EVALUATION OF THE EFFICIENCY OF SOME INTEGRATED PEST MANAGEMENT AGENTS AND THEIR INTERACTION FOR CONTROLLING EGGPLANT ROOT ROT DISEASE CAUSED BY SOME FUNGI ISOLATED FROM DIFFERENT AGRICULTURAL AREAS

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Abstract

The study aimed to evaluate the effectiveness of Pseudomonas fluorescens and the chemical inducer Chitosan in combating some causes of eggplant root rot disease. The results of isolation and diagnosis showed the presence of several genera of fungi isolated from the roots of eggplant plants infected with root rot disease. The results showed the ability of P. fluorescens bacteria to inhibit the growth of the pathogenic fungi F.solani and R. solani Fs2 and Rs3 on PDA medium and the percentage of inhibition reached 100.00%.The results showed that all the factors used in the experiment, including Pseudomonas fluorescens and chitosan, whether applied individually or in combination, had a significant effect in reducing the percentage and severity of eggplant root rot disease compared to the pathogenic fungi treatments alone (R. solani and F. solani), where the infection rate reached 100% and the disease severity was 80% and 75%, respectively. The integration treatment between P. fluorescens and chitosan in the presence of pathogenic fungi showed significant superiority over other treatments in reducing the infection percentage and severity, with infection rates of 16.67% for both, while the disease severity was 5% and 8.33%, respectively. The results showed that all treatments involving the biocontrol agent Pseudomonas fluorescens, chitosan, led to an increase in certain growth parameters of eggplant, including plant height, root length, root volume, and the fresh and dry weights of both the shoot and root systems, compared to the treatment with the pathogenic fungi alone (R. solani and F. solani), which significantly reduced all the studied growth parameters.

Key words: Eggplant, root rot, biological control, Pseudomonas fluorescens, Chitosan

-1Introduction:

Eggplant Solanum melongena L. crop in open and protected cultivation is affected by many pathogens such as fungi, bacteria, viruses and nematodes that cause a reduction in the yield in quantity and quality[34]. The most important of these diseases is root rot disease. Symptoms of seedling death and root rot disease are characterized by a decrease in the number of emerging plants due to the attack of fungal pathogens on seeds and seedlings [11]. It can also cause the appearance of different degrees of rot on the primary and secondary roots and reduce the formation of nodules, which affects the absorption of water and nutrients [15]. The modern trend in combating various agricultural pests tends towards using integrated pest management to reduce the use of chemical pesticides and limit their environmental and economic harms. Therefore, the efforts of most researchers at present have turned to using various possible methods to move away from the use of

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chemical pesticides, such as using biological agents as a practical and safe solution to control diseases, especially root diseases, including root rot disease, due to the many complex problems it causes. Biological control agents are used as an alternative to pesticides, as these organisms act as biopesticides that improve production and protect the crop [32,13]. Among the biological agents used to combat pathogenic fungi are Plant Growth Promoting Rhizobecteria (PGPR) [27]. Also, many recent studies have shown the importance of using chitosan as a component of the cell walls of some living organisms such as crustaceans such as crabs and shrimp and some insects, and it is also a major component of the cell walls of some fungi such as Aspergillus and Mucor. Chitosan plays an important role in inducing plant resistance against pathogens, including eggplant, cowpea, grapes, cucumbers, and sugarcane [31,22]. This study aims to assess the efficacy of Plant Growth Promoting Rhizobacteria (PGPR) and the chemical inducer Chitosan in mitigating root rot disease in eggplant, addressing the significant impact of seedling drop and root rot on the crop. It seeks to fill the research gap regarding biological control methods compared to a chemical pesticide and to evaluate the effectiveness of these control agents in inducing systemic resistance and enhancing growth parameters in the plant.

-2Materials and methods

-21Isolation and diagnosis of fungi associated with the roots of infected eggplant plants

The isolation process was carried out from eggplant samples that showed symptoms of root rot disease represented by wilting, yellowing of leaves and general weakness in growth, with the presence of brown rots on the main and secondary roots, which were collected in the field survey. The sterilized pieces of infected roots were transferred using sterile forceps to Petri dishes with 4 pieces in each dish (dish diameter 9 cm) containing the culture medium Potato Dextrose Agar (PDA), the plates were incubated at 25±1°C for three days. Then, the diagnosis and purification process was carried out, and the genera were identified by Dr. Ahed Abd Ali Hadi based on the taxonomic keys [19,33,9,12]. The percentage of fungal appearance was calculated according to the following equation [20-:[

Fungi appearance = (Number of root pieces in dishes in which pathogenic fungi appear / The total number of root pieces used for each sample) * 100

2-2Pathogenicity Test:

1-2-2Detection of pathogenic isolates of Rhizoctonia solani, Fusarium solani and Macrophomina phaseolina using cabbage seeds on Potato Dextrose Agar (PDA) culture medium

The best pathogenic fungal isolates were selected, and the best among them was chosen. the pathogenicity of 7 isolates of F. solani, 7 isolates of R. solani and 6 isolates of M. phaseolina was tested according to the method of [8] .The PDA dishes were inoculated in their center with a 0.5 cm diameter disk taken from the edges of the colonies of F. solani, R. solani and M. phaseolina. The dishes were then incubated in an incubator at a temperature of 25±2°C for three days, after which the cabbage seeds at a rate of 10 seeds in each dish. The dishes were incubated in the incubator at a temperature of 25±1°C until the seeds in the comparison treatment were fully germinated. The percentage of germination was calculated.

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2-2-2the pathogenicity of the fungal isolates on eggplant seeds

This experiment was carried out under the conditions of the net shade (Siran) affiliated with the Department of Biological Control Technologies at Al-Mussaib Technical College in 2024. The fungal isolates (Fs-2, 3Fs, and Fs-4) of the pathogenic fungus F. solani and the fungal isolates (Rs-3, Rs-4, and Rs-5) of the fungus R. solani (which showed the highest inhibition rate on the amaranth seeds) were added in section 2-2-1, loaded onto local millet seeds [10]and added to sterile mixed soil distributed in plastic pots. Ten sterilized local eggplant seeds were planted in each pot, and the pots were carefully watered. The germination rate was calculated after the seeds in the control treatment had fully germinated.

2-3Determination of the effective concentration of the Pseudomonas fluorescens suspension that inhibits the growth of the two pathogenic fungi Fusarium solani and Rhizoctonia solani

Pseudomonas fluorescens bacterial inoculum was obtained from plant diseases laboratory (These bacteria were isolated from healthy eggplant plants rhizosphere that showed signs of good growth and production. They were diagnosed using PCR technology, tested for their effectiveness, and published in previous studies by the researcher., the bacterial isolate was grown on the liquid activation medium Nutrient Broth, The inoculated flasks were incubated at a temperature of 37°C for 48 hours [7]. A series of dilutions of the bacterial suspension of P. fluorescens were prepared from 10-1 to 10-5, then the plates containing the PDA culture medium were inoculated at a rate of 1 ml/plate for each dilution of the bacterial suspension. The plate was moved with a rotating motion to distribute the bacterial inoculum. A disk was taken from the edge of the fungal colony with a diameter of 0.5 cm from the fungal colony of F.solani isolate Fs 2 and R.solani isolate Rs 3, which were grown on the PDA medium . The plates were incubated at a temperature of 28±2°C. After that, the amount of inhibition was calculated after reaching The comparison treatment of the edge of the plate was done by calculating the diameter of the growing fungal colony and the percentage of inhibition was calculated according to the equation [25.[

$$\%\text{Inhibition} = [(R - r)/ R] \times 100.$$

Where, r is the radius of the fungal colony against the bioagents and R is the radius of the fungal colony without the bioagents .

According to these results, one bacterial isolate that showed high antagonistic ability to inhibit pathogenic fungi was selected for subsequent experiments.

2-4 Evaluation of the efficiency of Pseudomonas fluorescens bacteria, the chemical inducer chitosan, and the pesticide Beltanol in resisting Fusarium solani and Rhizoctonia solani fungi, which cause root rot diseases in eggplant plants, and some growth parameters under greenhouse conditions.

This experiment was conducted in the plastic greenhouse belonging to the Department of Biological Control Technologies at Al-Mussaib Technical College for the autumn season of 2024-2025. A mixture of soil and peat moss (1:2) was prepared and sterilized using commercial formalin at a rate of 20 ml/liter of water (with a commercial formalin concentration of 40%). The formalin was sprayed onto the soil after it was gathered on nylon, mixed, and then covered well with transparent nylon for 7 days under sunlight. Afterward, the soil was left to ventilate for three days before use [5]. The soil was then distributed into plastic pots with a capacity of

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4 kg/pot. Experimental treatments were added with three replications for each treatment Four30-day-old eggplant seedlings (Barcellona variety) were planted in each pot, and the treatments were applied as shown in the table below .

Table 1: the treatment used in the woody canopy experiment

No.	Treatments	No.	Treatments
1	Rs3	8	Fs2 + Pf
2	Rs3 + Pf	9	Fs2 + Pf + Ch
3	Rs3 +Ch	10	Fs2 + Bel
4	Rs3 + Pf +Ch	11	Pf
5	Rs3 + Bel	12	Ch
6	Fs2	13	Pf+ Ch
7	Fs2 + Pf	14	Control

Rs = R. solani , Fs = F. solani Pf= Pseudomonas fluorescens , Ch = chitosan,Bel = Beltanol

The experiment was conducted using a Completely Randomized Design (CRD). The inoculum of the pathogenic fungi Fusarium solani (Fs2) and Rhizoctonia solani (Rs3) was introduced into the designated treatments by loading it onto millet seeds at a weight-to-weight ratio five days before planting.For the biological control agent Pseudomonas fluorescens, a bacterial suspension was applied to the pots at a rate of 10 mL per planting hole Regarding Chitosan, the planting holes were initially sprayed, followed by a subsequent foliar application at a concentration of 5% one month after planting, ensuring full coverage of the vegetative parts.The chemical fungicide Beltanol was applied as a soil drench at a concentration of 1% one day after inoculating the pathogenic fungi [18].The results were evaluated three months post-planting by assessing the incidence and severity of root rot disease caused by R. solani and F. solani

3Results and Discussion

1-3Isolation and diagnosis of fungi associated with the roots of eggplant plants infected with root rot disease

The results of isolation and diagnosis showed the presence of several genera of fungi isolated from the roots of eggplant plants infected with root rot disease, which showed symptoms of the disease represented by brown discoloration of the roots and rotting of part or all of the root, with yellowing and wilting of the plant leaves (Table 2). The most frequently occurring pathogenic fungi was Fusarium solani, which was isolated from 7 areas covered by the survey, with an incidence rate of 74.14% and the highest incidence rate of 95%, followed by Rhizoctonia solani, which was isolated from 7 areas with an incidence rate of 36.2% and the highest incidence rate of 81%. These results are consistent with many studies that confirmed the association of these fungi with root rot of many crops. The diagnostic results showed the presence of many fungi associated with eggplant roots at a lower frequency, including Trichoderma spp., F. oxysporum, Aspergillus niger, Penicillium spp., Sclerotium seclerotinia, Alternaria alternata, and Mucar spp., which appeared at a rate of 12%, 8%, 6%, 25%, 30%, 22%, and 14%, respectively. These results were consistent with what [4] found that these fungi F. solani and R. solani infect eggplant plants

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and cause root rot diseases and seedling damping off.

Table (2) Percentage of fungi associated with eggplant roots infected with root rot disease

Names of fungi	Rashidiy	Akir	Imam	Muwailh	Al-	Tali'ah	Rashid	Zubaidi	Kish	Abu Sha'ir	Sumoud	Rate (%)	Highest presence rate (%)
Fusarium solalni	60	95	93	93	-	-	-	50	66	-	62	74.14	95
Rhizoctonia solani	25	30	25	-	81	37	25	-	-	31	-	36.2	81
Macrophomina phaseolina	30	25	-	68	31	38	-	10	-	-	-	33.66	68
Trichoderma spp.	8	8	-	-	-	12	-	-	-	-	-	10	12
Fusarium oxysporum	10	8	-	-	10	-	-	-	-	6	-	8.5	10
Aspergillus nigeria	4	4	-	-	6	-	-	6	1	6	-	4.5	6
***Pencillium* spp.**	8	13	-	-	-	-	-	-	25	6	6	11.6	25
Scleroctinia sclerotium	-	30	-	-	-	-	-	-	-	-	-	30	30
Alternaria alternata	10		22	-	-	-	-	12	-	-	--	14.67	22
***Mucor* spp.**	-	14	12	-	-	-	-			11	-	12.33	14

2-3Pathogenicity Test

1-2-3Pathogenicity Test of Pathogenicity of Pathogenic Fungal Isolates Using Cabbage Seeds on PDA Media

The results of Table (3) showed that all tested pathogenic isolates led to a significant reduction in the germination percentage, compared to the comparison treatment. in which the percentage of germinated seeds reached 100%, as the Fusarium solani isolate (Fs2) (Akir isolate) outperformed the rest of the isolates in reducing the germination percentage, as the germination percentage rate reached 0.00%. The results also indicated that all tested Rhizoctonia solani isolates caused a clear significant reduction in the germination of Cabbage seeds compared to the comparison treatment. The results also indicated that the fungus isolates Macrophomina phaseolina caused a reduction in the germination percentage.The reason for the variation of isolates in their effect on the percentage of germination of cabbage seeds is due to the genetic differences between these isolates, which were collected from different regions, or the difference between these isolates in their ability to produce toxins or enzymes that decompose pectin and cellulose in the early stages of infection. These enzymes play a major role in penetrating the plant host and causing infection, such as Phosphatase, Pectinase, Cellulase, and pectin lyase. This was confirmed by [38]. These results also agree with what [28,23]indicated, that these fungi are important and major causes of root rot disease, and that they are among the most important pathogens of many plant families .

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Table (3) Detection of pathogenic isolates associated with the roots of eggplant plants infected using cabbage seeds

No.	Isolate	Site	No. of seed germinated	% Germination
1	Control	-	10.00	100.00
2	Fs1	Rashidiya	5.00	50.00
3	Fs2	Akir	0.00	0.00
4	Fs3	Imam	1.00	10.00
5	Fs4	Muwailha	1.33	13.33
6	Fs5	Zubaidi	4.00	40.00
7	Fs6	Kish	2.33	23.33
8	Fs7	Sumoud	2.00	20.00
9	Rs1	Rashidiya	3.66	36.67
10	Rs2	Akir	2.66	26.67
11	Rs3	Imam	0.00	0.00
12	Rs4	Al-Azzawiya	1.00	10.00
13	Rs5	Tali'ah	1.33	13.33
14	Rs6	Rashid	3.33	33.33
15	Rs7	Abu Sha'ir	2.66	26.67
16	Mp1	Rashidiya	3.66	36.67
17	Mp2	Akir	3.00	30.00
18	Mp3	Muwailha	4.33	43.33
19	Mp4	Al-Azzawiya	5.33	53.33
20	Mp5	Tali'ah	2.66	26.67
21	Mp6	Zubaidi	3.33	33.33
	LSD=0.05		1.0170	10.170

Each number represents the average of three replicates, Fs represents the symbol of the fungus Fusarium solani, Rs represents the fungus Rhizoctonia solani Mp=Macrophomina phaseolina, the numbers near the symbol epresent the isolate number.

2-2-3Testing the pathogenicity of the pathogenic fungi Fusarium solani and Rhizoctonia solani in the germination of eggplant seeds in plastic pots

The results of the pathogenicity in plastic pots, Table (4), showed that the fungal isolates under study were able to infect eggplant seeds, as the germination percentage reached 0.00% for the isolate Fs2 compared to the comparison treatment, in which the germination percentage reached 100%, while the germination percentage reached 23.3% and 36.7% for the isolates Fs3 and Fs4, respectively. The germination percentage of eggplant seeds reached 0.00% for the isolate Rs3 compared to By treating the fungus alone, which was 100%. The results of this study are consistent with what many studies have reached regarding the emergence of pathogenic soil fungi and their spread on eggplant and their causing root rot on eggplant and other crops, most notably the fungus Fusarium sp. And R.solani [29,24. [

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Table (4) Testing the pathogenicity of pathogenic fungi Fusarium solani and Rhizoctonia solani in the germination of eggplant seeds in plastic pots

No.	Isolate	No. of seed germinated	% Germination
1	Control	10.00	100.00
2	Fs2	0.00	0.00
3	Fs3	1.00	23.3
4	Fs4	1.33	36.7
5	Rs3	0.00	0.00
6	Rs4	1.00	36.7
7	Rs5	1.33	40.00
0.05=LSD		1.146	11.46

*Each number in the table represents the average of three replicates, Fs = F. solani, Rs = R. solani and the number near the isolate symbol represents the isolate number

3-3Testing the antagonistic ability of Pseudomonas fluorescens bacteria against the pathogenic fungi Fusarium solani and Rhizoctonia solani on PDA culture medium .

The results showed in Table 5 and Figure 1 the ability of P. fluorescens bacteria to inhibit the growth of the pathogenic fungi F.solani and R. solani Fs2 and Rs3 isolation on PDA culture medium and P. fluorescens bacteria showed its highest effect at concentration 10-1on the growth of the pathogenic fungi F.solani and R.solani as the percentage of inhibition reached 100.00%. These results are consistent with the results of a number of studies that confirmed the effectiveness of P. fluorescens bacteria in inhibiting the growth of the fungi F. solani and R. solani [2,6,14.[

Table 5 Testing the antagonistic ability of Pseudomonas fluorescens bacteria against the pathogenic fungi Fusarium solani and Rhizoctonia solani on the PDA culture medium

Treatment	**Concentration**	**Colony diameter.cm**	**Inhibition (%)**
P.f+ Fs2	Control	9.00	0.00
	10^{-1}	0.00	100.00
	10^{-2}	1.33	85.33
	10^{-3}	2.50	73.00
	10^{-4}	3.00	67.00
	10^{-5}	3.50	62.00
Rs3+ P.f	Control	9.00	0.00
	10^{-1}	0.00	100.00
	10^{-2}	1.00	89.00
	10^{-3}	2.00	78.00
	10^{-4}	2.50	73.00
	10^{-5}	3.00	67.00
0.05= L.S.D		0.2809	3.089

* Each number in the table represents the average of three replicates, Fs = F. solani, Rs = R. solani and Pf = P. fluorescens bacteria and the number near the isolate symbol represents the isolate number

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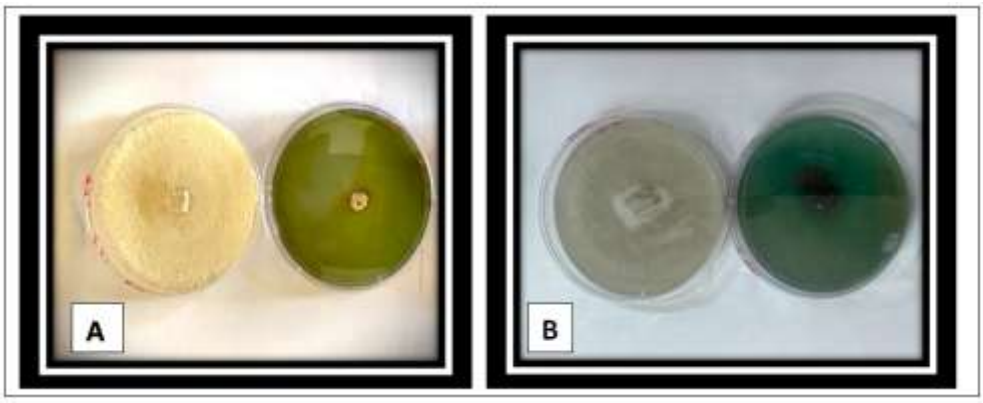

Figure 1 shows the antagonistic ability of P.fluorescens bacteria against the two pathogenic fungi A = with the pathogenic fungus F.solani B = with the pathogenic fungus R.solani on the PDA culture medium.

These results are also consistent with what [37] found regarding the inhibitory effectiveness of P. fluorescens bacteria against the growth of the pathogenic fungi R. solani and F. oxysporum on the PDA culture medium, as it reached The inhibition rate was 80% and 40%, respectively. These results were close to what [30] found using P.fluorescens bacteria as a biocontrol agent against the pathogenic fungus F.solani, as the bacteria inhibited fungal growth by 70.29% compared to the control treatment, which had an inhibition rate of 0.00%.

3-4 Evaluation of the efficacy of the biological agent Pseudomonas fluorescens and chitosan in controlling the pathogenic fungi Fusarium solani and Rhizoctonia solani, which cause root rot disease in eggplant, and their effects on certain growth parameters under greenhouse conditions.

The results (Table 6) showed that all the factors used in the experiment, including Pseudomonas fluorescens and chitosan, whether applied individually or in combination, had a significant effect in reducing the percentage and severity of eggplant root rot disease compared to the pathogenic fungi treatments alone (R. solani and F. solani), where the infection rate reached 100% and the disease severity was 80% and 75%, respectively.The integration treatment between P. fluorescens and chitosan in the presence of pathogenic fungi showed significant superiority over other treatments in reducing the infection percentage and severity, with infection rates of 16.67% for both, while the disease severity was 5% and 8.33%, respectively. This was followed, with a significant difference, by the treatment of P. fluorescens alone in the presence of the pathogenic fungi R. solani and F. solani. This effect is attributed to its production of cell wall-degrading enzymes that break down the pathogenic fungi, as well as its ability to synthesize various antibiotics and growth regulators, which inhibit many microorganisms and promote plant growth. These include cytokinins, gibberellins, and auxins, which improve the root growth environment, enhance nutrient availability, fix atmospheric nitrogen, and produce HCH compounds that contribute to inhibiting the growth of pathogenic fungi [40]Similarly, the treatment with chitosan in the presence of pathogenic fungi was effective in reducing the infection percentage and severity, reaching 50% for both, with disease severity values of

20% and 21.66%, respectively. The antifungal activity of chitosan is attributed to its ability to increase fungal cell membrane permeability due to the interaction between its positively charged molecules and the negatively charged fungal membrane. Additionally, chitosan inhibits the synthesis of essential proteins and enzymes [39]. It also stimulates plants to produce low-molecular-weight proteins known as pathogenesis-related proteins, such as chitinase, β-1,3-glucanase, peroxidase, and polyphenol oxidase [17].These results are consistent with the findings of [35], who reported that adding chitosan to the soil or applying it as a foliar spray at different concentrations significantly reduced the percentage and severity of tomato root rot disease caused by F. solani and R. solani.

Table (6): Evaluation of the Efficiency of the Biocontrol Agent Pseudomonas fluorescens and Chitosan Against the Pathogenic Fungi Fusarium solani and Rhizoctonia solani, the Causal Agents of Eggplant Root Rot Disease Under Greenhouse Conditions.

NO.	treatments	Disease Incidence %	Severity %
1	Rs3	100	.0075
2	Rs3 + Pf	25.00	15.00
3	Rs3 +Ch	50.00	20.00
4	Rs3 + Pf +Ch	16.67	5.00
5	Rs3 + Bel	0.00	0.00
6	Fs2	100	80.00
7	Fs2 + Pf	25.00	16.66
8	Fs2 + Ch	50.00	21.66
9	Fs2 + Pf + Ch	16.67	8.33
10	Fs2 + Bel	0.00	0.00
11	Pf	0.00	0.00
12	Ch	0.00	0.00
13	Pf+ Ch	0.00	0.00
14	Control	0.00	0.00
LSD=0.05		9.124	4.470

Each number represents the average of three replicates, Rs3 = Rhizoctonia solani, Fs2 = Fusarium solani Pf= Pseudomonas fluorescens , ch= Chitosan, Bel= Beltanol

The results (Table 7) showed that all treatments involving the biocontrol agent Pseudomonas fluorescens, chitosan, and the fungicide Beltanol led to an increase in certain growth parameters of eggplant, including plant height, root length, root volume, and the fresh and dry weights of both the shoot and root systems, compared to the treatment with the pathogenic fungi alone (R. solani and F. solani), which significantly reduced all the studied growth parameters. The recorded values for the pathogenic fungi treatments alone were 18.53 and 17.17 cm for plant height, 21.66 and 20.33 cm for root length, 3.10 and 3.00 mL for root volume, 11.20 and 10.03 g for fresh shoot weight, 2.50 and 2.00 g for dry shoot weight, 3.53 and 3.36 g for fresh root weight, and 0.33 and 0.21 g for dry root weight, respectively.The combination treatment of P. fluorescens and chitosan applied to soil contaminated with the pathogenic fungi significantly outperformed all other treatments in enhancing growth parameters, reaching 35.87 and 34.03 cm for

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plant height, 44.10 and 44.00 cm for root length, 8.00 mL for root volume in both fungal treatments, 35.00 and 34.00 g for fresh shoot weight, 6.40 and 6.00 g for dry shoot weight, 8.53 and 8.11 g for fresh root weight, and 1.70 and 1.67 g for dry root weight, respectively, compared to the pathogenic fungi treatments alone.This was followed by the treatment of P. fluorescens alone in soil contaminated with R. solani and F. solani, which also led to an increase in growth parameters, recording 35.06 and 33.93 cm for plant height, 40.00 and 39.00 cm for root length, 7.10 and 7.00 mL for root volume, 32.36 and 31.50 g for fresh shoot weight, 5.80 and 5.60 g for dry shoot weight, 6.94 and 6.70 g for fresh root weight, and 1.32 and 1.31 g for dry root weight, respectively.The efficiency of Pseudomonas fluorescens in promoting plant growth is attributed to several mechanisms, including competition with soil microorganisms, production of various antibiotics that enhance plant growth, secretion of siderophores and volatile compounds, and its ability to withstand environmental stresses. Additionally, this bacterium has the capability to fix atmospheric nitrogen and convert it into ammonia, which becomes available to plants through the production of the enzyme nitrogenase. Furthermore, P. fluorescens can solubilize phosphorus, potassium, and other complex minerals in the soil [16,26,36]).The findings of this study align with several previous studies that demonstrated the effectiveness of chitosan in enhancing crop growth parameters. For instance, [3] reported in a study on tomato plants that chitosan application resulted in an increase in plant height and fresh and dry shoot biomass by 1.5–2 times compared to untreated plants. These results are consistent with multiple studies indicating that the interaction between biotic and abiotic factors enhances their role in controlling various plant pathogens by inducing systemic resistance in plants. Additionally, these factors stimulate plant growth by promoting the production of growth regulators and other bioactive compounds [21,1

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Table (7): Evaluation of the Efficiency of the Biocontrol Agent Pseudomonas fluorescens and Chitosan Against the Pathogenic Fungi Rhizoctonia solani and Fusarium solani and their Effect on the Growth Parameters of Eggplant Under Greenhouse Condition

NO.	Treatment	Shoot Length (cm)	Shoot Weight (g)		Root Length (cm)	Root Volume (ml)	Root Weight (g)	
			Fresh	Dry			Fresh	Dry
1	Rs3	18.53	11.20	2.50	21.66	3.10	3.53	0.33
2	Rs3 + Pf	35.06	32.36	5.80	40.00	7.10	6.94	1.32
3	Rs3 +Ch	33.25	31.33	5.23	37.20	6.80	6.25	1.21
4	Rs3 + Pf +Ch	35.87	35.00	6.40	44.10	8.00	8.53	1.70
5	Rs3 + Bel	30.21	30.00	4.00	35.00	5.15	6.00	1.21
6	Fs2	17.17	10.03	2.00	20.33	3.00	3.36	0.21
7	Fs2 + Pf	33.93	31.50	5.60	39.00	7.00	6.70	1.31
8	Fs2 + ch	33.03	31.03	5.00	37.00	6.20	5.15	1.18
9	Fs2 + Pf + Ch	34.03	34.00	6.00	44.00	8.00	8.11	1.67
10	Fs2 + Bel	30.20	30.00	4.00	34.00	5.00	6.00	1.21
11	Pf	40.50	37.00	8.00	46.00	10.33	10.50	2.96
12	Ch	35.07	35.46	7.00	45.00	9.00	9.00	2.16

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13	Pf+ Ch	43.07	39.86	9.00	49.00	12.00	10.70	3.34
14	Control	32.20	30.50	4.37	35.40	5.20	6.50	1.51
LSD=0.05		0.894	0.9466	0.8010	0.999	0.894	1.315	0.1325

Each number represents the average of three replicates, Rs3 = Rhizoctonia solani, Fs2 = Fusarium solani Pf= Pseudomonas fluorescens ch=, Chitosan, Bel= Beltanol

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