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ORIGINAL ARTICLE

Diseases of solanaceous crops and integrated management of *Cladosporium fulvum Cooke* and *Oidium lycopersici Cooke et Masse* of tomato

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For the first time in Azerbaijan pathogenic viruses, mycoplasmas, bacteria, fungi, and chromista occuring on and within the plants (tomatoes (*Solanum Lycopersicum* L.), potatoes (*Solanum tuberosum* L.), eggplant (*Solanum melongena* L.), peppers (*Capsicum annum* L.)) belonging to *Solanaceae* family were revealed and registered. The species recorded and grouped by modern systematics and the types of the diseases have been determined. *Cladosporium fulvum* Cooke, *Oidium Lycopersicum* is a widespread disease of tomatoes grown indoors in the past 5 years and causes yield loss. The spread of these diseases, distribution conditions, and yield loss were studied. Environmentally-friendly control of these diseases has been developed. The integrated plant protection system used agricultural, biological methods to increase the disease resistance of crops. The degree of plant damage and microscopic characteristics of pathogens were studied. The morphological characteristics of the pathogen inform about specific changes and the occurrence of a new specialized race.

Keywords: Solanaceae, Tomato, Disease, Fungi, *Cladosporium fulvum*, *Oidium lycopersicum*, Fungicide, Biological control, Integrated protection.

Introduction

Tomato is a heat-loving and drought-resistant crop and the optimal soil humidity level should be between 75-80% and the relative humidity between 65-70%. The flowering usually occurs at temperatures above 15^{o}C. Tomato prefers neutral, rich in humus, light soils. Nitrogen, phosphorus, and potassium requirements are in 1:0.2:0.5 (Aghayev, 2012, Aliyev, 1998). When the tomatoes are cultivated in peat, the amount of macro-and micronutrients in 1 liter of feed solution should be the same (mg/l):N-281, P-43, K-392, Ca-176, Mg-64, Sh-3, Fe-1.8, Mn-0.9, Cu-0.1, Zn-0.1, B-0.2, Mo-0.02, Y, Cr, Co-0.01. The reaction of Ca-1 mg/l, Mg-0.5 mg/l, HCO_3-3 mg/l in 1 liter of irrigation water should be pH=5.8-6 (Hidayatov, Eyyubov, 2001; Kondratyeva, Kandoba, 2007).

In the temperate climate of Azerbaijan, infection of tomatoes caused by various diseases of non-infectious and infectious origin was revealed. The main infectious diseases were spread in subtropical climate regions as Lankaran, Astara, Absheron peninsula, as well as mycoplasma, and viral diseases and various fungal fruit rot in Mughan, Shirvan, Guba-Khachmaz, and Caspian plains of Azerbaijan (Akhundov, Eyyubov, Ahmadov, 2008).

The diseases spread in *Solanaceae* family members were investigated by in Azerbaijan V.I. Ulyanishev (1968), V.V. Belousova, J.H. Abdullayev (1989), B.B. Eyyubov (1978), I.H. Jafarov (2012) and other scientists. The latest diversity of cultivation technologies of potato, tomato, eggplant, and pepper varieties, different hybrids had caused the change of various compositions of diseases.

New subspecies and pathogenic races in the republic caused their mass spread and adaptation to the new circumstances (Aghayev, 2012, 2021). During 2000-2020 the diseases registered on route surveys held by us in Azerbaijan, analysis of surveys presented by manufacturers have been determined.

The use of the methods of agricultural and biological control of plant pathogens is the main component in sustainable manufacturing.

Agricultural control measures, being environmentally safe methods of disease and pest control, play a key role in optimizing the agro-ecosystem and are characterized by various measures in crop production. These include the selection of previous crops, enrichment of the soil by the needs of the crop, soil cultivation, seed sorting, selection and application of sustainable varieties, preparation and application of optimal rotation system, scheme, irrigation regime, vegetation period, use of appropriate mineral and organic fertilizers in order to increase the disease resistance of plants, timely harvesting are of great importance in diseases prevention (Burtseva, 2005; Kokoreva, 2006; Aslanov, Gasimova, 2009; Kirichenko, Sergiyenko, 2011).

The actual method of biological control of plant diseases is the use of substances secreted by beneficial microorganisms with a lethal effect on pathogens. Extensive scientific research has been conducted on the artificial obtainment, reproduction, and use of these biological agents to control plant pathogens (Bodnya, 2011; Borovaya, 2009, 2013; Mironova, 2008; Ukraintseva, 2008).

Sh.B. Bayrambekov studied the application of Alirin-B, Gamair, and Gliokladin on potatoes against the effect of Alternariosis. The author mentioned the 62% and 73% biological therapy effect of the applied preparations for *Alternaria solani* and *A.alternata* control. To increase the resistance of plants, V.P. Borovaya tested planriz, pseudobacterin-2, bactophyte IT, phytolavin on barley and melon plants, and a decrease of 50-55% was observed. Compared to etalon variant, control variant was increased by 42-56%, and productivity by 70-85% (Bayrambekov, 2009).

To prevent the spread of fungal pathogens in plants, various methods and tools were used. These include special preparations that can be used to infertile sex haploid cells in fungi (Rashidova, Aripova, 2006). The preparations obtained in this direction are called mycopheromones. Mycopheromones enter the cell sap and cause functional reproductive dysfunction. They are synthesized on the basis of alpha-ionic, pelargonic, valerian, isovaleric acids (Kashirskaya, 2009).

The integrated management of pathogens of greenhouse tomatoes is prepared on the basis of the following research methods.

Materials and Methods

The species composition of pathogens of potato diseases and the frequency of their occurrence in various regions of Azerbaijan was studied in route surveys taking into account the level of prevalence and degree of development. Analyzes of the collected affected materials were carried out with the methods of systematic microscopic examination with the subsequent involvement of mycological, immunoferment methods of determining pathogens for identification. The dynamics of the development of late blight were studied on specified plants in laboratory conditions.

The diseases have been determined on standard methods (Vlasov, 1992; Pidoplichko, 1977; Peresipkin, 2009) and divided into 2 groups:

1. Diseases, occurred due to the impact of non-infection or physiological processes functional imbalance, dietary deficiency, and ecological factors.
2. Diseases, occurred due to parasitic, infectious or different nematodes, viruses, bacterias, mycoplasma, and fungi species.

Determination of tomato pathogens was carried out by systematic microscopy methods. Samples were taken from the infected materials stored in humid conditions for 6, 12, 24, and 36 hours. The samples were examined under a microscope. Cladosporium and Oidium were used in a clean environment, the characteristics of the pathogen in the nutrient medium, microscopic and repeated artificial infection of the pathogen in infected specimens used in the treatment of plant diseases (Lilly, Barnett, 1953). Artificial infection was carried out during the period of seedlings, shrubs, the capture of the first flower clusters, and crop maturity. Artificial infection of experimental plants was carried out by spraying the leaves with a cultural solution of the pathogen, rubbing it with a brush and applying to the soil (Ryabchinskaya, Kharchenko, Zasotnikov, 2011).

Diagnosis, calculation, and observation of diseases are based on the visual measurement and calculation methods (Jafarov, 2012; Aghayev et al., 2017).

The affected by disease crops in field and laboratory conditions are characterized by the appearance of plant root rots, plaque, pycnidia, sclerosis, decay, wilting of the structure, tumors, cracks, necrosis, chlorosis, and other symptoms.

Experimental methods

Testing of biopreparations Alrin-B, Agrin-B, Phytosporin-M, Gamair, Gliocladine for *Cladosporium fulvum, Oidium licopersici, Levellula taurica, Botrytis cinerea, Sclerotinia sclerotiorum, Septoria licopersici and Sercospora* sp. was carried out and the biological, economic efficiency of these preparations was investigated. The biological properties of pathogens were studied in a pole thermostat and incubator in laboratory conditions.

Biological features of pathogens were studied in the laboratory conditions at different temperatures in a thermostat (Shimadzu CTO-20AC). Field experiments were conducted using generally accepted methods (Dospekhov, 1985).

Results and Discussion

During the route surveys, it was found out that the mass spread of pathogen infections and epiphytotic diseases emerges both in the underground, and aboveground organs in open areas. Among the diseases, three varieties of *Phythopthora* genus of *Chromista* are widespread in Absheron and Guba-Khachmaz regions.

Spread of 2 Alternaria solani species, 3 Fusarium species, 2 verticillium species occur among the plants more than other fungi.

During the investigations of the potato plant, the pathogens as bacterial ring rot, establishing *Clavibacter michiganensis subsp. Sepedonicu*, *Streptomyces scabies Lambert and Loria* bacteria establishing scab, viruses *Potato virus* A, *Potato virus* Y, *Potato leafroll virus* establishing mosaic and leaf curl were found. Also, in tomato, egg-plant, pepper, and other vegetables belonged to the Solanaceae family, the root-knot nematodes as *Meloidegine incoqnita*, *M.arenarea*harms were revealed in open and covered areas of the Absheron region. In 2001-2020 the infected samples in potato fields were investigated by systematic microscopy laboratory analyses. According to the results presented by the manufacturer and the analysis of the research materials involved, the frequency of observed diseases of potato plants (*Solanum tuberosum* L.) are as follows (Table 1).

Table 1. The disease frequency of potato plant (*Solanum tuberosum* L.) in Azerbaijan (2001-2020).

Disease	**Spread in Azerbaijan**		**Level of disease spread**
	Viral diseases		
Potato virus A	Absheron	N40°27ʹ49.2ʺ E49°57ʹ27.29ʺ	+

	Jalilabad	N39°12'0" E48°18'0"	
Potato virus Y	Absheron	N40°27'49.2" E49°57'27.29"	+
	Jalilabad	N39°12'0" E48°18'0"	
Potato leafroll virus	Absheron	N40°27'49.2" E49°57'27.29"	+
	Bacterial diseases		
Clavibacter michiqanensis sub. sp. Sepedonicum.	Shabran	N41º17'44" E48°52'53"	+ +
	Jalilabad	N39°12'0" E48°18'0"	
Streptomyces scabies Lambert and Loria	Absheron	N40°27'49.2" E49°57'27.29"	++
	Salyan	N39°45" E49º00"	
	***Chromista* diseases**		
Phytophthora infenstans (Mont.) de Bary	In all regions		+++
	***Fungi* diseases**		
Synchytrium endobioticum Schilb.	Jalilabad	N39°12'0" E48°18'0"	+ +
*Alternariasolani*Sorauer, *Alternariaalternata* (Fr.) Keissl	In all regions		+++
Rhizoctonia solani Kuhu	Shamakhi	N40º37'49" E48°38'29"	+ +
	Shabran	N41º17'44" E48°52'53"	
	Jalilabad	N39°12'0" E48°18'0"	
	Tovuz	N40º42' E45°42'	
Dusty scab	Absheron	N40°27'49.2" E49°57'27.29"	+ +
Spongospora subterranea f. sp. subterrana	Jalilabad	N39°12'0" E48°18'0"	

According to the results of the research, the following diseases of tomatoes were recorded (Table 2).

Table 2. The frequency and spread levels of revealed diseases of tomatoes (*Solanum Lycopersicum*) in Azerbaijan (2001-2020).

Disease	**Spread in Azerbaijan**		**Level of disease spread**
	Viral diseases		
Wrinkled mosaic	Absheron, Masallı Khachmaz Shabran	N40°27'49.2" E49°57'27.29" N39°02' E48°39" N41°28'05" E48°48'10" N41º17'44" E48°52'53"	+
Alfa mosaic virus	Open fields and greenhouses		+
Cucumber mosaic virus	Absheron Lankaran	N40°27'49.2" E49°57'27.29" N38°45'13" E48°51'04"	+
Potato X virus and *Tomato mosaic virus*	Absheron (in north and south regions)	N40°27'49.2" E49°57'27.29"	+
Tobacco mosaic virus *Tobacco Etch. Virus*	Absheron (in greenhouse)	N40°27'49.2" E49°57'27.29"	+
Tomato mosaic virus	Absheron(in greenhouse)	N40°27'49.2" E49°57'27.29"	+
Potato Y virus	Absheron Lankaran Astara Guba Khachmaz (Open fields and greenhouses)	N40°27'49.2" E49°57'27.29" N38°45'13" E48°51'04" N38°30' E48°40' N41°22'12" E48°30'00" N41°28'05" E48°48'10"	+
	Bacterial diseases		
Pseudomonas siringae pv. tomato	Lankaran Astara Masalli Khachmaz	N38°45'13" E48°51'04" E48°51'04" N38°30' N39°02' E48°39' N41°28'05 E48°48'10"	+
Bacterial fading *Ralstonia solanasearum* (Smith) *Yabuuchi*	Guba Khachmaz(open	N41°22'12" E48°30'00" N41°28'05" E48°48'10"	+

et al.	field)		
Stem bacteriose *Pseudomonas corrugataRoberts and Scarlett*	Absheron, (greenhouse)	N40°27'49.2" E49°57'27.29"	+
	Disease caused by Chromista		
Phytophthora infestans Mont de Bari	In all regions of Azerbaijan		+++
Black shank	Absheron	N40°27'49.2" E49°57'27.29"	++
Phytophthora nicotianae	Lankaran	N38°45'13" E48°51'04"	
(parasitica) Breda de Haan.	Astara	N38°30' E48°51'04"	
Phytophthora sp.	Absheron	N40°27'49.2" E49°57'27.29"	+
	Lankaran	N38°45'13" E48°51'04"	
	Astara	N38°30' E48°51'04"	
Root rot in seedling	Guba	N41°22'12" E48°30'00"	
Pythium debaryanum Hesse.	Khachmaz	N41°28'05" E48°48'10"	++
	Lankaran	N38°45'13" E48°51'04'	
	Fungi diseases		
Oidium licopersicum Cooke et Masse (Levellula taurica G. Arna.)	Absheron	N40°27'49.2" E49°57'27.29"	++
Septorioz-*Septoria licopersici* Speg.	Open fields and greenhouses in all regions		++
Fusarium oxysporum f.sp. licopersici Shlecht.	Open fields and greenhouses in all regions		++
Fusarium solani f. sp. radicus licopersici Jarvis & Shoemaker.	Lankaran	N38°45'13" E48°51'04"	+
	Astara	N38°30' E48°51'04"	
	Guba	N41°22'12" E48°30'00"	
	Khachmaz	N41°28'05" E48°48'10"	
Fusarium solani Mart.	Open fields and greenhouses in all regions		++
Didymella lycopersici Kleb.	Absheron (greenhouse)	N40°27'49.2" E49°57'27.29"	+
Alternaria solani Sor.,	Open fields and greenhouses in all regions		++
A.alternata f.sp. licopersici,			+
A.alternata			+
Verticillium lycopersici Pit. et. P.,	Mughan,	N39°26'53" E48°32'34"	
Verticillium albo-atrum Rein. et B.Smith	Shirvan	N 40°34'59.88" E 48°40'0.12"	
	Mil-Garabagh	N 40°00'0.00" E 47°00'0.00"	++
Stemphylium solani Web.	Jalilabad	N39°12'0" E48°18'0"	
St. Botryosum f.sp. lycopersici,	Bilasuvar	N39°26'53" E48°32'34"	
Stemphylium sp.	Absheron	N40°27'49.2" E49°57'27.29"	++
	Lankaran	N38°45'13" E48°51'04"	+
Sclerotinia sclerotiorum (Lib.) De Bary	Astara	E48°51'04" N38°30'	
	Guba	N41°22'12" E48°30'00"	
	Khachmaz	N41°28'05 E48°48'10"	
	Jalilabad,	N39°12'0" E48°18'0"	+
Colletotrichum coccodes Wallr.	Bilasuvar	N39°26'53" E48°32'34"	
	Sabirabad	N39°59'39" E48°36'15"	
	Absheron	N40°27'49.2" E49°57'27.29"	+
Athelia rolfsii Curzi. (*Sclerotinia rolfsii)*	greenhouse		
Rhysoctonia solani Kuhn.	Absheron(covered areas)	N40°27'49.2" E49°57'27.29"	+
	Bilasuvar	N39°26'53" E48°32'34"	+
Rhizopus sp.	Sabirabad	N39°59'39" E48°36'15"	
Geotrichum candidum Link	Absheron(covered areas)	N40°27'49.2" E49°57'27.29"	+

As seen from the Table, the diseases caused by *Ph.infestans*, early blight, (fungi: *Phytophthora, Pythium, Fusarium,* bacteria: *Pseudomonas sp.*), the viruses caused different root rots of different origins, mosaics, and deformities in potatoes, tomatoes, and peppers are widespread in Azerbaijan. The results show that *Fusarium* wilt also is widespread and specialized on plants.

Fig. 1. The viruses in different root.

During the study, the dynamics of development and biological features of pathogens in the tomato diseases control were studied. When the control measures were applied, environmental stability had been provided. Control Agricultural and biological measures are aimed at enhancing the physiological processes of crops, due to which increases immunity and stress resistance.

In this case, the plant is healthy and disease resistant and improves its health using the inner potential in the control of diseases and excessive use of pesticides and agrochemicals is not required. The development of integrated control measures of pathogens should be carried out by the optimization of all collected data for the system.

The following technologies for major diseases control have been prepared and applied under SRI, carried out in 2000-2020, by determination of analyses of bioecological characteristics of the parasites and optimal application period.

From the observation held in plastic-covered vegetable greenhouses in the Zira settlement of Absheron Peninsula it was revealed that some years of continuous tomato growing caused the spread of Cladosporium fulvum on the plants. From the records, we can see that during 28-35 days all leaves have been infected with *Cl. licopersici* and burnt (Fig. 1).

Infection due to the *Cladosporium* occurs in open and closed leaves, stem, calyx, calyx lobe, and fruit. First signs were observed on the top of the lower leaves as light green, later with yellowish spots. Then at the bottom of these spots form conidia and fungal conidia as brown dots, which play the main role in the spread of disease.

The disease spread occurs by water drop or wind shortly. The relative humidity of air must be 80-95%. The foggy morning and evening weather is favorable for the spread of disease. Because of high humidity, the disease is widespread in the plastic-covered greenhouses. *Cladosporiose* is a widespread disease in the regions of Azerbaijan.

It was found that during its development the pathogen creates different races and subspecies. It occurs when pathogen is a free living-soil saprophyte. Pathogen falls onto the soil in the plant remains and provides the saprophyte circumstances. It extends its growing area under favorable conditions. Because of this feature, the development of sustainable varieties and their use are not successful. The main role in the spread of *Cladosporiose* play conidia, which creates brown cover on the yellowish spot, appeared in the lower leaves. The conidia are round or egg-shaped and they have 1-5 cells. The membrane color of conidia is light brown; intracellular color is whitish-grey.

The size of unicellular organisms is 4-7 × 6-9 mkm, bicellulars' is 5-8 × 10-14 mkm, with 3-5 cells being 6-10 × 13-29 mkm. The pathogen develops and damages tomato leaves. Although the use the fungicides with different source is too low, the breeders cannot conduct the disease control, and the economic damage increases. To Clasdiporum control were used the systems, or fungicides with substances Metalaxyl, Iporoion, Triadimefon, Mefenoksam, Azoksistrobin, and high productivity was obtained.

In recent years, greenhouse vegetable growing expands against the background of growth of agricultural reforms. Transportation and application of modern technologies to Azerbaijan and increasing of productivity of tomato and its marketable quality had caused changing of the composition of diseases and pests and widespread of individual pathogens. So, the phytosanitary analysis of the Absheron Peninsula in the last twenty years shows that spread of powdery mildew (Oidium lycopersici Cooke et Masse) and fungal phytopathogen (Cladosporium fulvum Cooke) lead to problems of the greenhouse farming.

Firstly, Powdery mildew on tomatoes in Azerbaijan was recorded by S.H. Abdullayev and V.V. Belousova (1989). In spite of different data, pathogen was identified by T.A. Tereshenkova (2002) in her research about fungi and specified as Oidium licopesici Cooke Et. Masse. The disease occurs mostly in the Absheron Peninsula of Azerbaijan. At first, on the tomato grown in the greenhouse appear a white-grey little spot on the lower epidermis. O. Lycopersicum spreads in polyethylene-covered greenhouses in Absheron Peninsula and covers all leaf surfaces. Tomato leaf spot disease of model plants continues its development from first observation until the end of vegetation.

Conidia of the pathogen have been studied properly; observations of the samples were carried out by the systematic microscopy. Conidia have egg-shaped, elliptic, and cylindrical forms (Fig. 2).

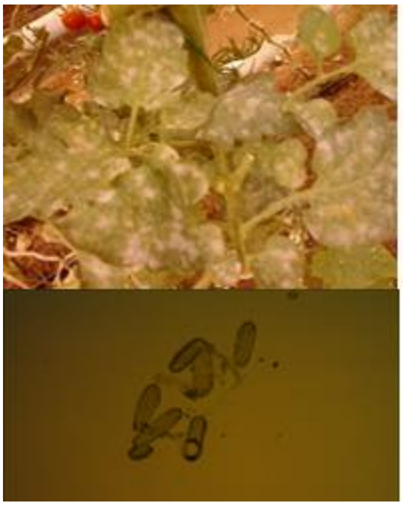

Fig. 2. Conidia of the pathogens.

Conidia's micelles are short, sept as are observed. First, this sign was found by us and was made visual (Fig. 3).

Fig. 3. Pathogens in tomatoes.

The main reason for the spreading of this disease in 2014 is the development of a new pathogenic race specialized in tomatoes. Dynamics of the disease have been studied on the seedlings of the Durinta F1 tomato variety until the end of the vegetation period in the plastic-covered greenhouse condition.

Development of the pathogen continues until the end of the vegetation. It was found that 20-32°C temperature and 55-85% relative humidity had been favorable for the optimal development of *Oidium lycopersicum*. As can be seen from the result, a condition like that exists in all greenhouses. If the pathogen has resources, its spread is inevitable. During the disease period, power mildew spreads and as the result, the leaves turn yellow, their parenchyma becomes yellowish-brown. Too much humidity causes the deformation of leaves, turgor disappears and occurs early Abscission. Fruit contaminated with the disease was not observed. In spite of it the stalk, rosette, and sepal were infected.

In addition, you can see powdery mildew on the tomato growing in open conditions, but it has no economic importance. In the summer period, after foggy and drizzly on the weather appears dew, as the result of it, the disease spreads too quickly. If in the sowing area, the aeration among the plants is very little and the agrotechnical conditions aren't met, the infection destroys lower leaves. Under favorable conditions, the disease spreads on middle leaves quickly, which leads to aging and abscission of leaves.

Besides tomato, *Oidium lycopersicum* infects other sweet and bitter plants, wild nightshade, and other weeds. N.M. Pidoplichko (1977) considered that ascigerous form of Levellula taurica Arnaud is indicated as Yachevsky (1917).

First, *L. taurica* is observed with light-green and yellow spots on the leaves. It covers the surface of the leaf as powdery cover under favorable conditions. Whitish-grey covers are conidia and micelles of the pathogen. conidia spread by irrigating water drops and mist. In mass infection, abscission of leaves, little fruits are observed, as the result of intensive sunlight can be observed the sunburns on the fruit. Conidia can spread to the far distance by mist and wind. It develops intensively in 13-32°C temperature and 50-85% relative humidity.

Measures of *Cladosporium fulvum* Cooke of tomato:

1. Phytosanitary and agricultural measures:

- Keeping of optimal climate condition (the relative humidity of weather of 65-75%, temperature 18-22°C).
- Take measures on water drops in plastic-covered greenhouses.
- Refuse of artificial rain.
- Use of drip irrigation and growing of rows and intervals between plants.
- Clearing of plant remains and weeds for decreasing of pathogen resources.
- Apply of regular sowing system.

2. Chemical control measures must be stopped 15 days before the ripening of the first fruit. So the composition of azoxystrobin and polioksin are more productive. It means that Kvadris CK with the norm of 1litr/ha, Tivoksin AL with the norm of 0.5 liter/ha can be used in both seed-plot and productive areas. The expense of working solution 200-400 liter/ha in productive area and 1 liter in 10

m^2 seed-plot. During the application, the preparations must be replaced, so it helps to prevent the creation of sustainability of pathogen to fungicides and increases the efficiency of agents.

3. Biological control measures. To keep in control the plant during its ripening we use the preparations of Psevdobakterin-2 with the norm of 0.03 kg/ha, working solution consumption 200-400 liter/ha. From ecological view during the safety yield regularly use of Psvdobakterin-2 with 250 gram of Qamair IT (*Bacillus subtilis* M-22, titer 1010 CFU/gr), 250-300 gram Alrin-B (*Bacillus subtilis*, stamp B-10 VİZR, titer 1010 CFU/gr) gives an opportunity to get pesticide-free and high yield.

Prevention and control of *Oidium lycopersicum*

First, the first signs of pathogen must be identified before application of biological and chemical control measures for *Oidium lycopersicum*.

In order to pathogen control, after determination of the presence of pathogen must be used the biological preparation received from its natural antagonist. In 2012-2014 the schedule of the tested the applied preparations as Gamair (Bacillus subtilis M22) and Alirin-B (Bacillus subtilis B-10) against Oidium Licopersicum was studied.

The titer of applied Gamair was 1011 CFU/ml. From the tests, carried out on efficiency of influence to development and spread of disease under different conditions, the results showed that the biological efficiency of preparation was by 68% in 0.3 kg/ha variant. During the application process, the titer of Alrin was 1011 CFU/gr. Alrin-B had been applied during fruit ripening time of the first and second flower clusters of tomato and efficiency was by 65% in 0.2 kg/ha application rate.

Sharing of Alirin-B and Gamair was effective by 72% in 0.2+0.2 kg/ha application rate. Based on the results, use of Gamair and Alirin-B is promising in green food production, so pesticide remains were not observed in the ripening period (Aghayev, 2012).

In order to control powdery mildew, application of 0.3-0.5 kg/ha of strobi (krezoksin-metil), 0.4-0.6 liter/ha of kvadris SK (azoksistrobin) 20 days before yield collecting is effective for 85-90%. When these agents are absent, they can be replaced with penkonazol and triadimefon.

Conclusion

Ecological factors play a key role in powdery mildew control. If the sowing scheme is broken, the space between plants and rows is close, aeration balance is disturbed because of continuous humidity among dense parts of plants is suitable for developing pests. Temperature and humidity balance must meet to quota.

Cool, dewy and foggy evenings and the increase of relative humidity after evening watering in the greenhouse are the main reasons which cause disease. Therefore, watering must be carried out in the morning. The aeration will be better if the leaves are closer to the ground and lower leaves will be cleaned in time. The macro and microelements in the ground must be under control. Before each sowing, the ground must be analyzed and the feed solution according to the plant demand was provided, and food components must be reached to the normal level. Irrigation also plays an important role. During the irrigation, use of water sour with or alkali reaction, as well as hard water, the metabolism of tomato plant is interrupted and sustainability decreases, the plant gets weak and infects with powdery mildew rapidly.

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