

CONTROL OF THE PATHOGENS ON BELL PEPPERS AND EGGPLANTS UNDER HIGH PLASTIC TUNNELS

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Abstract

The experiments aimed to evaluate the efficacy of some fungicides for the control of pathogens in peppers and eggplants crops under high plastic tunnels. The crops (extended cycle) were established on May 9, in the 2024 year, at R.D.I.V.F.G.-Vidra. The biological material was represented by 2 bell pepper hybrids (Piedone F1 and Blancina F1) and 2 eggplant hybrids (Aragon F1 and Epic F1). Experiments included 5 variants (V5. Untreated control), with 3 replicates. Four treatments with fungicides were applied, at 10-day intervals. The tested products were: V1. Amistar 0.1%, V2. Dagonis 0.1%, V3. Ortiva Top 0.1% and V4. Cidely Top 0.1%. On peppers crops, the Piedone F1 hybrid was attacked by the pathogens *Alternaria solani* and *Colletotrichum capsici*, and the Blancina F1 hybrid only by the pathogen *Alternaria solani*. On eggplants crops, the Epic F1 hybrid was attacked by the pathogens *Alternaria solani* and *Botrytis cinerea*, and the Aragon F1 hybrid, only by the pathogen *Botrytis cinerea*. Among the tested fungicides, Ortiva Top 0.1% and Amistar 0.1% for peppers and Dagonis 0.1% and Amistar 0.1% for eggplants stood out for their efficacy and yield. The Blancina F1 peppers hybrid is less sensitive to the attack of the pathogens *Alternaria solani* and *Colletotrichum capsici* and the Aragon F1 eggplants hybrid is less sensitive to the attack produced by *Alternaria solani* and *Botrytis cinerea*.

Keywords: bell peppers, eggplants, fungicides, pathogens

1. INTRODUCTION

In Romania, during 2023 year, the area cultivated with peppers was 9,510 ha, with a total yield of 104,560 tons. Globally, in 2023, the largest peppers producing countries were China, Mexico and Turkey (FAO, 2023). In the same year, the area cultivated with eggplants was 4,460 ha, and the total yield was 64,850 tons. The largest eggplants producing countries were China, India and Egypt (FAO, 2023).

Peppers and eggplants crops are frequently attacked by several pathogens. Among them, *Alternaria solani* can cause significant losses in peppers crops. Symptoms include leaf spots leading to defoliation, fruit rot and stem lesions. Larger lesions may show alternating light-brown and dark-brown concentric areas (Pawar et al., 2020).

Another pathogen with economic importance is *Colletotrichum capsici* which causes anthracnose, a major disease that limits commercial peppers yield worldwide. Attack is favored by temperatures between 20 and 26°C (Shin et al., 2024).

Temperatures between 25°C and 30 °C, relative humidity >90% and the presence of water drops on plant foliage for over 20h are favorable for the initiation and evolution of the attack produced by *Alternaria solani* in eggplants (Kumar et al., 2021) . It manifests as small, circular, brown, necrotic spots, with a chlorotic halo, that gradually enlarge and coalesce, causing the leaves to dry and drop. The lesions that appear on the fruit are small, concentrically zoned, dark brown and deep in the tissues, then becoming olivaceous due to the formation of spores, which sometimes cover the entire surface of the fruit (Balai et Kumar, 2022).

On eggplants fruits, *Botrytis cinerea* attack usually starts at the insertion site of the peduncle and progresses from there to the apex. The affected tissues become discolored and purple with a gray tint. Active lesions have a reddish-purple border, are relatively hard and those that reach a diameter of 5-7 cm can penetrate the pulp of the fruit to a depth of 1-2.5 cm. When the atmospheric humidity is high, an abundant gray fluff formed by the fructifications of the fungus appears on the surface of the lesions (Costache et al., 2023).

The objectives of the experiences undertaken at R.D.I.V.F.G. - Vidra aimed to identify pathogens with economic importance for peppers and eggplants crops under high plastic tunnels and evaluate the efficacy of some fungicides in combating them.

2. MATERIALS AND METHODS

In the year 2024, the peppers and eggplants crops under high plastic tunnels were established on May 9 (extended cycle). The biological material was represented by 2 bell peppers hybrids (Piedone F1 and Blancina F1) and 2 eggplants hybrids (Aragon F1 and Epic F1).

The experiments included 5 variants each, with 3 replicates. Four treatments with fungicides were applied, at intervals of 10 days. The treatments were performed on: June 25, July 05, July 15 and July 25. Used products for pathogen control are shown in Table 1.

Table 1. Experimented fungicides for diseases control on peppers and eggplants under high plastic tunnels (Vidra, 2024)

Crt. no.	Fungicid	The active ingredient	Concentration (%)	The spectrum of action	Break time (days)
1.	Amistar	azoxistrobin 250 g/l	0.1	<i>Alternaria solani</i> (alternariosis) <i>Botrytis cinerea</i> (gray mold) <i>Colletotrichum</i> spp. (anthracnose) <i>Leveillula taurica</i> (powdery mildew)	3
2.	Dagonis	difenoconazol 50 g/l + fluxapiraxad 75 g/l	0.1	<i>Alternaria solani</i> (alternariosis) <i>Colletotrichum</i> spp. (anthracnose) <i>Leveillula taurica</i> (powdery mildew)	3
3.	Ortiva Top	azoxistrobin 200 g/l + difenoconazol 125 g/l	0.1	<i>Alternaria solani</i> (alternariosis) <i>Botrytis cinerea</i> (gray mold) <i>Leveillula taurica</i> (powdery mildew)	7
4.	Cidely Top	difenoconazol 125 g/l + ciflufenamid 15 g/l	0.1	<i>Alternaria solani</i> (alternariosis) <i>Colletotrichum</i> spp. (anthracnose) <i>Leveillula taurica</i> (powdery mildew)	3

During the vegetation period, observations were made on the appearance and evolution of pathogen attack (frequency and intensity of attack) on the basis of which the degree of attack and the efficacy

of the products were calculated. The yields on variants and repetitions were recorded in dynamics, which, at the end, were processed by the variance analysis method, using the ANOVA program.

3. RESULTS AND DISCUSSIONS

During the vegetation period, peppers crops were attacked by the pathogens *Alternaria solani* (alternariosis; fig. 1) and *Colletotrichum capsici* (anthracnose; fig. 2), and eggplants crops by *Alternaria solani* (alternariosis; fig. 3) and *Botrytis cinerea* (gray mold; fig. 4).

In the peppers crop, the hybrid Piedone F1, the attack of the pathogen *Alternaria solani* occurred (July 10) at average temperatures between 27.5°C-31.3°C and maximum relative humidity between 78.8%-88.7%. In the peppers crop, hybrid Blancina F1, the attack of the pathogen *Alternaria solani* occurred (July 14) at average temperatures between 30.6°C-31.3°C and maximum relative humidity between 78.8%-87.5%. In the peppers crop, Piedone F1 hybrid, the attack of the pathogen *Colletotrichum capsici* occurred (June 11) at average temperatures between 19.3°C-27.5°C and maximum relative humidity between 88.7%-90.2%.



Figure 1. *Alternaria solani* attack on pepper leaf



Figure 2. *Colletotrichum capsici* attack on pepper fruit

In the eggplants crop, Epic F1 hybrid, the attack of the pathogen *Alternaria solani* appeared (July 17) at average temperatures between 30.6°C-31.3°C and maximum relative humidity between 78.8%-87.5%. In eggplants crop, hybrids Epic F1 and Aragon F1, the attack of the pathogen *Botrytis cinerea* occurred (June 15; June 20) at average temperatures between 19.3°C-27.5°C and maximum relative humidity between 88.7% -90.2%.



Figure 3. *Alternaria solani* attack on eggplants leaves



Figure 4. *Botrytis cinerea* attack on eggplants fruits

The evolution of the attack of the pathogen *Alternaria solani* was relatively slow due to the average temperatures higher than the optimum temperature (25-28°C) and due to the maximum relative humidity lower than the optimum (>95%).

Also the evolution of the attack of the pathogen *Botrytis cinerea* was relatively slow due to average temperatures higher than the optimum temperature (15-20°C) and due to the maximum relative humidity lower than the optimum (100%).

The evolution of the attack of the pathogen *Colletotrichum capsici* was also relatively slow due to higher average temperatures than the optimum (25-27°C) as well as lower than optimum maximum relative humidity (>95%).

The products Amistar 0.1%, Dagonis 0.1%, Ortiva Top 0.1% and Cidely Top 0.1% ensured good protection of peppers plants against the attack of pathogens, their efficacy being between 89.6% (Ortiva Top 0.1%, Cidely Top 0.1%) and 92.5% (Dagonis 0.1%) for *Alternaria solani*, in the hybrid Piedone F1. In the Blancina F1 hybrid, the efficacy was between 88.9% (Cidely Top 0.1%) and 96.3% (Ortiva Top 0.1%) for the same pathogen. The *Colletotrichum capsici* attack was manifested only in the Piedone F1 hybrid, the efficacy being between 70.6% (Ortiva Top 0.1%) and 87.1% (Amistar 0.1%; table 2).

Table 2. Efficacy of some fungicides for control of the pathogens on the peppers crops under high plastic tunnels (Vidra, 2024)

Variant	<i>Alternaria solani</i>		<i>Colletotrichum capsici</i>	
	Degree of attack (%) (on foliage)	Efficacy (%)	Frequency of attacked fruit (%)	Efficacy (%)
Piedone F1 hybrid				
V1.Amistar	0.6	91.0	1.1	87.1
V2.Dagonis	0.5	92.5	1.2	85.9
V3.Ortiva Top	0.7	89.6	2.5	70.6
V4.Cidely Top	0.7	89.6	1.3	84.7
V5.Untreated control	6.7	-	8.5	-
Blancina F1 hybrid				
V1.Amistar	0.2	92.6	0	-
V2.Dagonis	0.2	92.6	0	-
V3.Ortiva Top	0.1	96.3	0	-
V4.Cidely Top	0.3	88.9	0	-
V5.Untreated control	2.7	-	0	-

The fungicides Amistar 0.1%, Dagonis 0.1%, Ortiva Top 0.1% and Cidely Top 0.1% also ensured good protection of eggplants plants against the attack of pathogens, their efficacy being between 92.3% (Amistar 0.1% and Cidely Top 0.1%) and 100% (Dagonis 0.1% and Ortiva Top 0.1%) for *Alternaria solani*, in the Epic F1 hybrid and between 68.3% (Cidely Top 0.1%) and 94.2% (Dagonis 0.1%) for *Botrytis cinerea*, at the same hybrid. In the hybrid Aragon F1, only the attack of *Botrytis cinerea* was manifested on the fruits, its frequency being between 69.9% (Cidely Top 0.1%) and 97.3% (Dagonis 0.1%; table 3).

Table 3. Efficacy of some fungicides for control of the pathogens on the eggplants crops under high plastic tunnels (Vidra, 2024)

Variant	<i>Alternaria solani</i>		<i>Botrytis cinerea</i>	
	Degree of attack(%) (on foliage)	Efficacy (%)	Frequency of attacked fruit (%)	Efficacy (%)
Epic F1 hybrid				
V1.Amistar	0.1	92.3	1.4	86.5
V2.Dagonis	0	100.0	0.6	94.2
V3.Ortiva Top	0	100.0	1.8	82.7
V4.Cidely Top	0.1	92.3	3.3	68.3
V5.Untreated control	1.3	-	10.4	-
Aragon F1 hybrid				
V1.Amistar	0	-	0.9	87.7
V2.Dagonis	0	-	0.2	97.3
V3.Ortiva Top	0	-	0.3	95.9
V4.Cidely Top	0	-	2.2	69.9
V5.Untreated control	0	-	7.3	-

Regarding the yields obtained, in the Piedone F1 pepper hybrid, variant 3 (Ortiva Top 0.1%) took first place with 5.48 kg/m² as compared to the untreated control variant (2.69 kg/m²), and for the Blancina F1 pepper hybrid, also variant 3 (Ortiva Top 0.1%) stood out with 4.80 kg/m² as compared to the untreated control variant (3.08 kg/m²; tables 4 and 5).

Table 4. Obtained yield at the PIEDONE F1 peppers hybrid

Variant	Kg / m ²	The difference from the control (kg/m ²)	% from the control	Significance
V1.Amistar	5.29	2.60	196.6	***
V2.Dagonis	4.65	1.96	173.0	**
V3.Ortiva Top	5.48	2.79	203.7	***
V4.Cidely Top	5.00	2.31	185.7	***
V5.Untreated control	2.69	-	100.0	-

LD 5% = 1.01 ; LD 1% = 1.44; LD 0.1% = 2.08

In the case of the Piedone F1 hybrid, very significantly positive yield differences were obtained on variants 1, 3 and 4 (table 4), and on the Blancina F1 hybrid, only in variants 3 and 4 (table 5).

Table 5. Obtained yield at the BLANCINA F1 peppers hybrid

Variant	Kg / m ²	The difference from the control (kg/m ²)	% from the control	Significance
V1.Amistar	4.44	1.37	144.4	**
V2.Dagonis	4.38	1.30	142.4	**
V3.Ortiva Top	4.80	1.73	156.1	***
V4.Cidely Top	4.60	1.52	149.4	***
V5.Untreated control	3.08	-	100.0	-

LD 5% = 0.72; LD 1% = 1.02; LD 0.1% = 1.48

Referring to the yields obtained, for the Epic F1 eggplants hybrid, variant 2 (Dagonis 0.1%) took first place with 4.83 kg/m² as compared to the untreated control variant (1.53 kg/m²), and on the eggplants hybrid Aragon F1, variant 2 (Dagonis 0.1%) took first place with 4.70 kg/m² as compared to the untreated control variant (1.90 kg/m²; tables 6 and 7).

Table 6. Obtained yield at the EPIC F1 eggplants hybrid

Variant	Kg / m ²	The difference from the control (kg/m ²)	% from the control	Significance
V1.Amistar	4.52	2.99	295.42	***
V2.Dagonis	4.83	3.30	315.5	***
V3.Ortiva Top	4.23	2.70	276.5	***
V4.Cidely Top	4.39	2.86	286.7	***
V5.Untreated control	1.53	-	100.0	-

LD 5% = 0.62; LD 1% = 0.89; LD 0.1% = 1.28

In the case of the Epic F1 eggplants hybrid, very significantly positive yield differences were obtained in all 4 experimental variants (table 6), and on the Aragon F1 hybrid only in variants 1, 2 and 3 (table 7).

Table 7. Obtained yield at the ARAGON F1 eggplants hybrid

Variant	Kg / m ²	The difference from the control (kg/m ²)	% from the control	Significance
V1.Amistar	4.19	2.29	220.9	***
V2.Dagonis	4.70	2.81	248.0	***
V3.Ortiva Top	3.83	1.94	202.1	***
V4.Cidely Top	3.34	1.44	176.1	**
V5.Untreated control	1.90	-	100.0	-

LD 5% = 0.75; LD 1% = 1.07; LD 0.1% = 1.54

4. CONCLUSIONS

Under high plastic tunnels peppers crops, the Piedone F1 hybrid was attacked by the pathogens *Alternaria solani* and *Colletotrichum capsici*, and the Blancina F1 hybrid was only attacked by the pathogen *Alternaria solani*.

Under high plastic tunnels eggplants crops, on the Epic F1 hybrid, the attack of the pathogens *Alternaria solani* and *Botrytis cinerea* was manifested, and on the Aragon F1 hybrid, only the attack of the pathogen *Botrytis cinerea*.

In the 2024 year, the attack of the pathogens *Alternaria solani* and *Colletotrichum capsici* on peppers crops (Piedone F1 and Blancina F1 hybrids) and the pathogens *Alternaria solani* and *Botrytis cinerea* on eggplants crops (Epic F1 and Aragon F1 hybrids) had a relatively slow evolution due to higher average temperatures and lower maximum relative humidities than optimal. Among the tested fungicides, Ortiva Top 0.1% and Amistar 0.1% for peppers and Dagonis 0.1% and Amistar 0.1% for eggplants stood out for their efficacy and obtained yield.

The Blancina F1 peppers hybrid is less sensitive to the attack of the pathogens *Alternaria solani* and *Colletotrichum capsici* and the Aragon F1 eggplants hybrid is less sensitive to the attack produced by *Alternaria solani* and *Botrytis cinerea*.

5. ACKNOWLEDGEMENTS

Work carried out within the Academy of Agricultural and Forestry Sciences Project 1164 "Integrated management for the control of pests of *Solanaceae* and *Cucurbitaceae* vegetable crops in the field and protected areas" (contract no. 1164 /29.11.2022).

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