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BIOECOLOGICAL CHARACTERISTICS OF PLANT PATHOGENS FROM THE FAMILY OF *SOLANACEAE* AND EFFECTIVENESS OF BIOLOGICAL CONTROL MEASURES

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Abstract. The pathogenicity of *Alternaria solani*, *Fusarium solani* and *Phytophthora infenstans* fungi in relation to eggplant, peppers and potatoes has been investigated. The dynamics of *Phytophthora infenstans* (Mont.) de Bary, *Fusarium solani* Mart., *F.oxysporum f.sp. licopersici* and *Alternaria solani* Sor. fungi and *Pseudomonas corruqata* R. derived from diseased organs of tomato was studied in various cases.

The development of *Fusarium solani* Mart., *Alternaria solani* Sor. and *Verticillium sp.* fungi in different temperatures has been specified. According to the results, the minimum temperature for *Fusarium solani* was 5^{o} C, the optimal temperature was 20-30^{o}C, while the maximum temperature was 40^{o}C. The minimum temperature for *Alternaria sp.* fungus was 5-7^{o}C, the optimal temperature was 20-30^{o}C, while the maximum temperature was higher than 40^{o}C. The minimum temperature of *Verticillim sp.*fungi was 5^{o}C, optimal limit was 20-30^{o}C, while the maximum limit is 40^{o}C.

In the paper, the influence of pathogen *Fusarium* and *Alternaria* genus fungus toxins to germination of seeds has been studied. The efficiency of preparation of *Zircon* obtained from *Echinacae purpurea L.* against disease pathogens is analyzed. It is shown that the disease resistance, height and growth of the test plants increased.

Keywords: *Solanaceae, fungi, Alternaria solani, Fusarium solani, Phytophthora infenstans,biological control, mycotoxin, Echinacae purpurea L., Zirkon.*

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1. Introduction

The rich biochemical composition of crops belonging to *Solanaceae* family enables to be supplied of various microorganisms with them. The optimal conditions on tomato plant tissues for the feeding and development of *Chromista*, funqi, bacteria, mycoplasma and viruses ends with the formation of different types of infectious diseases. Random sowing in agrocenosis is one of the reasons of specialization of pathogens on plants. One of important bio ecological features of pathogen is study of its pathogenic features (Polovnikova, 2007; Spiglazova, 2004; Stekmen & Harrar, 1959).

Alternaria solani Sor. fungi is infect of tomato, it was separated by us from damaged tomato in 1998 and brought up to pure culture of pathogen. The fungi have originated from Saprotroph and parasitize on plants in suitable conditions.

Observations over the past years showed that, *Alternaria solani* Sor has already specialized on *Solanales* plants, parasitizing on them in Absheron.

During pathological processes fungus are excreting different ferments, toxins, antibiotic compounds, substances possessing toxically impacts. They are split up complex polymers of plant tissues and organic substances (Monasirskiy & Svirelis, 2008). By many factors fungus connected to *Fusarium and Alternaria* are excrete different toxic substances mycomarazmin, *Fusarium* acids, *Yavanizin, Martizin*, *Enniatin* and et.cetra (Bilay, 1978; Ashmarina, 2007; Lu Zhen *et al*., 2008). Fungus are weaken in connecting to these substances in plants cells membrane and then they are penetrating to endoderm. Afterwards by pathogenenesis processes accrued in plant tissues storage and transportation of water is weaken in transportation processes. Therefore the total water balance is broken.

There are decreased the activity levels of fungal toxins impacts to plant cells oxidation processes provided by enzymes, there are changed the nucleus structure, the activity of mitochondria's diminished (Borovkov, 1983). In connection with toxic impacts are spread propagated use of biological struggle methods among of natural antibiotics against plants poisoned disease derivations, antagonists, hyperparasites, phytohormons, phytoncides (Alekseyeva, 2010; Malevannaya & Alekseyeva, 2006).

Zirkon drugs obtained from *Echinacae purpurea L.* are used to increase plant anti stress increasing resistance, as the growth and development regulator, plant flowering, fruiting, anti diseases resistance increasing. Zirkon is used as stimulator in different plants immune system regulation.

2. Materials and methods

The pathogenicityof *Alternaria solani*, *Fusarium solani* and *Phytophthora infenstans* fungi on potato, tomato, eggplant and pepper of *Solanales* group have been studiedin 4 versions and in an experiment, carried out in 4 replications.

Fungal contamination was carried out with the plants, which each number was 70; they were infected with intersection method by artificial inoculation (Mirinchik, 1970). The cultural solution of pathogens derived from tomato surface artificially infected other plants by sprinkling and rubbing on them.

After that, the records on spread of this pathogen over these plants have been taken.

Definition of optimal substrate is significant for optimal development of pathogens. By experimental mycological methods has been obtained clean environment in the accessions, taken from leaves, fruit and root collar (Kirilenko, 1982). To study of biology of *Fusarium solani* Mart., *F.oxysporum f.sp. radicus licopersici* and *Alternaria solani* Sor. fungi in laboratory conditions have been carried out the experiment with agar wort (AW), potato agar (PA), but development extract of leaves and branches of tomato in agar conditions (PAC) has been studied in Petri dishes.

Agar wort is a standard substrate and obtained results are compared with this version. Pathogens have been put into thermostat at 25^0 C. Daily development of pathogens was recorded and observation of development dynamics continued for 15 days. In order to study the development of *Fusarium solani* Mart., *Alternaria solani* Sor. and *Verticillium sp*. fungi at various temperatures, the development of pure culture of pathogens has been studied at different temperatures (in poliethermostat) from 0^0 C to 40^0C during 15 days (Pescova, 1973; Lilly & Barnett, 1953).

There are studied by *O.A.Berestestski (3) and V.I.Bilayn (4)* methods in laboratory condition to research the phytotoxic abilities of *Solanum tuberosum L., Solanum*

lycopersicum L., Capsicum L., Solanum melongena L. species leaf spots, withering induced by *Alternaria sp, Fusarium solani və F.oxysporum f.sp. licopersici* fungus.

There are determined phytotoxic abilities by measuring of the growth and development of *Zea mays L.* and *Solanum lycopersicum L.* seeds after moisten by pathogenic cultural decoction (CD).

Results are calculated by the formula: $A_f = 100 (D_x D_n) / D_k D_n \cdot 100$.

Here,

A_f – phototoxic activity, %

D_x – length of shoots after 24, 48 and 72 hours later, in mm;

D_k – length of shoots in control version, in mm;

D_n – initial length of shoots, in mm.

Zirkon is used in closed area above the Amiry F1 hybrid of *Solanum lycopersicum L.* species for increasing the sustainabilities against diseases.

Experiments are put in 5 variants:

1. Zirkon 10 ml/ha;
2. Zirkon 12,5 ml/ha;
3. Zirkon 15 ml/ha;
4. Standard: Megafol 0,1 l/ha;
5. Control: no acts proceeded.

Experiments are proceeded in 4 repeats. The spread of diseases in plants has been carried out on the basis of registration of the 5-point scale by evaluation of *Zirkon* against plants diseases sustainability.

3. Results and discussion

The results on pathogenicity study show that in relation to eggplant, pepper and potato *Alternaria solani*, *Fusarium solani* və *Phytophthora infenstans* fungi have high pathogenic features. So, *A.solani* Sor. fungi, derived from damaged organs of tomato infected eggplant 65,7%, pepper 31,4%, potato 88,5% by artificial inoculation (Table 1).

Table 1. Pathogenicity of *Alternaria solani*, *Fusarium solani* və *Phytophthora infenstans* fungi in relation to plants of *Solanaceae* family

Plant	Number of experimental plants	Infected plants					
		Alternaria solani Sor.		*Fusarium solani* Mart.		*Phytophthora infenstans* M.de Bary	
		Num.	%	Num.	%	Num.	%
Tomato	70	70	100	70	100	70	100
Eggplant	70	46	65,7	29	41,4	45	64,2
Sweet pepper	70	22	31,4	16	22,8	47	67,1
Potato	70	62	88,5	31	44,2	70	100

Artificial inoculation with *Fusarium solani* fungi infected eggplant 41,4%, pepper 22,8%, potato 44,2%. *Ph.infenstans* infected all plants seriously and outstripped other infections by making serious damages. Infection percent was 100% in tomato and potato, in eggplant it was 64,2%, in pepper it was 67,1%.

Alternaria solani Sor., *Fusarium solani* Mart. və *Ph.infenstans* de Bary *Solanales* fungi specialized on potato, tomato and pepper plants and showed high pathogenicity in relation to those plants. Therefore, during the successive sowing system placing of one of these plants before or after tomato is inadmissible. The planting of these vegetables next to sowing areas also is not advisable.

In substrates of R. AW, PA və PAM the development dynamics of *Fusarium solani* Mart., *F.oxysporum f.sp. licopersici* and *Alternaria solani* Sor.fungi, derived from damaged organ of tomato and *Pseudomonas corruqata* was as following. At three nutritional environment, the development of pathogens obtained from accessions of tomato leaves, fruit and root collar is various.

But on 15th day development of all pathogens was maximum and it shows that tomato plant is attractive for these pathogens. According to results of development of pathogens in potato agar condition, it might be said that the pathogens are specialized freely on potato plant and they can widespread in sowing areas if they have resources and damage them intensively. Pathogens widespread in TAC on 8th day, in *Alternaria* it occurred on 10th day, *Ps.corruqata* on 15th day. Total development of investigated pathogens in TAC shows that they have already specialized on TP (Table 2).

Table 2. Development of pathogens in various substrates

Names of pathogens	Development of pathogens in petri dishes, mm					
	2nd day	4th day	6th day	8th day	10th day	15th day
In PA						
Fusarium solani Mart.	22x29	45x50	76x85	90x90	90x90	90x90
F. oxysporum f.sp. lycopersici	20x30x	50x58	80x85	90x90	90x90	90x90
Alternaria solani Sor.	12x18	22x27	46x60	65x82	83x90	90x90
Pseudomonas corruqata Roberts	-	8x14	32x55	67x72	90x90	90x90
In TAC						
Fusarium solani Mart.	18x16	30x30	65x70	90x90	90x90	90x90
F. oxysporum f.sp. lycopersici	20x20	30x30	60x66	90x90	90x90	90x90
Alternaria solani Sor.	9x15	26x28	42x53	76x82	90x90	90x90
Pseudomonas corruqata Roberts	14x19	21x30	34x57	72x77	87x90	90x90
In AW						
Fusarium solani Mart.	44x57	85x85	90x90	90x90	90x90	90x90
F. oxysporum f.sp. lycopersici	45x65	87x90	90x90	90x90	90x90	90x90
Alternaria solani Sor.	43x46	78x84	90x90	90x90	90x90	90x90
Pseudomonas corruqata Roberts	23x31	34x46	56x67	78x85	90x90	90x90

Optimal level of temperature has a significance for the normal development and spread of pathogen. The main condition of organizing of pathogen control during the process is to keep in hand the development of pathogen.

Most of scientists had carried out various researches in this field. The optimal temperature of development of pure culture of fungi coincides with the requested temperature for their formation in pure culture. The pure culture of *Fusarium solani* fungi grown at 28^{o}C has the most toxic ability for TP (Pescova, 1973). The development of tomato pathogens as *Fusarium solani* Mart., *Alternaria solani* Sor. and *Verticillium sp*. has been specified in various temperature. Development of *Fusarium*, *Alternaria*, *Verticillium* fungi has been studied in various temperature modes (0, 5, 15, 20, 25, 30, 40^{o}C) on 5th, 10th, 15th days.

At 5°C the spores of *Fusarium* və *Verticillium* fungi does not finish developing. So, *Alternaria* fungi does not develop at all. The results from researches showed that at 25°C all of three fungi have maximum progress on 5th day. On 5th day in petri dishes the culture area is covered totally-90 mm. at 40°C fungi doesn't develop. *Alternaria* fungi begins develop and in pure culture, it grows up 26 mm during 15 days, then its development stops (Table 3).

Table 3. Development of pathogens in various temperatures (is agar wort condition)

T °C	Diameter of colonies on recorded days, mm								
	Fusarium solani			*Alternaria solani*			*Veticillium sp.*		
	5th day	10th day	15th day	5th day	10th day	15th day	5th day	10th day	15th day
0	0	0	0	0	0	0	0	0	0
5	6	11	13	0	0	0	0	5	6
15	41	77	90	20	55	80	10	55	70
20	75	90	90	54	72	90	42	70	90
25	90	90	90	90	90	90	90	90	90
30	80	90	90	65	90	90	56	80	90
40	0	0	0	8	20	26	0	0	0

According to results, the minimum development temperature of *Fusarium solani* fungi is 5°C, the optimal temperature is 20-30°C, maximum temperature is 40°C. Minimum development temperature of *Alternaria sp*. fungi is 5-7°C, optimal temperature is 20-30°C, maximum temperature is more than 40°C. and the minimum development temperature of *Verticillim sp*. Fungi is 5°C, optimal temperature is 20-30°C, maximum temperature is 40°C. Obtained results can be used in preparation of short-term projection of recorded diseases, for efficient organization of protecting and preventive measures for pathogen in suitable weather temperature periods.

Solanum lycopersicum L. seed shoots are moistened in cultural decoction (CD) by artificial infection of pathogens. After 72 hours size of shoots in control measure were 26 mm, moistened in *Alternaria solani* by CD the size of shoots were in 8 mm, moistened in *Fusarium solani* fungus(Table 4).

Table 4. Toxic impacts and growth indications of *Solanum lycopersicum L.* seeds shoots pathogens

Variants	Initial shoots, in mm	Shoots length, in mm				Before growth development, %			
		24 hour	36 hour	48 hour	72 hour	24 hour	36 hour	48 hour	72 hour
Alternaria solani Sor.	2	5	7	8	8	37,5	46,1	55,5	69,2
Fusarium solani Mart.	2	6	9	12	13	25	30,7	33,3	50
F.oxysporum f.sp. licopersici	2	7	10	11	12	12,5	23,1	38,9	53,8
Control: moistened in distilled water	2	8	13	18	26	-	-	-	-

*B*y CD the size of shoots were in 13 mm, moistened in *F.oxysporum f.sp. licopersici* by CD the size of shoots were in 12 mm. The seed shoots were 69,2% less than compared with the results of the control options by moistened in *Alternaria solani* CD, the growth and development of seed shoots were 50% less than by moistenedin

Fusarium solani fungus CD, the growth and development of seed shoots were 53,8% less than by moistened in *F.oxysporum f.sp. lycopersici* CD.

It is observed accrued the stagnation in growth and development of seeds by impacts of pathogen toxins nevertheless to sharp difference in control compare under the same sprout condition belonging to the same seeds exposures. It has shown by microscope definition under experiments in shoots width ends that *Fusarium solani* and *F.oxysporum* fibers are spread in xylema pipes. Fungus candides and fruit particles are clear shown in *Alternaria solani* grown shoots under micoscope observations.

The tests have been done as a biological struggle against propogation of pathogens Zircon obtained from the terestrial space of *Echinacea purpurea L.* and 3 organic acids combination against withering diseases the *Alternarioz* and *Fusarioz*.

Obtained results have shown in control version the distribution of *Altenarioz* is in 34,6%, in standard version 20,9%, in control of *Fuzarioz* against withering disease 42,6%, by use of *Zirkon* in normal version to 15 ml/ha it was 16,2%, intensivity was in 4%. These results are more by using of *Zirkon* in compare with anotherversions. By high biology benefits version - 61,9% (Table 5).

Table 5. Increase of sustainability impacts of *Zirkon* to *Solanum lycopersicum L.* seeds shoots pathogens Amiry F1. Station: in Buzovna private hothouse

Experiment versions		Alternarioz, in %			Fusarioz withering, in %			$S_{\bar{x}}$, in %
		Distribution, in %	Intensivity, in %	Biology benefits, %	Distribution, in %	Intensivity, in %	Biology benefits, in %	
1	Zirkon 10 ml/ha	17,8	6,2	48,5	28,5	14,2	33,1	1,62
2	Zirkon 12,5 ml/ha	14,2	5,7	58,9	24,0	10,6	43,6	
3	Zirkon 15 ml/ha	12,5	4,2	63,9	16,2	4,0	61,9	
4	Standart Megafol 1 l/ha	20,9	10,6	39,5	30,4	15,0	28,6	
5	Control:	34,6	18,9	-	42,6	21,8	-	

Zirkon can be mixed in neutral condition (pH=6-7) with most drugs. It is profitable to eliminate influences of diseases and their toxic impacts during products maturity periods with the application of biological drugs.

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