PREVENTIVE AND CURATIVE MEASURES FOR BIOLOGICAL CONTROL OF THE PATHOGEN BOTRYTIS CINEREA IN EGGPLANT CULTIVATION IN GREENHOUSE

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Abstract

Romanian agricultural research gives special importance to the development of technologies for the cultivation of vegetables grown in ecological agriculture. This paper presents the biological control of grey mould (Botrytis cinerea) pathogen on eggplant (Solanum melongena) cultivated in greenhouse, using the following products: Cavaler 600SL (microorganisms Bacillus pumillus and Bacillus subtilis) 0.3%, Amulet (microorganisms Bacillus thuringiensis, Bacillus subtilis, Bacillus megatherium) 40 l/ha, Zytron (citrus seed extract 20%) 0.15% and Mimoten (Mimosa tenuifolia 80% extract) 0.3%. The efficacy of biological products varied between 65.9% (Mimoten 3 l/ha) and 90,1% (Amulet 40 l/ha) in controlling this pathogen on leaves and lower efficacy on the fruits with values ranging between 34.3% (Mimoten 0.3%) and 62.2% (Amulet40 l/ha).

Key words**: **biological control, pathogen, grey mould, Botrytis cinerea

INTRODUCTION

In recent years, agriculture has been subjected to excessive use of chemicals, which has caused significant damage to the soil, climate, water and global ecosystem of the planet (Barcanu et al., 2023). The use of pesticides can have negative effects with risks to human health and the environment (Radwan et al., 2005; Shim et al., 2023). Practicing organic agriculture can be a solution to these problems, and its role will contribute to improving food security (Sterie et al., 2023). There are many advantages to growing plants in solariums, but also disadvantages, such as reduced ventilation, which can lead to an increase in temperature and relative humidity, which leads to a favorable environment for the emergence and development of pests (Weintraub, 2006). In Romania, the main pathogens that cause damage to eggplant crops are: *Alternaria solani* (brown spot or alternariosis), *Botrytis cinerea* (gray rot), *Phytophthora parasitica*, *Didymella lycopersici* (brown spot of leaves and fruits), *Verticillium dahliae* (verticillosis) and *Fusarium oxysporum* f. sp. *melongenae* (wilt or fusariosis) (Sovarel et al., 2022).

MATERIALS AND METHODS

The biological material is represented by two eggplant hybrids (Epic F1, Aragon F1), which were planted in the greenhouse on May 5, 2025, ensuring a density of 26,600 plants/ha. The planting scheme was 2 rows per furrow, at a distance of 50cm, and

between plants per row of 50cm, which were mulched with black foil. The distance between the strips was 1m.

The monitoring of climatic data from protected spaces was done using thermohygrometers, which record air temperature and humidity at one-hour intervals (table 1).

Table 1 Greenhouse climate data for the period June – September 2025

Month	Atmospheric temperature (^{0}C)			Atmospheric humidity (%)		
	minimum	maximum	average	minimum	maximum	average
June	14.2	38.4	25.8	28.1	90.4	59.0
July	16.6	39.9	27.2	23.8	81.2	51.6
August	14.8	36.5	25.8	23.5	81.1	50.6
September	13.3	34.8	22.3	23.8	83.0	52.5

The pathogen control experiment includes 5 variants:

1. Cavaler 600SL 0.3%
2. Amulet 40 l/ha
3. Zytron 0.15%
4. Mimoten 0.3%
5. Untreated control.

Cavaler 600SL is a product based on microorganisms: *Bacillus pumillus* and *Bacillus subtilis*. In eggplant cultivation it combats the following diseases: alternariosis (*Alternaria solani*), gray rot (*Botrytis cinerea*), vascular wilt (Verticillium *dahliae*), *Phytophthora parasitica* and fusarium wilt (*Fusarium oxysporum*). The microorganisms contained in the product populate the entire surface of the plant, preventing pathogenic factors from establishing themselves. When the disease has already established itself upon application, Cavaler 600 SL isolates the pathogenic factors and destroys them.

Amulet is a biodynamic product formulated based on liquid extract from marigold leaves. The content of the product is based on microorganisms resulting from the natural fermentation process of marigold leaves, respectively by populating the resulting liquid with beneficial bacilli (*Bacillus thuringiensis, Bacillus subtilis, Bacillus megatherium*). In eggplants, it combats the following diseases: gray rot (*Botrytis cinerea*), fusarium wilt (*Fusarium oxysporum*), white rot (*Sclerotinia sclerotiorum*) and brown spot (*Alternaria solani*).

Zytron is a product based on 20% citrus seed extract. It is used on eggplants to prevent and control the following diseases: gray rot (*Botrytis cinerea*), brown spot (*Alternaria solani*), fusarium wilt (*Fusarium oxysporum*) and white rot (*Sclerotinia sclerotiorum*).

Mimoten is a product obtained from 80% *Mimosa tenuifolia* extract whose formulation ensures safe absorption through leaves and roots, stimulating metabolic processes in the plant that generate self-defense reactions. It is used in eggplants to prevent and combat the following diseases: gray rot (*Botrytis cinerea*), brown spot (*Alternaria solani*), fusarium wilt (*Fusarium oxysporum*) and white rot (*Sclerotinia sclerotiorum*).

3 treatments were carried out on September 1, 8 and 15, when favorable conditions for the appearance and evolution of the gray rot attack (*Botrytis cinerea*) in protected spaces were met.

Observations and determinations were made on leaves (10 plants/variant) regarding the frequency and intensity of the pathogen, based on which the degree of attack and the effectiveness of the products were calculated.

RESULTS AND DISCUSSIONS

Prevention measures play an important role in reducing the number of phytosanitary treatments during the growing season.

Crop rotation in protected areas is limited due to the relatively small number of economically important vegetable species. It is recommended to rotate crops with species from different botanical families: *Cucurbitaceae, Solanaceae, Leguminosae*,

Cruciferae, etc., which should have as few common pests as possible.

Mulching the soil with black foil provides multiple advantages: it inhibits weed growth, ensures a lower soil temperature during the calicular period, maintains a humidity more favourable to plant growth and development, inhibits the development of pathogens (*Verticillium dahliae* - verticillium wilt) and avoids fruit contamination with soil pathogens (*Phytophthora parasitica*) in eggplants, which frequently manifest themselves in protected spaces.

The use of "anti-condensation" foil for covering solariums can prevent the formation of condensation which, when it reaches plants in the form of water droplets, can favour the appearance and development of the attack of some pathogens: brown spot or alternariosis (*Alternaria solani*), gray rot (*Botrytis cinerea*), Phytophthora parasitica, brown spot of leaves and fruits (*Didymella lycopersici).*

The use of anti-insect nets, mounted laterally on the edge of solariums, contributes greatly to reducing the attack of pests in protected spaces and implicitly reducing the number of phytosanitary treatments.

Balanced fertilization of crops is done according to the vegetation phase to obtain vigorous plants and a rich harvest. Potassium, considered one of the essential macronutrients for plants, supports the ability of plants to resist diseases and pests, helps in the development of the root system, ensures the optimal functioning of plant metabolism and contributes to the regulation of water balance in the plant.

By using resistant/tolerant cultivars to pest attacks when planting, it is possible to reduce the number of treatments during the growing season and implicitly reduce the pollution of the environment and vegetables with toxic pesticide residues.

Shading of solariums, by cretization, has the following advantages: it reduces the temperature inside the greenhouse/ solarium, partially reflects sunlight, significantly reducing crop losses, ensures a favorable climate for plant development, especially at times when high temperatures are recorded, prevents the occurrence of mild stress situations and physiological disorders of plants due to strong solar radiation.

The timely removal from crops of plant organs attacked by pathogens and foliar pests and of plants strongly attacked by soil pathogens (*Fusarium* spp., *Verticillium dahliae, Phytophthora parasitica*) or various viruses contributes greatly to the reduction of sources of infection and infestation. Drip irrigation offers many advantages over furrow or sprinkler irrigation: reduced water consumption by 30 – 40% compared to furrow irrigation, lower atmospheric humidity, ensuring unfavorable conditions for the emergence and multiplication of pathogens, especially bacteriosis and gray rot.

Curative measures for biological control of the pathogen *Botrytis cinerea* in eggplant

In eggplants, Epic F1 and Aragon F1, the efficacy of biological products was over 65% under conditions of reduced attack in the control. In the two hybrids, the highest efficacy on leaves was ensured by the product Amulet 40 l/ha, 81.8% in Aragon F1 and 90.1% in Epic F1 (table 2).

The frequency of attack by *Botrytis cinerea* on fruit was lower than on leaves in all treated variants (table 3). The frequency of attack in the control was 4.5% in Aragon F1 (fig. 1) and 3.5% in Epic F1. The effectiveness of biological products was lower on fruit than on leaves, with values ranging between 34.3% (Mimoten) and 62.2% (Amulet).

Figure 1. Eggplant fruit with grey mould (*Botrytis cinerea*)

Table 2. Efficacy of products to control the pathogen *Botrytis cinerea* in eggplant crops in a biological system

Var.	Control product	Dose / ha (L/ha)	Attack frequency (%)	The intensity of the attack (%)	The degree of attack (%)	Efficacy (%)
Aragon F1						
1	Cavaler 600SL	3.0	25	10	2.5	77.3
2	Amulet	40.0	20	10	2.0	81.8
3	Zytron	1.5	20	15	3.0	72.7
4	Mimoten	3.0	25	15	3.75	65.9
5	Untreated control	-	40.0	27.5	11.0	-
Epic F1						
1	Cavaler 600SL	3.0	20	15	3.0	70.6
2	Amulet	40.0	20	5	1.0	90.1
3	Zytron	1.5	20	10	2.0	80.4
4	Mimoten	3.0	20	10	2.0	80.4
5	Untreated control	-	40.0	25.5	10.2	-

Table 3 Efficacy of products in controlling *Botrytis cinerea* on eggplant fruits

Variant	Control product	Dose / ha (L/ha)	Aragon F1		Epic F1	
			Attack frequency (%)	Efficacy (%)	Attack frequency (%)	Efficacy (%)
V1	Cavaler 600SL	3.0	2.1	53.3	1.6	54.3
V2	Amulet	40.0	1.7	62.2	1.4	60.0
V3	Zytron	1.5	2.4	46.7	2.1	40.0
V4	Mimoten	3.0	2.0	55.6	2.3	34.3
V5	Untreated control	-	4.5	-	3.5	-

CONCLUSIONS

Biological products (Cavaler 600SL 3 l/ha, Amulet 40 l/ha, Zytron 1.5 l/ha and Mimoten 3 l/ha) have an efficacy of between 65,9 and 90,1% in the control of the pathogens *Botrytis cinerea* on the leaves and lower efficacy on the fruits.

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