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Diseases of Tomato in the Conditions of Azerbaijan

Jabrayil AGHAYEV
Institute Dendrology of Azerbaijan National Academy of Sciences

Samadova EZET
Institute Dendrology of Azerbaijan National Academy of Sciences

Abstract: According to research 2001-2018 in Absheron, Lankaran-Astara and Guba- Khachmas regions dynamics and spread of major malware disease progressed. Among the most harmful diseases, as *Phytophthora infenstans (M.) de Bary*, *Phytophthora SP.*, *Alternaria solani Sor. Alternaria alternata*, aggressive species from the genera of *Fusarium and Vertisillium*, *Pseudomonas sp.* causing wilt of seedlings, fruit rot of different origin, mosaic and leaf curling caused by viruses, gall nematodes (*Meloidegine incoqnita, M. arenarea*).

Keywords: Tomato, Diseases, *Phytophthora infestans, Alternaria solani, Tabasco* etch. virus, *PotatoX* virus

Introduction

The continuous supply of food and vegetable products to the population is an integral part of our food security. In this field, the creation and application of new technologies based on national agricultural traditions is one of the current problems of the day. Thus, plant protection products imported without control and applied without regulation, as well as an unprofessional approach to production, the species composition of diseases and pests that damage farmland have changed, and harmful species have spread (Aghayev, 2018).

Tomato (from the Italian word pomo-d'oro-golden apple) is a plant genus from the *Aubergine* family. They are annual or perennial (in the tropics) grasses and semi-shrubs. His homeland is South America. Wild species are found in Peru, Ecuador and Chile. The tomato genus is divided into three species: common tomato (*Lycopersicun esculentum*), Peruvian tomato (*L. peruvianum*) and hairy tomato (*L. hirsitum*). There are 3 subspecies of common tomato, more than 2000 varieties and forms. Contains 4.5-8.1% dry matter, including 50% soluble sugars, 3.5-8.5% organic acids, sodium, potassium, calcium, iron, phosphorus, ascorbic acid, acetyl-salicylic acid, B1 , B2, PP provitamin, carotenoids, etc. there is The fruit ripens in 80-140 days. Tomato is a heat-loving plant. At temperatures below 15ºC, the plant usually does not flower. Relatively resistant to drought. It is considered optimal that the soil moisture requirement is 75-80%, and the average humidity of the surrounding air is 65-70%. Tomatoes can be grown in most fertile soils. Since tomato is a heat-loving plant, it is mainly cultivated in the central and southern regions. The structure and composition of the soil has an important role in the normal development of plants and resistance to diseases. The tomato plant grows better in light soils with a neutral reaction, rich in humus. Nitrogen, phosphorus, potassium requirements are in the ratio of 1:0.2:0.5. Therefore, phosphorus and potassium, and then nitrogen fertilizer should be applied before transplanting the seedlings to the field. When growing tomatoes in peat, when feeding them with minerals, the ratio of macro and micronutrients in 1 liter of feeding solution should be as follows (mg/l): N-281, P-43, K-392, Ca-176, Mg-64, Sh-36, Fe -1.8, Mn-0.9, Cu-0.1, Zn-0.1, B-0.2, Mo-0.02, Y, Cr, Co-0.01 [26]. Ca-1 mg/l, Mg-0.5 mg/l, HCO3 -3 mg/l in 1 liter of irrigation water should have pH=5.8-6 (Aliyev,1998; Hidayatov & Eyyubov, 2001).

The vast majority of the population engaged in agriculture prefers only chemical control, as they have little information about the new achievements of plant protection science, advanced protection means and methods. This increases the volume of use of toxic chemicals. Compared to 1986-1988, in 2009-2015, the number of pesticides used in open-field potato and tomato production increased from 2-4 to 6-8, and against pests from 2-3 to 7-9. When additional feeding fertilizers and soil fungicides are added, the number of sprayings with chemicals during the season to protect against diseases and pests reaches 12 in potato fields and 20 in tomato production. This situation leads to the pollution of the environment and the soil, and the residual amount of pesticides in the produced products is much higher than the allowed norm. In this case, phytosanitary-threatening products multiply in markets and sales centers (Aghayev, 2018).

In the current conditions, the development and implementation of ecologically clean and phytosanitary control measures for agricultural producers is of national and strategic importance. Considering the effects of pesticides on the human body (this is a problem that is studied at the international level and distinguished by its relevance), the production of agricultural products that meet phytosanitary standards is of particular importance in raising a healthy generation in Azerbaijan.

Potatoes, tomatoes, eggplants and peppers that are used on a daily basis are among the products that are most contaminated with agrochemicals and pesticides, and are considered more dangerous for the body due to their wide acceptance. In recent years, new aggressive disease agents on these plants (Phytophthora, Alternaria, Botrytis, Sclerotinia, Didimella and other fungi, some bacteria, viroids, mycoplasmas belonging to the genera Pseudomonas, Eriwina) have entered the republic, and specialized races and mutants have been created in the existing strains to the agricultural fields. causes serious damage and crop loss (Eyyubov, 1996, 1997).

The species composition of the diseases of plants belonging to the Solanaceae family and the spread of the main harmful species in Azerbaijan were studied in 2001-2020 by route observations conducted in potato, tomato, pepper and eggplant fields in Lankaran-Astara, Jalilabad, Bilasuvar, Absheron and Guba-Khachmaz regions. The analysis of diseased materials collected from the fields was performed in the Phytopathology laboratory of the Absheron Experimental Station of the AzET Institute of Plant Protection, and in the mycology laboratory of the Institute of Microbiology of the Azerbaijan National Academy of Sciences.

Method

In the conditions of Azerbaijan, different determination methods were used to determine the diseases of SSAB. Changes in external signs of plants are based on visual observation methods. After the visible changes were registered, symptoms were recorded, diseased materials were collected and pathogens belonging to bacteria, Chromista, Fungi were analyzed by systematic microscopy, cultivation in a moist chamber, removal to a clean environment, re-infection with the inoculum of the pathogen, and analysis of viruses by enzyme immunoassay (IFA) methods. done and appointed. In the determination of viruses, enzyme immunoassay is the most widespread and most accurate method based on serological methods. The enzyme immunoassay method is based on the use of antibodies registered (tagged) with enzymes (59).

If the analysis of the materials studied by the primary microscopy methods did not yield the desired result in the determination of the pathogen, the samples prepared at 12, 24, 36, 48 and 72 hours of the diseased materials placed in the moist chamber were re-examined and analyzed under the microscope. During the study and determination of diseases caused by Alternaria Phytophthora, Uncinula fungi, Pseudomonas, Erwinia bacteria, the methods of comparative analysis of the symptoms caused by the pathogen in a clean environment, the symptoms caused by the pathogen in the food environment, the microscopy of the pathogen in stained samples and the repeated artificial infection methods were used. . Artificial inoculation was carried out during the period of seedling, bushing, initial flower ball and crop maturity. It was carried out by the methods of spraying with a culture solution of the pathogen's clean environment, brushing with a brush, and introducing inoculum from the injury site.

Artificial infection with fungi belonging to the genera Fusarium, Verticillium, Rhysoktonia, Pythium of soil origin was carried out by mixing the culture solution of the pathogen with the substrate and injecting the inoculum into the damaged areas of the rhizomes. The obtained results were compared with the literature on designation and diseases were determined (Pidoplicko,1977; Vlasov, 1992; Peresypkin, 2009).

Route observations and disease registration were performed 3 times during the season: on seedlings, plants up to the flowering phase, fertile plants, and harvested crop. The analysis and determination of the main harmful

diseases, including root and tuber diseases, was carried out on the basis of the analysis of the materials provided by the producers for diagnosis, as well as on the samples taken at the end of the vegetation and the sorting of the seedlings. Registration and observations were performed on the basis of visual measurement and calculation methods. In the field and in the laboratory, the signs of diseased organs were visualized by recording spots, covering, pycnidia, sclerosia, decay, wilting, drying, swelling, cracks, necrosis, chlorosis and other signs caused by the pathogen on the plant (Aghayev, 2018).

In open conditions, the spread of the main diseases of PB (PBBX) Phytophthorosis, Alternaria, Fusarium, Hill rot and others in separate regions and in the region, the intensity of the spread (degree of development) was determined. The role of predecessor plants, crop rotation system, soil structure irrigation norms and irrigation schemes, sowing or planting times, changes in groundwater level depending on the source of irrigation water in the spread of diseases was studied based on visual observations and analysis of data collected from producers.

Comparative calculation methods of healthy plants and diseased plants were used in the study of the spread of the main diseases that cause wilting, drying, burning, root rots in PB (273). During visual observations, the status of disease infection of 10 plants included in the registration was evaluated. 10-20 samples were selected in a diagonal direction, covering the planting area. The samples were numbered and the results obtained from all the samples were summed up and the average number was obtained. The total number of plants in the samples was calculated by comparing healthy and disease-infected plants using the general spread formula:

$$Y = \frac{n}{N} \times 100 \qquad (1)$$

Here,
Prevalence of Y-disease, in %;
number of wilted or dried plants in n-sample, in numbers;
Total number of N-registered plants, in numbers:
The average result of the results obtained from the stations covering the region

$$P_o = \frac{\sum SP}{S} \qquad (2)$$

Here,
Po- the average prevalence of the disease in the area, in %;
∑SP- the sum of products of disease prevalence of areas;
Total size of S-viewed fields.
The average prevalence level of the calculated disease in the area and region was determined [272].
Spotting, coating, wounds, pycnid growths, etc. on the plant. during the registration of diseases manifested by symptoms, the intensity of the infection, which expresses the general prevalence and the degree of development of the disease, was studied. At this time, the level of development of diseases observed with the mentioned symptoms was evaluated on a 4-point scale:
0 honey-healthy plants;
1 honey-disease symptoms up to 10% of plant organs;
2 points-up to 10-25%;
3 points - up to 25-50%;
4 points - covers more than 50% of its surface.
During evaluation, each leaf area was examined in compound leaves. The formula for the intensity of disease spread was used:

$$\dot{I} = \frac{\Sigma(r \cdot b)x100}{n \cdot a} \qquad (3)$$

Here,
I-disease spread intensity, in %;
r-disease infection score;
b-number of plants infected with suitable honey, numbers;
Σ r·b) - total number of suitable honey yield of infected plants;
The total number of cases viewed in the n-sample, number;
a-highest score;
100 -% conversion factor.

Results and Discussion

Table 1. The frequency and spread levels of noticed diseases on tomato plant (*Solanum licopersicum L.*) in Azerbaijan (2001-2018)

№	Disease	Spread in Azerbaijan	Spread level
1	2	3	4
1.	Non- infection diseases		
1.1.	Apical rot of tomatoes	Absheron, Xachmas, Xyzy, Masallı, Shamakhı	++
1.2.	Tomato cracking	In covered areas	+
1.3.	Thermal burn	Absheron and Mughan	++
1.4.	Salt stress	Absheron, Masallı, Jalilabad regions	+
1.	Nutrient elements deficiency	In all regions	++
2. Infection diseases			
2.1.Viral diseases			
2.1.1.	Wrinkled curl	Absheron, Masallı, Khachmaz, Shabran	+
2.1.2.	Potato calico virus *Alfa mozaik virus*	Open and covered areas	+
2.1.3.	Spot mosaic *Cucumber mosaic virus*	Absheron and south regions	+
2.1.4.	Potato mottle *PotatoX virus* and *Tomato mosaik virus*	Absheron, in north and south regions	+
2.1.5.	Tobacco mosaic virus *Tobacco Etch. Virus*	Absheron, in covered area	+
2.1.6.	Tomato mosaic *Tomato mosaic virus*	Absheron, in covered area	+
2.1.7.	*Potato Y virus*	Absheron, Lankaran-Astara, Guba-Khachmaz regions, open and covered areas	+
2.2.	Mycoplasma Stolbur *Solanum micoplasma*	Absheron region, open and covered areas	+
2.3.Bacterial diseases			
2.3.1.	Black spot *Pseudomonas siringae pv. tomato* Van Hall.	Lankaran, Astara, Masallı, Khachmaz and etc.	+
2.3.2.	Bacterial cancer *Clavibacter michiganensis subsp. michiganensis* (Smith) Davis	Absheron region, open and covered conditions	++
2.3.3.	Bacterial fading *Ralstonia solanasearum* (Smith) *Yabuuchi et al.*	Guba-Khachmas region, open area	+
2.3.4.	Stem bacteriose *Pseudomonas corrugata Roberts and Scarlett*	Absheron, covered area	+
2.4. Diseases for *Chromista* family			
2.4.1.	Potato blight. *Phytophthora infestans (Mont.) de Bary.*	In all regions of Azerbaijan	+++
2.4.2.	Black shank *Phytophthora nicotianae (parasitica)* Breda de Haan.	Absheron, Lankaran-Astara, open and covered areas	++
2.4.3.	*Phytophthora sp*.	In seedlings in Absheron, Lankaran-Astara	+
2.4.3	Seedling root rot *Pythium debaryanum* Hesse.	Guba-Khachmaz and Lankaran, in the seedlings	++
2.5.Fungi diseases			
2.5.1.	Powdery mildew Tomato *Oidium licopersicum* Cooke et Mass. *Levellula taurica* (G. Arna.)	Open and covered areas in Absheron	++
2.5.3.	Septoria-*Septoria licopersici* Speg.	Open and covered areas in all regions	++
2.5.4.	Fusarium wilt*Fus. Oxysporum f.sp. Licopersici* Shlecht.	Open and covered areas in all regions	++

2.5.5.	*Fusarium solani f. sp. radicus licopersici* Jarvis & Shoemaker.	Open and covered areas in Lankaran-Astara and Guba-Khachmaz	+
2.5.6.	*Fusarium solani* Mart.	Open and covered areas in all regions	++
2.5.7.	Stem rot with *Didymella lycopersici* Kleb.	In covered areas in Absheron	+
2.5.8.	Alternaria *Alternaria solani* Sor., *A.alternata f.sp. licopersici, A.alternata*	Open and covered areas in all regions	++ + +
2.5.9.	Verticillium wilt of potato *Verticillium lycopersici* Pit. et. P., *Verticillium albo-atrum* Rein. et B.; Smith	mughan, Shirvan lowland, Shirvan lowland and Mil-Garabagh lowland	++
2.5.10	Grey and brown spotting *Stemphylium solani* Web., *St. Botryosum f.sp. lycopersici, Stemphylium sp*.	Open area in Jaliabad, Bilasuvar, Absheron	++
2.5.11	White rot *Sclerotinia sclerotiorum* (Lib.) De Bary	Open and covered areas in Lankaran-Astara and Guba-Khachmaz	+
2.5.12	Anthracnose in fruit *Colletotrichum coccodes* Wallr.	Open and covered areas in Jaliabad, Bilasuvar, Sabirabad	+
2.5.13	Southern blight *Athelia rolfsii* Curzi.(*Sclerotinia rolfsii)*	Covered areas in Absheron	+
2.5.14	Brown patches Rhysoctonia *solani* Kuhn.	Covered areas in Absheron	+
2.5.15	Black bread mold *Rhizopus sp.*	Open and covered areas in Bilasuvar and Sabirabad	+
2.5.16	Geotrichosis *Geotrichum candidum* Link	Covered areas in Absheron	+

During 2001-2018 the diseases registrated on route observations held by us in Azerbaijan, observations in nurseries and analyses presented by manifacturers have been determined. The registarated diseases have been determined on standard methods (1, 2, 3, 4) and devided into 2 groups:
1. Diseases, occurring to the impact of non-infection or physiological processes functional imbalance, dietary deficiency and ecological factors.
2. Diseases, occured due to parasitic, infectious or different nematodes, viruses, bacterias, micoplasma and fungi species.

During the race observations, it was found out that in the open area the mass spread pathogen infectors and epiphytoty diseases are more frequent both ground, and aboveground organs (5). Among the diseases, three varieties of *Phythopthora* genus of *Chromista* widespread in Absheron and Guba-Khachmaz regions. Two varieties of early blight genus of Fungi family, three varieties of Fusarium genus, and two varieties of vertisillium genus infect the plants more than other fungi. According to the results of the research, the following diseases on the tomato plant was noticed (*Solanum lycopersicum L.*) (Table 1).

As seen from the table, the diseases on Ph. infestans, early blight, (fungi for *Phytophthora, Pythium, Fusarium,* bacteria *Pseudomonas sp.*), the viruses making different root rots of different origins, mosaics and disformities in tomato widespread in Azerbaijan. The results on disease spreading show that the diseases as Phytophthora infestans, early blight, Fusarium wilt widespread and specialized on plants. The spread of these diseases on tomato plant develop loss of crops for 30-40% in Absheron, Lankaran-Astara and Guba-Khachmas regions of Azerbaijan. Degree distribution dynamics for disease spreading in the regions has been investigated by our scientists and found that the following diseases develop loss of crops and infect the tomato plants (table 2). During 2001-2018 the dinamics and change of the spread area of three different race of Phytophthora infestans was different in TP (tomato plant). However, Ph. infenstans (Mont) de Bary was distributed in both of three region in 2001 it was observed in Guba-Khachmaz and Lankaran-Astara with great force in comparision with Absheron region. So in Lankaran-Astara region spread of disease was 44,6%, spread intensity was 16, 4%, in Absheron 32,4%, intensity 7,2%, in Guba-Khachmas region 48,4%, intensity was 21,6%. Phy.parasitica Dastur. was not observed in Lankaran-Astara region in 2001, in Guba-Khachmaz region its intensity was 5,8%. In 2008-2018 spread dynamics of Ph.parasitica was 29 and 31% and intensity was 9,8-14,6%. According to the data, 2001-2018 years, the dynamic of Phytophthora infenstans, fungi of the genus Alternaria, Botritis, Sclerothinia, Didimella, the bacterium Pseudomonas sp., viruses PoMV, ToMV increases.

Table 2. Distribution of major disesases of tomato in Azerbaijan in open area

Disease	Distribution degree of diseases for years, %								
	Lankaran-Astara			Absheron Peninsula			Guba-Khachmas		
	2001	2008	2018	2001	2008	2018	2001	2008	2018
Phytophthora *Phy. Infenstans* (M/) de Bary.	44,6	50,6	66,5	44,0	48,4	52,5	48,4	52,5	88,0
Phy.parasitica Dastur	--	31,2	38,8	--	--	14,6	18,5	29,0	31,7
Phytopthora spp.	--	22,1	48,9	--	34,8	25,3	--	76,2	46,8
Blight	32,0	41,2	37,1	37,3	58,2	54,6	32,6	38,2	42,8
Vascular wilt and Fusarium	26,5	38,0	42,4	27,7	29,2	22,5	24,6	26,2	18,9
Powdery mildew	--	--	--	22,6	24,6	42,6	--	--	--
Head rot	18,1	20	24,0	48,6	22,4	24,0	18,8	17,5	24,6
Bacterial stem rot	--	11,9	26,7	--	28,9	34,0	--	--	--
Mosaic viral diseases	--	23,6	41,7	22,4	45,8	52,7	--	--	28,7

Scientific Ethics Declaration

The authors declare that the scientific ethical and legal responsibility of this article published in EPHELS journal belongs to the authors.

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Author Information

Aghayev Jabrayil
Institute Dendrology of Azerbaijan National Academy of Sciences,
Baku, Azerbaijan
Contact e-mail: cabrailagaev@gmail.com

Samadova Ezet
Institute Dendrology of Azerbaijan National Academy of Sciences,
Baku, Azerbaijan

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