22.8-30.5 µm, 4- It is surrounded by a chain of 6 cones. This pathogen, which has had a larger distribution area in recent years, is a real threat to tomato plantations. According to reports made before the harvest in 2019-2021, the infection in some plantations reaches 35-40%.

Conclusion

1. Studies have shown that tomato plantations are primarily *Phytophthora-Phytophthora infestans* due to the prevalence and harmful nature of the fungus Bary. It causes 30-40% and sometimes more excretion of the product. As an obligate parasite, the causative agent of *Phytophthora* moves to the mouthparts with drops of water on the underside of the leaf to infect young organs, loses its lashes and spreads inside the tissue with a caustic.
2. The route and stationary examinations carried out in the western region of Azerbaijan showed that many pathogens were spread in tomato crops. Among these diseases, it was found that true powdery mildew, which had previously been of no economic importance, was predominant due to its prevalence and harm.
3. During the study, it was found that the fungus forms a conidia in the greenhouse, and both conidia and cleistothecia (fruit body) in the open field.
4. In the Ganja-Gazakh region, the causative agent of powdery mildew gives 5-6 generations per year, depending on environmental conditions.

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