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THE INFLUENCE OF CULTIVAR AND PHYTOSANITARY TREATMENTS ON THE ATTACK OF SPECIFIC PATHOGENES AND TOMATO YIELD IN THE VIDRA AREA, ILFOV COUNTY

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Abstract

The aim of the research was to monitor the influence of the cultivar and the phytosanitary intervention on the attack of tomato pathogens. The 'Vipon' variety and the 'Perfect Peel F1' hybrid were studied. Variants with chemical and biological treatments were used. The best results were obtained in the variant of treatments with Copper Max 50 WP 0.2%, Bravo 500 SC 0.2%, Ortiva Top 0.1%, Melody Compact 49 WG 0.2% and Score 250 SC 0.05% the yield obtained was 6.55kg/sq.m (year 2016) and 7.85 kg/sq.m (year 2017) at 'Perfect Peel F1', and at the 'Vipon' variety the yield was 5.28 kg/sq.m (year 2016) and 6.65 kg/sq.m (year 2017). In the case of organic products, the best results were obtained for the Funres 0.3% treatment variant, the yield was 5.60 kg/sq.m (year 2016), 6.17 kg/sq.m (year 2017) at 'Perfect Peel F1', for the 'Vipon' variety the yield was 4.42 kg/sq.m (year 2016), 5.52 kg/sq.m (year 2017).

Key words*: pathogens, degree of attack, efficacy.*

INTRODUCTION

Tomatoes are one of the most important horticultural crops in human nutrition and industry. In Romania, tomatoes are grown in field conditions and greenhouse, consumption increasing year by year. There are ongoing concerns in agricultural research for data on cultivated areas and the yield (Popescu et al., 2018; Toth and Cristea, 2018; Ichim et al., 2018).

In 2016 the area cultivated with tomatoes was 41.1 thousand hectares with a yield of 627.1 thousand tons, and in 2017 an area of 40.0 thousand hectares was cultivated with a yield of 679.8 thousand tons (FAO, 2018).

The pathogen *Pseudomonas syringae* pv. *tomato*, is manifested on the foliage of tomato plants by the appearance of brownish-black spots, surrounded by chlorotic zones. On the green fruits, black superficial points appear and on the ripe fruits the points are more prominent and are surrounded by a delayed ripening area (Preston, 2000).

This pathogen was reported in Taiwan and the U.S.A. in 1933, and in Romania was identified by Oprea and Rafailă in 1974 (Velichi, 2012). Timothy P. Denny (1988) studied the phenotypic diversity of the pathogen *Pseudomonas syringae* pv. *tomato*.

The pathogen *Xanthomonas campestris* pv. *vesicatoria* was reported in 1920 by Doidge, the bacterium being frequent especially in the years with abundant precipitation (Marinescu et al., 1986).

Alternariosis is a disease caused by the fungus *Alternaria solani*, which may manifest itself in all phases of plant development, on leaves, stems and fruits (Chaerani and Voorrips, 2006). Studies on the benefits of using fungicides for the control of this pathogen in tomatoes were conducted in New York and New Jersey in 1993 and 1994. Fungicides with the active substance chlorothalonil or mancozeb were applied at 7, 10 or 14 day intervals, to control pathogens *Colletotrichum coccodes* and *Alternaria solani*. Fungicide treatments reduced the severity of foliar diseases, and yield was significantly increased (Dillard et al., 1997). Flaherty et al. (2000), in the tomato crop, performed treatments with Infinito SC and Ridomil Gold MZ 68 WG for the attack produced by *Phytophthora infestans*, and following their application the severity of the disease was significantly reduced, compared to the untreated control.

Botrytis cinerea is a pathogen that causes significant losses to different species of vegetables. The pathogen infects the leaves, stems, flowers and fruits. The disease is manifested especially in tomato crops from protected areas, but also in the field. Outbreaks occur under moderate temperatures and atmospheric humidity >90%, which favours infections and may predispose the host to become susceptible. Important environmental factors that influence the occurrence and evolution of the disease are the high relative humidity in greenhouses and the free water on the foliage of plants. The application of chemical-based fungicides is a measure to slow and to stop the evolution of the attack. Another alternative method of control is the use of biological control products (Elad and Shtienberg, 1995).

Dillard and Cobb (1998), conducted two-year studies to evaluate the long-term survival ability of the pathogen *Colletotrichum coccodes* in the tissues of infected tomato plants and in the soil. In tomato fruits, studies have been carried out of infections and the development of lesions produced by the pathogen (Dillard, 1989).

Initially, the disease settles on the fruits by the appearance of light brown spots. As the disease progresses the lesions increase and become circular and deepened. The sporulation of the fungus are represented by blackish pustules, which form on the surface of the spots. In conditions of high atmospheric humidity they are covered with a mass of pink-orange spores (Dillard and Cobb, 1998).

MATERIALS AND METHODS

The experiments were carried out in 2016 and 2017, in field conditions at R.I.V.F.G Vidra, was organized a bifactorial experience, placed in randomized blocks, with 10 variants and 4 repetitions. Factor A was represented by the cultivar, with two graduations (A1-hybrid Perfect Peel F1 and A2-Vipon variety), and factor B with 5 graduations (B1, B2, B3, B4) representing the variants of phytosanitary treatments for control the pathogens and untreated control (B5).

Table 1. Cultivars and variants of applied treatments (Vidra - 2016; 2017)

No. crt.	Cultivar	Phytosanitary treatments	June	July	August
			Treatments 1.2	Treatments 3.4	Treatments 5.6
1.	A1 Perfect Peel F1	B1	1.Champ 77 WG 0.25% 2.Cabrio Top 0.2%	3.Ortiva Top 0.1% 4.Consento 450 SC 0.2% + Score 250 SC 0.05%	5.Ortiva Top 0.1% 6.Consento 450 SC 0.2%
2.		B2	1. Copper Max 50 WP 0.25% 2. Bravo 500 SC 0.2%	3. Ortiva Top 0.1% 4. Melody Compact 49 WG 0.2% + Score 250 SC 0.05%	5. Ortiva Top 0.1% 6. Melody Compact 49 WG 0.2%
3.		B3	1.2. Funres 0.3%	3.4.Funres 0.3%	5.6.Funres 0.3%
4.		B4	1.2. Citro Seed 0.2%	3.4.Citro Seed 0.2%	5.6.Citro Seed 0.2%
5.		B5	Untreated control		
6.	A2 Vipon	B1	1. Champ 77 WG 0.25% 2. Cabrio Top 0.2%	3.Ortiva Top 0.1% 4.Consento 450 SC 0.2% + Score 250 SC 0.05%	5.Ortiva Top 0.1% 6.Consento 450 SC 0.2%
7.		B2	1. Copper Max 50 WP 0.25% 2. Bravo 500 SC 0.2%	3. Ortiva Top 0.1% 4. Melody Compact 49 WG 0.2% + Score 250 SC 0.05%	5. Ortiva Top 0.1% 6. Melody Compact 49 WG 0.2%
8.		B3	1.2. Funres 0.3%	3.4.Funres 0.3%	5.6.Funres 0.3%
9.		B4	1.2. Citro Seed 0.2%	3.4.Citro Seed 0.2%	5.6.Citro Seed 0.2%
10.		B5	Untreated control		

Table 1 presents the variants of phytosanitary treatments that were used to control the pathogens present in the tomato crop. Were applied 6 treatments, at intervals of 7-14 days, correlated with the climatic factors.

Observations were made on the occurrence and evolution of the attack of pathogens (frequency F% and intensity of attack IA%). Based on the data obtained, the degree of attack (DA%) of the formula (F% xI%)/100 and the effectiveness (E%) of the formula (untreated GA% -treated GA%) x100/untreated GA were calculated.

The yields obtained on variants and repetitions were recorded. The yield data were processed with the ANOVA programm.

RESULTS AND DISCUSSIONS

During the vegetation period, the following pathogens were identified on the leaves and fruits of tomato plants: *Xanthomonas axonopodis* pv. *vesicatoria* (bacterial spot), *Pseudomonas syringae* pv. *tomato* (bacterial speck), *Alternaria solani* (early blight), *Botrytis cinerea* (gray mold), *Colletotrichum coccodes* (anthracnose), *Phytophthora parasitica* (root rot, stem and fruit rot) and *Phytophthora infestans* (late blight) in the two cultivars (Perfect Peel F1 and Vipon).

Analysing the data in the Table 2, it is found that in the case of the Perfect Peel F1 hybrid the degree of attack on the leaves was between 8.8% (*Xanthomonas axonopodis* pv. *vesicatoria*) and 11.7% (*Phytophtora infestans*) in the untreated control variant.

In the Vipon variety, the degree of attack on the leaves was 9.3% (*Xanthomonas axonopodis* pv. *vesicatoria*) and 12.3% (*Phytophtora infestans*) in the untreated control variant.

In the research carried out by Mândru et al. (2018), in tomato crops, under field conditions, the best results in terms of efficiency and yield, were obtained in the variants treated with copper hydroxide products of 50%, chlorothalonil 500 g/l, azoxystrobin 200 g/l + diphenoconazole 125 g/l, iprovalicarb 8.4% + 40% oxychloride, diphenoconazole 250 g/l, mancozeb 80% and mefenoxam 4% + macozeb 64%.

Table 2. Degree of attack (%) of the pathogens and efficacy (%) depending on cultivar and variant of treatments applied (Vidra, 2016)

Variant	*Pseudomonas syringae* pv. *tomato*		*Xanthomonas axonopodis* pv. *vesicatoria*		*Alternaria solani*		*Phytophtora infestans*	
	DA (%)	E (%)	DA (%)	E (%)	DA (%)	E (%)	DA (%)	E (%)
A1B1	1.1	89.5	0.9	89.8	1.3	88.1	1.5	87.2
A1B2	0.7	93.3	0.6	93.2	1.0	90.8	1.2	89.7
A1B3	2.5	76.2	1.8	79.5	2.6	76.1	3.6	69.2
A1B4	3.0	71.4	2.3	73.9	3.3	61.5	3.0	74.3
A1B5(Ut.)	10.5	-	8.8	-	10.9	-	11.7	-
A2B1	1.4	87.7	1.4	84.9	1.7	86.1	1.9	84.5
A2B2	1.1	90.3	1.0	89.2	1.2	90.2	1.5	87.8
A2B3	2.8	75.4	2.5	73.1	3.0	75.4	4.1	66.7
A2B4	3.4	70.2	3.0	67.7	3.8	68.8	3.6	70.7
A2B5(Ut.)	11.4	-	9.3	-	12.2	-	12.3	-

Chemical control measures can be effective in controlling the pathogen *Phytophthora infestans*. During the research carried out, fungicides were used that may be applied before and after the disease has been installed. Fungicide treatments may be ineffective when the climatic conditions are highly favorable, phenylamide treatments have created a pathogen resistance (Nowicki et al., 2013).

The effectiveness of the treatments used is an important point of view in establishing phytosanitary intervention schemes for crops (Toth and Cristea, 2020; Jaloba et al., 2019; Alexandru et al., 2019; Buzatu et al., 2018; Cristea et al., 2017; Ichim et al., 2017).

Research on the pathogen *Phytophthora infestans* has also been carried out by Amin et al. (2013). They evaluated the efficacy of combating the pathogen with two fungicides Ridomil Gold and Victory 72 WP. Better results in reducing the late blight attack and increasing fruit production were obtained when applying Victory 72 WP fungicide compared to Ridomil Gold fungicide.

Gondal et al. (2012) studied, in five tomato cultivars, the effect of different doses of fungicide with the active substance mancozeb on alternariosis.
Steel (1996) studied the sensitivity of *Botrytis* pathogen to fungicide (iprodione and fludioxonil) treatments, and Bolton (1976) conducted studies on the resistance of the pathogen to fungicides.
The frequency of attack on the fruits (Figure 1) was higher in the case of the untreated control variant for both cultivars. It can be seen that the lowest values were recorded for variants A1B2 (Perfect Peel F1) and A2B2 (Vipon).

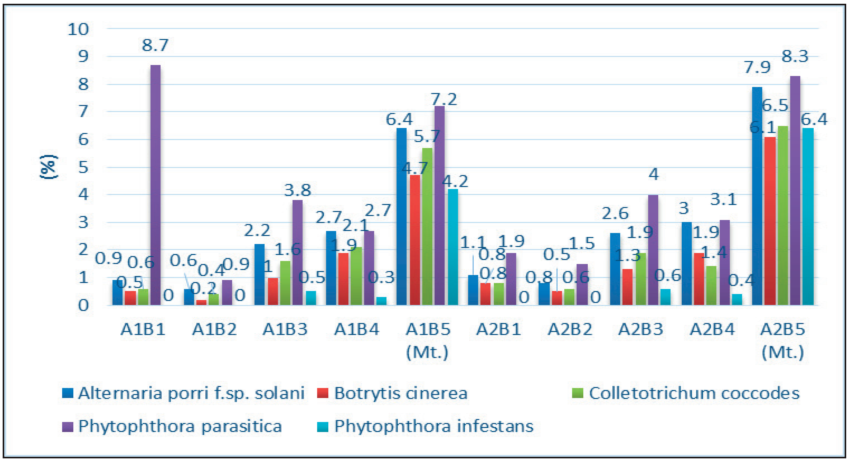

Figure 1. The attack frequency (%) on tomato fruits (Vidra, 2016)

From Table 3, it may be notice that in the B2 variant the highest yield was registered (5.92 kg/sq.m) followed by the B1 variant (5.80 kg/sq.m) for the treatments with chemical products. For the treatments with organic products variant B3 recorded the highest yield (5.01 kg/sq.m), followed by variant B4 (4.65 kg/sq.m), compared to the untreated control variant B5 (3.64 kg/sq.m). The yield differences, obtained in addition to the untreated control variant, are very significant in the case of variants B1 and B2, distinctly significant in the case of the B3 variant and significant in the case of the B4 variant.

Table 3. The influence of phytosanitary treatments on the yield (Vidra, 2016)

Factor B	Yield		The difference from the untreated control (kg/sq.m)	Signification
	kg/sq.m	%		
B1	5.8	159.2	2.16	***
B2	5.92	162.5	2.28	***
B3	5.01	137.6	1.37	**
B4	4.65	127.7	1.01	*
B5(Ut.)	3.64	100	0,00	Ut.

LSD 5%=0.994; LSD 1%=1.334; LSD 0,1%1.759

From the data presented in Table 4, it can be seen that the highest yield was obtained on the Perfect Peel F1 hybrid (5.63 kg/sq.m), compared to the Vipon variety (4.37 kg/sq.m), the difference of yield obtained in addition being significant (1.26 kg/sq.m).

Table 4. The influence of the cultivar on the yield (Vidra, 2016)

Factor A	Yield		The difference between cultivars (kg/sq.m)	Signification
	kg/sq.m	%		
A1	5.63	128.7	1.26	*
A2	4.37	100	-	-
LSD 5%=1.239; LSD 1%=1.657; LSD 0.1%=2.177				

Analysing the data presented in Table 5, we may notice that in the case of the Perfect Peel F1 hybrid, the highest yields were obtained in the variants A1B2 (6.55 kg/sq.m) and A1B1 (6.44 kg/sq.m) in the treatments with chemicals, being followed by the variants of treatments with organic products A1B3 (5.60 kg/sq.m) and A1B4 (5.21 kg/sq.m), compared to the untreated control variant (A1B5), where the yield was 4.35 kg/sq.m. In the Vipon variety, the highest yields were provided by the variants A2B2 (5.28 kg/sq.m) and A2B1 (5.15 kg/sq.m) for the treatments with chemical products, followed by the variants of treatments with organic products A2B3 products (4.42 kg/sq.m) and A2B4 (4.09 kg/sq.m) compared to the untreated control variant (A2B5) where the production was 2.93 kg/sq.m.

The yield differences obtained in addition to the untreated control variant are very significant.

Table 5. The influence of cultivar and phytosanitary treatments applied on yield (Vidra, 2016)

Variant	Yield		Difference from the untreated control (kg/sq.m)	Signification
	kg/sq.m	(%)		
A1B1	6.44	148.0	+2.09	***
A1B2	6.55	150.6	+2.20	***
A1B3	5.60	128.7	+1.25	***
A1B4	5.21	119.8	+0.86	***
A1B5(Ut.)	4.35	100.0	0.00	Ut.
A2B1	5.15	175.8	+2.22	***
A2B2	5.28	180.2	+2.35	***
A2B3	4.42	150.8	+1.49	***
A2B4	4.09	139.4	+1.16	***
A2B5(Ut.)	2.93	100.0	0.00	Ut.
LSD 5%=0.254; LSD 1%=0.342; LSD 0.1%=0.453				

For the second year of the study, in the case of the Perfect Peel F1 hybrid, the value of the degree of attack was 9.8% (*Xanthomonas axonopodis* pv. *vesicatoria*) and 13.3% (*Phytophtora infestans*) at the untreated control (Table 6).

At the same time, the value of the degree of attack, Vipon variety at the untreated control variant (A1B5), was 10.5% (*Xanthomonas axonopodis* pv. *vesicatoria*) and 14.1% (*Phytophtora infestans*). In the experiments performed by Mândru et al. (2017) the degree of leaf attack for *Alternaria solani* was between 1.6 and 2.2% in the treated variants, compared with 16.6% in the untreated control.

The lowest value of the attack degree was recorded in the variant that was treated with the following substances piraclostrobin + metiram, thiophanate methyl and chlorothalonil.

Table 6. Degree of attack (%) of the pathogens and efficacy (%) depending on cultivar and variant of treatments applied (Vidra, 2017)

Variant	*Pseudomonas syringae* pv. *tomato*		*Xanthomonas axonopodis* pv. *vesicatoria*		*Alternaria solani*		*Phytophtora infestans*	
	DA (%)	E (%)	DA (%)	E (%)	DA (%)	E (%)	DA (%)	E (%)
A1B1	1.5	87.6	1.3	86.7	1.6	87.0	1.9	84.2
A1B2	1.1	90.9	0.9	90.8	1.3	89.5	1.5	88.7
A1B3	2.9	76.0	2.1	78.6	3.0	75.8	4.0	70.0
A1B4	3.5	71.1	2.7	72.4	3.7	70.2	3.5	73.7
A1B5(Ut.)	12.1	-	9.8	-	12.4	-	13.3	-
A2B1	1.8	86.7	1.7	83.8	2.1	84.0	2.3	83.7
A2B2	1.5	88.9	1.3	87.6	1.6	87.8	1.9	86.5
A2B3	3.3	75.6	2.9	72.3	3.5	73.3	4.6	67.4
A2B4	3.9	71.1	3.5	66.7	4.1	68.7	4.0	71.6
A2B5(Ut.)	13.5	-	10.5	-	13.1	-	14.1	-

Among the variants of treatments experimented with chemicals for the control of foliar pathogens *Pseudomonas syringae* pv. *tomato, Xanthomonas axonopodis* pv. *vesicatoria, Alternaria solani* and *Phytophthora infestans* stood out in the hybrid Perfect Peel F1, A1B2 and A1B1 and in the Vipon variety A2B2 and A2B1. And in the case of organic products, A1B3 was noted for the Perfect Peel F1 hybrid and A2B3 for the Vipon A2B2 variety.

The frequency of fruits attacked by *Phytophthora infestans* was reduced (1.5 - 2.1% in the untreated control), in the case of both cultivars. In the variants with treatments A1B1, A1B2, A2B1 and A2B2, the attack produced by *Phytophthora infestans* did not manifest itself even in the second year (Figure 2). Satisfactory protection of the fruits was also ensured by treatments with organic products (Funres and Citro Seed), the frequency of attacked fruits was between 0.3% and 0.8 for the Perfect Peel F1 hybrid and between 0.9% and 0.5% for the Vipon variety for *Phytophthora infestans* (A2B3 and A2B4).

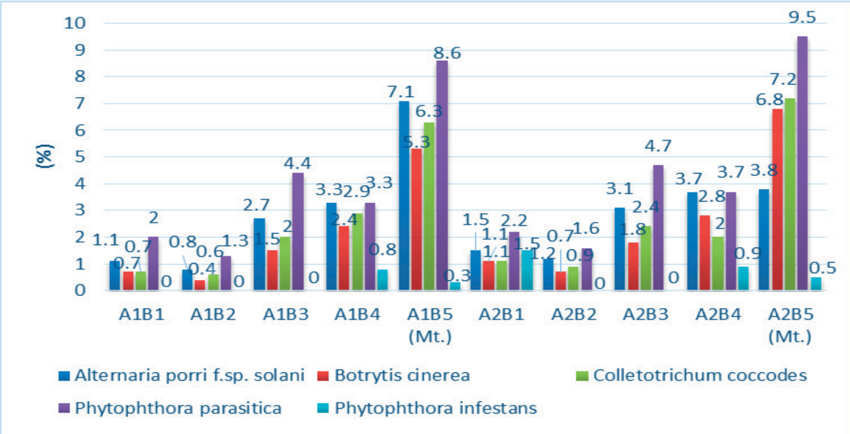

Figure 2. The attack frequency (%) on tomato fruits (Vidra, 2017)

Referring to the influence of the phytosanitary treatments with chemicals on the yield (Table 7) it can be seen that the highest yield (7.35 kg/sq.m) was obtained on the B2 variant followed by the B1 variant (7.20 kg/sq.m).

Table 7. The influence of phytosanitary treatments on production (Vidra, 2017)

Factor B	Yield		The difference from the untreated control (kg/sq.m)	Signification
	kg/sq.m	(%)		
B1	7.2	148.6	2.35	***
B2	7.35	151.7	2.5	***
B3	5.85	120.6	1	*
B4	5.57	114.9	0.72	-
B5(Ut.)	4.85	100	0	Ut.

LSD 5%=0.874; LSD 1%=1,173; LSD 0.1%=1.546

Treatments with biological products Funres (B3) and Citro Seed (B4) ensured a yield of 5.85 kg/sq.m and 5.57 kg/sq.m, respectively. At the same time, the yield obtained in the untreated control variant (B5) was 4.85 kg/sq.m. In the B1 and B2 variants, the yield differences obtained in addition to the untreated control variant are very significant, and in the B3 variant the difference is significant. Analyzing the data presented in Table 8, it is found that the highest yield was registered in the Perfect Peel F1 hybrid (A1=6.69 kg/sq.m). The difference of yield, obtained in addition to the Vipon variety, was insignificant.

Table 8. The influence of the cultivar on the production (Vidra, 2017)

Factor A	Yield		The difference between cultivars(kg/sq.m)	Signification
	kg/sq.m	%		
A1	6.69	118.8	1.06	-
A2	5.63	100	-	-
LSD 5%=1.450; LSD 0.1%=1.940; LSD 0.1%=2.548				

Analysing the data presented in Table 9, it may be notice that, in the case of the Perfect Peel F1 hybrid, the highest yield was obtained at variants A1B2 (7.83 kg/sq.m) and A1B1 (7.75 kg/sq.m) for chemical treatments, and for treatments with organic products variant A1B3 recorded the highest yield (6.17 kg/sq.m), followed by variant A1B4 (6.05 kg/sq.m) compared to the untreated control variant (A1B5) in which the yield was 5.66 kg/sq.m.

Table 9. The influence of cultivar and phytosanitary treatments applied on yield (Vidra, 2017)

Variant	Yield		Difference from the untreated control (kg/sq.m)	Signification
	kg/sq.m	(%)		
A1B1	7.75	136.9	+2.09	***
A1B2	7.83	138.3	+2.17	***
A1B3	6.17	109.0	+0.51	***
A1B4	6.05	106.9	+0.39	**
A1B5(Ut.)	5.66	100.0	0.00	Ut.
A2B1	6.65	165.0	+2.62	***
A2B2	6.87	170.5	+2.84	***
A2B3	5.52	137.0	+1.49	***
A2B4	5.09	126.3	+1.06	***
A2B5(Ut.)	4.03	100.0	0.00	Ut.

LSD 5%=0.224; LSD 1%=0.302; LSD 0.1%=0.400

A similar situation was registered in the Vipon variety, where, in the A2B2 variant, the yield was 6.87 kg/sq.m, followed by the A2B1 variant with 6.65 kg/sq.m.

For the biological products Funres (A2B3) and Citro Seed (A2B4) the registered yield was 5.52 kg/sq.m. and 5.09 kg/sq.m, respectively compared to 4.03 kg/sq.m. in the untreated control variant (A2B5).

The yield differences obtained in addition to these variants, compared to the untreated control variant, are very significant, only at A1B4 distinctly significant.

CONCLUSIONS

The pathogens detected in the tomato crop during the experiment period influenced the obtained yield.

The most effective for both cultivars were those with chemicals: B1: T1. Champ 77 WG 0.25%; T2.Cabrio Top 0.2%; T3. Ortive Top 0.1%; T4. Consento 450 SC 0.2% + Score 250 SC 0.05%; T5. Ortive Top 0.1%; T6. Consento 450 SC 0.2%; B2: T1. Copper Max 50 WP 0.25%; T2. Bravo 500 SC 0.2%; T3. Ortiva Top 0.1%; T4. Melody Compact 49 WG 0.2% + Score 250 SC 0.05%; T5. Ortiva Top 0.1%; T6. Melody Compact 49 WG 0.2%.

The biological products Funres variant B3 and Citro Seed variant B4 provided satisfactory protection against the attack of pathogens that attack the leaves and fruits of tomato plants for the both cultivars.

REFERENCES

Alexandru, I., Cristea, S., Hoza, D. (2019). Effectiveness of treatments on the attack of *Polystigma rubrum* pathogens and *Stigmina carpophila* on plum in Șoimari location, Prahova county. *Scientific Papers-Series B, Horticulture*, *63*(2), 79-82.

Amin, M., Mulugeta, N., & Selvaraj, T. (2013). Field evaluation of new fungicide, Victory 72 WP for management of potato and tomato late blight (*Phytophthora infestans* (Mont) de Bary) in West Shewa Highland, Oromia, Ethiopia. *Journal of Plant Pathology and Microbiology*, *4*, 192.

Bolton, A. T. (1976). Fungicide resistance in Botrytis cinerea, the result of selective pressure on resistant strains already present in nature. *Canadian Journal of Plant Science*, *56*(4), 861-864.

Buzatu, M. A., Costache, M., Hoza, D., Șovărel, G., Cristea, S. (2018). The efficacy of different treatments for pathogens control on the eggplant crops in the field. *Scientific Papers. Series B, Horticulture*, *62*, 495-498.

Chaerani, R., Voorrips, R. E. (2006). Tomato early blight (*Alternaria solani*): the pathogen, genetics, and breeding for resistance. *Journal of general plant pathology*, *72*(6), 335-347.

Cristea, S., Manole, M.S., Zala, C., Jurcoane, S., Dănăilă–Guidea, S.., Matei, F., Dumitriu, B., Temocico, G., Popa, AL., Călinescu, M., Olariu, L. (2017). In vitro antifungal activity of some steroidal glycoalkaloids on *Monilinia* spp. *Romanian Biotechnological Letters*, *22*(5), 12972.

Denny, T. P. (1988). Phenotypic diversity in *Pseudomonas syringae* pv. *tomato*. *Microbiology*, *134*(7), 1939-1948.

Dillard, H. R. (1989). Effect of temperature, wetness duration, and inoculum density on infection and lesion development of *Colletotrichum coccodes* on tomato fruit. *Phytopathology*, *79*(10), 1063-1066.

Dillard, H. R., Johnston, S. A., Cobb, A. C., Hamilton, G. H. (1997). An assessment of fungicide benefits for the control of fungal diseases of processing tomatoes in New York and New Jersey. *Plant disease*, *81*(6), 677-681.

Dillard, H. R., Cobb, A. C. (1998). Survival of *Colletotrichum coccodes* in infected tomato tissue and in soil. *Plant Disease*, *82*(2), 235-238.

Elad, Y., Shtienberg, D. (1995). *Botrytis cinerea* in greenhouse vegetables: chemical, cultural, physiological and biological controls and their integration. *Integrated Pest Management Reviews*, *1*(1), 15-29.

Ichim, E., Marutescu, L., Popa, M., Cristea, S. (2017). Antimicrobial efficacy of some plant extracts on bacterial ring rot pathogen, *Clavibacter michiganensis* ssp. *sepedonicus*. *The EuroBiotech Journal*, *1*(1), 85-88.

Ichim, E., Mocuta, D. E., Cristea, S. (2018). Some Aspects Regarding Potato Culture in Romania. *Sustainable Economic Development and Application of Innovation Management,* 6663-6668.

Flaherty, J. E., Somodi, G. C., Jones, J. B., Harbaugh, B. K., Jackson, L. E. (2000). Control of bacterial spot on tomato in the greenhouse and field with H-mutant bacteriophages. *HortScience*, 35(5), 882-884.

Gondal, A. S., Ijaz, M., Riaz, K., & Khan, A. R. (2012). Effect of different doses of fungicide (Mancozeb) against alternaria leaf blight of tomato in tunnel. *J Plant Pathol Microb*, *3*(125), 2.

Jalobă, D., Jinga, V., Cristea, S. (2019). Research on effectiveness of some fungicides treatments on Jonathan apple variety for apple scab control in Voinești Area. *Scientific Papers-Series A, Agronomy*, *62*(2), 135-139.

Marinescu, Gh., Costache, M., Stoenescu. A. (1986). *Bolile plantelor legumicole [Diseases of vegetable plants].* Editura Ceres, București.

Mândru, I., Costache, M., & Cristea, S. (2017). Aspects of the pathogens control in fall-summer field tomato (*Lycopersicon esculentum* Mill.,) crops in the region Vidra, Ilfov. *Current Trends in Natural Sciences Vol*, *6*(12), 60-67.

Mândru, I., Costache, M., Hoza, D., Cristea, S. (2018). Pathogens with economic importance for tomato crops growing in the field and their control. *Scientific Papers. Series B, Horticulture*, *62*, 499-505.

Nowicki, M., Kozik, E. U., Foolad, M. R. (2013). Late blight of tomato. *Translational genomics for crop breeding: John Wiley & Sons Ltd*, 241-265.

Popescu, M., Mocuta, D., Cristea, S. 2018. Trend on Maize Market Evolution in Romania. *Innovation management and education excellence through* vision 2020, Vol. I –XI,1680-1688.

Preston, G. M. (2000). *Pseudomonas syringae* pv. *tomato*: the right pathogen, of the right plant, at the right time. *Molecular plant pathology*, *1*(5), 263-275.

Steel, C. C. (1996). Catalase activity and sensitivity to the fungicides, iprodione and fludioxonil in Botrytis cinerea. *Letters in applied microbiology*, *22*(5), 335-338.

Toth, K., Cristea, S. (2020). Efficacy of treatments in controlling cercosporiosis (*Cercospora beticola* Sacc.) in sugar beet. *Scientific Papers. Series A. Agronomy*, Vol. LXIII, 2, 236-239.

Toth, K.G., Cristea, S. (2018). Evolution Areas Planted With Sugar Beet and Markets Beet in Romania. *Innovation management and education excellence through vision* 2020, Vol I –XI,1689-1695.

Velichi, E. (2012). *Fitopatologie generală și special [General and special phytopathology].* Editura Univesitară, București.

http://www.fao.org/statistics/en. (FAO 2018)