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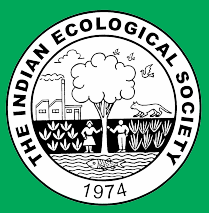

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Effectiveness of *Azotobacter* and *Azospierillum* in Controlling Cucumber Root Rot Pathogens

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Abstract: The study aimed to identify the problem in some region of Babylon province, isolate and diagnose the pathogen and evaluating the effectiveness of some biological control agents in disease resistance under laboratory conditions and lath house. The results of the field survey showed the presence of cucumber root rot disease in all areas covered by the survey in Babylon province, with infection ranging between 70-90% and infection severity from 30-68%. The isolation results showed the presence of 10 types of fungi associated with the roots of the infected cucumber plant, and *Fusarium solani* was the most frequent fungi. It appeared in most samples with different rates of frequency and at rate of 75.05%, followed by the fungi *Rhizoctonia solani* with a frequency of 62.05%. The use of *Azotobacter chroococcum* as a biological control agent inhibited the growth of pathogen *R. solani* (Rs-1) and *F.solani* (Fs-6) and *M. phaseolina* (Mp-2) in the PDA culture medium with good inhibition percentage. The isolation results showed the presence of 10 types of fungi associated with the roots of the infected cucumber plant, and *Fusarium solani* was the most frequent fungi. It appeared in most samples with different rates of frequency and at an average of 75.05%, followed by the fungi *Rhizoctonia solani* with a frequency of 62.05%. The results showed that the biological resistance factors *A. chroococcum* and *Azospirillum brasilense* interaction with each other, close to the efficiency of the Beltanol treatment in controlling pathogenic fungi. The results showed that all the treatments led to a significant increase in the studied cucumber plant growth parameters in increasing the plant height, fresh and dry weight.

***Keywords*:** Cucumber, Root rot disease, Biological control, Azotobacter, Azospirillum

The cucumber crop (Cucumis *satius* L.) belongs to the Cucurbitaceae family, where it is considered one of the economically important summer vegetable crops in Iraq. India, Africa and China are considered the origin country of cucumbers, where it was cultivated in these areas for thousands of years. In Iraq, cucumbers are grown in open fields in two seasons (spring and autumn) and also in the protected environment in tunnels, greenhouses and lath house. The area cultivated by the cucumber crop in Iraq was 69,502 dunums and yield was 149,302 tons in 2019 (Central Bureau of Statistics, 2019).The crop is exposed to many diseases, the most important of which is root rot disease caused by infection with many fungi, the most common of which is Schwartz (*Fusarium solani*,). As this fungus attacks crops in fields and greenhouses, it targets plant roots and stems bases, leading to rotting, plant wilting and death in advanced stages of the disease (Jamiolkowska et al 2011). *Rhizoctonia solani* also attacks the plant, causing seed rot, seedling death, and root rot (Agrios 2005, Al-Fadhal et al 2019). The incidence of this disease depends on the toxicity of the causative agent, the sensitivity of the host, and environmental conditions and entire fields can be affected by this disease. Seedling death disease and root rot caused by many fungi, including *Aphanomyces* spp, *Pythium* spp. and *Phytophthora* spp. and *Rhizoctonia* spp. *Fusarium* spp., *Macrophomina phaseolina* , *Phoma* spp., *Aphanomyces euteiches* and *Thielaviopsis basicola* (Bodah 2017, Gondal et al 2019, Ayala-Doñas et al 2020). The most common causes of root rot disease are *Macrophomina Phaseolina*, *Rhizoctonia solani*, *Fusarium oxysporum* and *F. solani*, which cause significant losses in many economic crops (Parveen et al 2020). Plant growth promoting *Rhizobateria* (PGPR), including *Azotobacter chroococcum* and *Azosperillium sp*. stimulate the growth of roots have been studied extensively. The importance of this species is not only in fixing atmospheric nitrogen, but also characterized by its ability to make plant hormones, the most important of which is indole acetic acid, and it also contributes to increasing plant tolerance to biotic and abiotic stresses.

MATERIAL AND METHODS

Survey of cucumber root rot disease: The field survey for the agricultural season 2018-2019 was conducted in 9 different areas of Babylon province. Samples were collected from plants that showed symptoms of general weakness in growth, yellowing of leaves, wilting of the plant and brown rot

on the main and secondary roots. Samples were taken for each field randomly by the intersection of the diagonals and the percentage of infection was calculated by taking 10 plant roots from different regions, The samples were brought to the laboratory in polythene bags. It was stored in the refrigerator at 4°C until the fungi accompanying the roots were isolated from each sample. The percentage of injury was calculated according to the following equation:

$$\text{Percentage of infection} = \frac{\text{The number of infected plants}}{\text{Number of plants tested}} \times 100$$

The infection severity was calculated for the root total according to the pathological index consisting of 5 degrees, as follows: 0 = healthy roots. 1 = secondary root rot. 2 = secondary root rot and part of the main root. 3 = main root rot without stem base rot.4 = main root rot, rotting, and stem base rot. 5 = Plant death. The percentage of infection severity was calculated according to Mckinney's equation (1923) as follows:

$$\text{Severity of infection} = \frac{\text{Number of plants degree (0 *0)} \ldots\ldots \text{Number of plants degree (5*5)}}{\text{The highest degree} \times \text{the total number of tested plants}} \times 100$$

Isolation and diagnosis of the fungi that cause rotting of cucumber roots: Pathogens were isolated from infected cucumber roots (Fig. 1) on the next day of collection of samples in the laboratory. The roots were washed with running water for 2-3 minutes and cut into small pieces 0.5-1 cm long. They were surface sterilized by immersing them for 2-3 minutes in a solution of sodium hypochlorite (1% free chlorine), washing with sterile distilled water for two minutes and dried with sterile blotting paper, and the pieces were transferred to Petri dishes at 4 pieces in each petri dish of 9 cm diameter with four replicates. For each treatment, each plate contains 15-20 cm^3 of Potato Dextrose Agar (PDA). The antibiotic Tetracycline was added to it at a concentration of 250 mg/L after sterilization with autoclave at 121°C and 1.5 kg cm^2 for 20 minutes and after cooling to 48°C. The dishes were placed in the incubator at a temperature of 25 ± 1°C for a period of 4 days, after which the dishes were examined and the fungi were diagnosed by Dr. Ahed Abd Ali Hadi based on the agricultural and phenotypic traits by following the approved taxonomic keys. According to the frequency of the presence of fungi in the dishes was calculated as:

$$\text{Percentage of fungi presence} = \frac{\text{The number of root pieces in the dishes in which the pathogenic fungi appeared}}{\text{The total number of root cuttings used for each sample}} \times 100$$

After that, a purification of the fungi was conducted by transferring small pieces from the ends of the pathogenic fungal hyphae and placing them in the center of a petri dish containing the PDA. The plates were incubated for 4 days and the isolates were given numbers according to the sequence and areas of isolation.

Detection of pathogenic isolates using radish seeds: The pathogenicity of *F. solani*, *R solani* and *M. phaseolina* isolates was tested according to the method of Bolkan and Butler (1974) by inoculating with petri dishes of 9 cm diameter (container with 15-20 cm3 of more agar culture medium and water agar (WA) with the addition of the antibiotic Tetracyclin 250. mg L^{-1} after sterilization with a buffer device at temperature of 121 ° C and a pressure of 1.5 kg cm^{-2} for 20 minutes with a disc of 5 mm diameter. The tablet was placed in the center of the plate. Four plates were used for each isolation. The dishes were placed in the incubator at a temperature of 25 ± 2°C for a period of 3 days, after which they were planted with local radish seeds which were surface sterilized with sodium hypochlorite solution for two minutes, at 25 seeds /plate in a circular motion near the edge of the plate at approximately equal distances. For each isolate, in addition to the control treatment without pathogen, the plates were incubated after sowing radish seeds in the incubator at a temperature of 25 ± 1°C for 7 days after and percentage of seed germination was calculated.

Preparing pathogenic fungi vaccines by loading them on millet seeds: Pathogenic isolates were prepared according to the Dewan method (1989). *Panicum miliaceum* seeds were used to prepare the fungal vaccines, the millet seeds were taken and washed thoroughly with water to remove the dust and impurities related to them, then soaked for 6 hours with water, after which it was left on a piece of gauze for half an hour to remove the excess water from it. The 50 g of seeds were put into a 250ml glass beaker and sterilizing the flasks in the autoclave for one hour. The flasks were left for three days, then inoculating each beaker with five 0.5 cm diameter PDA tablets containing the fungi growths. The flasks were incubated at a temperature of 25 ± 1 C° for 15 days. The jugs as shaken by hand every 3 days to ensure aeration and distribute the fungi to all seeds.

Preparation of *Azosperillium sp.* and *Azotobacter sp:* Isolation of the bacteria *Azosperillium sp*. and *Azotobacter sp* from the laboratory of the Agriculture College belonged to the University of Baghdad, for use in laboratory experiments, lath house and field experiments, where this bacteria was grown on the culture medium (Nutrient broth NB) by placing 50 ml of this medium in a 100 ml conical flask and. The flasks were incubated in the incubator at 30°C. for a period of 2-3 days. For the purpose of preparing a sufficient amount of vaccine for field experiments, 250 ml conical flasks were prepared each

containing 100 ml of the liquid activated culture medium and after sterilizing them with an autoclave, inoculate each of them by adding 1 ml of the prepared liquid culture .These flasks were incubated a temperature of 30°C. for 2-3 days (Black 1965).

Numbers of bacteria: The Plate Count Technique was followed to calculate the total number of *A. chroococcum* bacteria. Dilutions 10^{1}-10^{7} were prepared by transferring 1 mL of growing bacteria culture on to a liquid activation medium at 3 days age into a series of sterile distilled water tubes using a sterile micropipette. Transfer 1 ml, starting from the fourth dilution, to a Petri dish containing the medium (Nutrient broth NB) with the movement of the plate.

Number of bacteria/ml of the original sample = number of colonies in the dish x inverted sample dilution.

Antagonistic of *Azotobacter* and *Azosperillium* against *Fusarium solani*, *Rhizoctonia solani* and *Macrophomina phaseolina* on PDA culture media: The antagonistic activity for the nitrogen fixing bacteria against the pathogen *F. solani* (Fs-6), *R. solani* (Rs-1) and *M. phasolina* (Mp-2) was tested on the PDA culture medium by adding 1 ml of suspension to each of the bacterial isolates. This was grown on liquid activation medium aged 5 days in the middle of a petri dish containing the PSA culture medium and moving it in a circular motion to distribute the vaccine homogeneously. A 0.5 cm diameter disc from the 7-day-old pathogen culture was placed in the center of the plate. Four plates were used for the treatment and 4 plates were left without adding bacteria as a control. The plates were incubated (25 ± 1 Mº for 7 days) (Fatima et al. 2009). The growth rate of the pathogen and the percentage of inhibition were calculated according to the following equation:

$$\text{Percentage of inhibition} = \frac{\text{Fungus growth in control treatment} - \text{fungus growth in treatment}}{\text{Fungus growth in control treatment}} \times 100$$

Evaluation of the efficiency of some biological: The experiment was conducted in the lath house of Al-Mussaib Technical College, using 3 kg plastic pots containing loam soil sterilized in an autoclave. The experiment was conducted using complete randomized design and with three replicates for each treatment. The bacterial suspension was added to the soil according to Singh et al. (2008), with some modifications. The 10 ml of suspension were added to each pot with 2 x 710 CFU / ml for *Azotobacter* and 8 x 610 CFU / ml for *Azosperillium* three days before adding the pathogen. Beltanol was also added within the aforementioned treatment at a concentration of 1 ml / liter after one day of adding the pathogen. The control treatment was without any addition. The pot was sown with local cucumber seeds (not treated with fungicides) Super Faris with seeds/pot. The data were calculated after 10 days on percentage of germination. The percentage and infection severity, fresh and dry weight and plant height were calculated after 40 days of the experiment.

RESULTS AND DISCUSSION

Field survey for cucumber root rot disease: The cucumber root rot disease indicated varying percentage of infection ranging between (70-90%) and the severity of infection from (30-68%).The highest severity of infection was in samples from the areas of Jableh, Abu Gharaq, Al-Muhawil, Al-Mussaib and Al-Azzawiya, with infection of 80, 85 and 90% respectively. The reason for the high incidence in these regions may be due to the fact that they are specialized regions for cucumber cultivation. This crop is grown annually in it, which led to the accumulation of pathogenic fungi, especially sclerotia stone bodies that remain in the soil for a long period of up to five years (Vadakattu and Paterson, 2005). The reason for the difference in infection percentage may be the difference in agricultural operations and adding organic and chemical fertilizers.

Environmental factors such as humidity and temperature have a great effect on increasing the fungus vaccine, as well as increasing the pathogenicity of fungi as all of these factors affect plants, making them more sensitive to the response to plant pathogens. The lowest percentage and severity of infection appeared in the samples of Al-Kifl, Al-Bada and Al-Hilla region, and the reason is due to the fact that these regions were cultivated with crops for the first time, as well as differences soil and crop service operations.

Isolation and diagnosis of infected cucumber root fungi: The isolation showed the presence of 10 types of fungi accompanying the infested roots of the cucumber plant, which showed symptoms of the disease represented by yellowing of the leaves, weakness of the plant, the appearance of ulcers on the bases of the stems, and rot of the main root and secondary roots (Table 2). *Fusarium solani* was the most frequent fungus. It appeared in most samples with different percentage of recurrence, with a rate of 75.05%. It was followed by the fungi *Rhizoctonia solani* with a frequency of 62.05% and *acrophomina phaseolina* in the samples from Al Mahawil area, Jableh and Al Mussaib, 68.75%, while *M. phaseolina* recorded an appearance in a number of regions. The results are consistent with Rahim et al (2013) where the *R.solani*, *F.solani* and *M. phaseolina* is one of the main pathogens of cucumber root rot. Al-Fadhal et al (2019) found that the pathogenic fungi *Rhizoctonia solani* and *Fusarium solani* were the main causes of root rot and seedling death in cucumbers.

The isolation results showed the appearance of some

fungi associated with the roots of the cucumber plant, *F.oxysporum* and *F. sulphureum*, which may have a parasitic ability on plants, and some fungi such as *Aspergillus flavus, Aspergillus niger* and *Rhizopus sp*. The presence of these types of fungi may be due to their growth and penetration of their fungal spin inside the decomposing plant tissues that were previously infected with the fungi that cause root rot, which provided them with protection from the surface sterilizer and also found another group of fungi with less frequency, including *Alternaria alternata* and *Pythium sp*. The isolates, according to the priority of isolating them, were given numbers next to the fungus symbol, to distinguish them from other isolates. The fungus *F. solani* colonies were characterized by white to gray colony color and the formation of small conidia spores with large oval numbers, Microconidia, and large macroconidia crescent-shaped, divided by transverse septa, and chlamydospores with rough wall and bilaterally divided (Carling 2002). As for the isolates of *M. phaseolina* colony was characterized by a dark charcoal color, with an aerobic mycelium of medium density and consistent with the food medium. The stone bodies formed are characterized by their small size and almost spherical shape. The fungus *M. phaseolina* survives from one season to the next mainly in the form of small stone bodies in the remains of the host or in the soil and is the main source of primary vaccine for the fungus (Mihail 1992).

Pathogenicity Test

Detection of pathogen isolates by using radish seeds: The results showed that all *R. solani*, *F. solani* and *M. phaseolina* caused a significant reduction in the percentage of radish seed germination, where showed that there was a variation in the pathogenicity of isolates of fungi (Table 3) (Fig. 1), where the isolates Rs-1,3-Rs-, Rs-. 6, Fs-1, 5Fs-, 8Fs- and 1Mp-, Mp-2 were superior with their pathogenic

Table 1. Field survey of cucumber root rot disease in some fields in Babylon province for the agricultural season 2018-2019

Sample number	Region	Date of survey (2019)	Field area / dunums	Infection percentage (%	Infection severity (%)
1	Al Azzawiyah	26/4/2019	3	90	66.0
2	Al Bada	25/4/2019	4	70	31.0
3	Al Nil	1/5/2019	2	75	33.0
4	Al Mahawil	28/3/2019	1.5	85	40.1
5	Al Mussaib	22/7/2019	3	90	68.0
6	Jableh	2019/8/19	4	80	44.5
7	Al Kifl	2019/8/10	5	70	32.0
8	Center of Hilla	7/3/2019	3	70	50.0
9	Abu Gharaq	2019/8/1	2.5	80	30.0

Table 2. Percentages of fungi associated with the infested roots of the cucumber plant, their locations, and their frequency in samples

Fungus	Sample number	Highest percentage of fungus appearance	Average of fungus appearance (%)
Fusarium solani (Mart.) Sacc.	9,1	96.00	75.05
Rhizoctonia solani Kuhn	1,7	93.05	62.05
Macrophomina phaseolina (Tassi) Goid.	1,2,4,6	85.00	68.75
Aspergillus niger Van Tieghem	8,5,2,1	15.00	5.00
Fusarium sulphureum Schlecht	5,1	50.00	27.05
Fusarium oxysporum Schlecht	1-8	68.00	21.00
Rhizobus sp.	2,3,4	15.00	13.75
Aspergillus flavus	62,	12.06	12.05
Pythium sp.	3,1	8.00	6.25
Alternaria alternata (Fres.) Keissler	4,2	17.00	11.00

*Figures represent sample collection areas (Table 1)

potential on the rest of the isolates, which was evident in the effect of reducing the percentage of germination that was 0% in treatments compared to the control treatment in which the germination percentage was 96%. The other isolates achieved a significant reduction in germination percentage of radish seeds. The reason for the variation of the isolates in their effect on the germination percentage of radish seeds ranged between 8.00-25.33 percent.

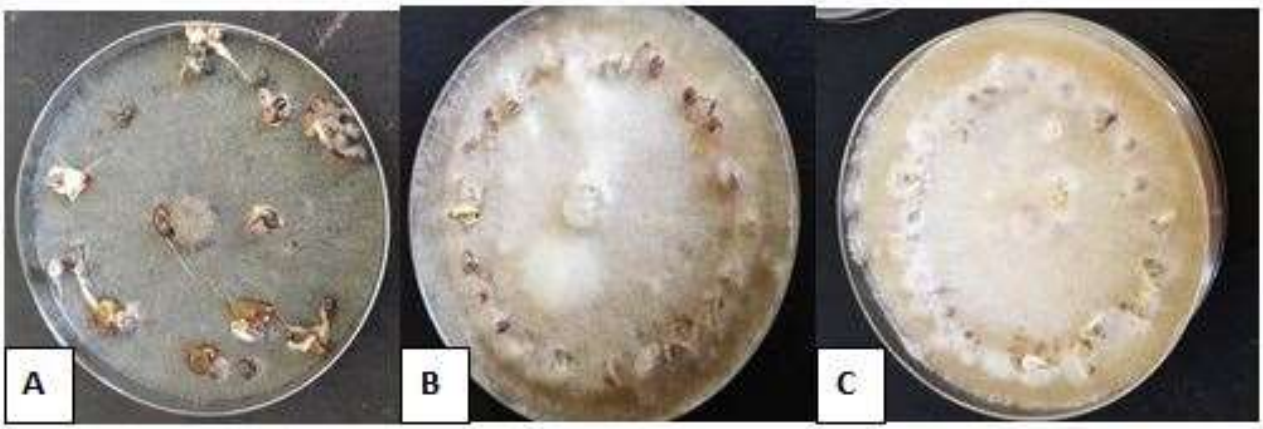
Antagonistic effect of *A. chroococcum*, *Azospirillum brasilense* against cucumber root rot fungi on the medium (PDA): Inhibition of the isolation of bacteria and the different target fungi, indicated isolation of *A. chroococcum* achieved a reduction in the growth rate of pathogenic fungi isolates ranging between 0.9-0.733 cm and a good inhibition rate, and the highest inhibition percentage against *F. solani* (Fs-6), which was 93.70%. The effect of using these bacteria to inhibit the growth of plant pathogenic fungi, it may be due to the ability of bacteria to produce metabolites, organic compounds, and indole acetic acid, some enzymes and antibiotics, and the production of hydrogen cyanide, etc., as well as their competition of pathogens for space and food (Hillel 2005, Sumbul et al 2020). The use of *Azospirillum brasilense* bacteria as a biological control agent also inhibited the growth of pathogenic fungi *R.solani* (Rs-1), *F. solani* (Fs-6 and (Mp-2) *M. phaseolina* in the PDA culture medium (Table 4). The percentages of inhibition varied according to the different target fungi, where the isolation of *A. brasilense* bacteria achieved a reduction in the growth rate of pathogenic fungi isolates ranging between 0.93-1.57 cm and a good inhibition rate between 82.24- 89.62%. The highest rates of inhibition against the fungus ((R.s) (89.62%).

Effect of biological control agents and Beltanol on the percentage and severity of the infection and some growth parameters of cucumber root rot disease under lath house conditions: The bacteria *A. chroococcum* achieved a reduction in the incidence and severity of the pathogenic fungi *F. solani* by 45.00 and 31.67%, *M. phaseolina* 42.00 and 31.33% and *R.solani* by 42.67 and 30.00%. As reduced the percentage and severity of the disease without a significant difference between the two

Table 3. Detection of pathogen isolates associated with cucumber roots infected with radish seed

Isolates	Germination (%)
Rs-1	0.00
Rs-2	25.33
Rs-3	0.00
Rs-4	9.33
Rs-5	16.00
Rs-6	0.00
Fs-1	0.00
Fs-3	12.00
Fs-4	24.00
Fs-5	0.00
Fs-6	8.00
Fs-7	20.00
Fs-8	0.00
Fs-9	8.00
Mp-1	0.00
Mp-2	0.00
Mp-3	8.00
Mp-4	12.00
Control	96.00
LSD (p=0.05)	5.12

Each number represents an average of three replicates
Rs = *R. solani*, Fs = *F. solani*, *M. phaseolina* M.p = Number next to the symbol represents the isolate number



A. *Fusarium solani* B. *Rhizoctonia solani* C. *Macrophomina phasiolina*

Fig. 1. Effect of pathogenic fungi on radish seed germination in PDA

treatments, which differed significantly from the treatment of the plant with the pathogenic fungi *R. solani*, *F. solani*, *M. phaseolina* alone had an infection percentage of 100% and infection severity of 88.33, 88.67 and 80.00%, respectively. The treatment of *Azospirillum* sp. reduced the percentage of infection and its severity, where caused a significant reduction in the severity of infection, which ranged between 30.00, 31.00, and 32.33% compared to the control treatment. The interaction treatment was excelled between *Azospirillum* sp. and *A. chroococcum* and decreased the percentage of infection with the pathogenic fungi Rs-1, Mp-2 and 6-Fs to low levels of 27.33 and 24.00, 27.33, 22.00%, 33.00 and 25.00%, respectively. The results showed that the biological resistance factors *A. chroococcum* and *Azospirillum brasilense* interaction with each other close to the efficiency of the Beltanol treatment in controlling pathogenic fungi (Meister 2000).

A. chroococcum bacteria play an important role in antagonism with pathogenic fungi through their competition for location and nutrients, especially iron, to form siderophore, which may also have a catalyst role for systemic resistance induced in plants and the resulting actions and inhibitory compounds for pathogenic fungi (Glick and Bashan 1997, Hofte and Bakker 2007). The results showed that all treatments used for the purpose of controlling the pathogens of cucumber root rot disease achieved a significant increase in the growth indicators represented by the fresh and dry weight of the treated plants compared to the treatment of the pathogen alone, and the complementary treatment between the bacteria *A. chroococcum* and *Azospirillum brasilense* bacteria, in the presence of the pathogen on the rest of the treatments, achieved the highest increase in the average fresh weight, reaching 40.33-47.00 g and the dry weight 13.33-12.33-12.66 g, respectively, compared to the pathogenic fungi, Fs, Rs Mp alone, which reached a plant height of 19.00. -20. 00-19.00cm, soft weight 18.33-20.66-21.00g, and dry weight 5.00-6.00-6.33g, respectively. On the other hand, the treatment of pathogenic fungi with the chemical pesticide Beltanol contributed to a significant increase in fresh and dry weight, whose rates ranged from different pathogenic fungi between 28.00 -31.33 gm for fresh weight and 9.00-10.33 g. On the other hand, the addition of biological control agents alone led to a significant increase in the fresh and dry weight of the cucumber plant and a significantly excelled for the treatment of the interaction between *A. chroococcum* and *Azospirillum brasilense* bacteria, which improved both the fresh and dry weight. The results also showed that interaction treatment between biological agents improved plant height and height increased to 39-42 cm. The integration between *A. chroococcum* and *Azospirillum brasilense* without pathogenic fungi excelled 48.67% compared to the control treatment without any addition (23.67 cm). The lowest average of dry and fresh weight were 21.10 and 2.81 g / plant, respectively, in the treatment of *R. solani* pathogen compared to the control treatment in which the fresh and dry weight were 48.80 and 10.70 g / plant, respectively. *A.chroococcum* is at the forefront of the bacterial species that stimulate plant growth (PGPR), where it fixes atmospheric nitrogen in a non-symbiotic manner and increases the availability of nutrients, especially iron through its production Siderophore and also has the ability to produce plant hormones, including IAA, gibberellins, cytokinins and auxin, which have great importance in regulating plant growth and development (Mrkovacki and Milic 2001 , Vaddar 2007). It also produces many vitamins and enzymes that degrade organic matter in

Table 4. Effect of antagonistic activity of *A. chroococcum* and *Azospirillum brasilense* against pathogenic fungi *R.solani*, *M. phaseolina* and *F. solani* root rot of cucumber on PDA

Treatments	Inhibition percentage (%)	Diagonal growth average (cm)
Rs-1 fungus alone (control treatment)	0.00	9.00
Rs-1 + *A. chroococcum*	91.82	0.733
fungus Rs-1 + bacterium *Azospirillum sp*	89.62	0.93
F.s fungus on its own	0.00	9.00
Fs-6 + *A. chroococcum*	93.70	0.57
fungus Fs-6 + bacterium Azospirillum sp	82.24	1.6
Mp-2 fungus alone	0.00	9.00
Mp-2 + *A chroococcum*	89.99	0.9
Mp-2 + bacterium *Azospirillum sp*	82.62	1.57
LSD at 5%	4.710	0.61

The number next to the symbol represents the isolation number: Rs = Rhizoctonia solani، Fs= Fusarium solani ، Mp= M. phaseolina A= Azotobacter chroococcum، brasilense A.= A

Table 5. Effect of *Azotobacter chroococcum* and *Azospirillum brasilense* on the percentage and severity of cucumber root rot disease, and some parameters under lath house conditions

Treatments	Plant height (cm)	Dry weight (g)	Fresh weight (g)	Infection severity (%)	Infection percentage
Rs-1	19.00	5.00	18.33	88.33	100.0
Rs-1+Azot	37.00	11.33	33.33	30.00	42.67
Rs-1+Asp	36.00	10.67	32.00	30.00	45.00
Rs-1+AA	42.00	13.33	40.33	24.00	27.33
Rs-1+Belt	25.00	10.00	31.33	20.00	25.00
Mp-2	20.00	6.00	20.66	80.00	100.0
Mp-2+ Azot	28.00	11.00	40.33	31.33	42.00
Mp-2+ Asp	29.00	12.00	41.33	32.33	43.00
Mp-2+AA	42.00	12.33	47.00	22.00	27.33
Mp-2+Belt	26.00	9.00	28.00	18.00	23.00
Fs-6	19.00	6.33	21.00	88.67	94.67
Fs-6+Azot	35.00	12.67	36.66	31.67	45.00
Fs-6+Asp	29.00	12.88	36.33	31.00	48.33
Fs-6+AA	39.00	12.66	47.00	25.00	33.00
Fs-6+Belt	24.00	10.33	30.00	20.33	28.00
Azot	38.00	14.00	50.00	0.00	0.00
Asp	39.34	15.67	52.00	0.00	0.00
AA	48.67	16.66	58.00	0.00	0.00
Control	23.67	12.33	19.00	3.00	15.00
LSD (p=0.05)	1.807*	0.752*	2.250*	3.522*	3.521*

* Each number represents an average of 3 plants / replicates, and with three replicates.
The number next to the symbol represents the isolation number: Rs-1 = *Rhizoctonia solani*، Fs-= *Fusarium solani* ، *Macrophomina phaseolin a* =M.P، Azot =*Azotobacter chroococcum*، *Azospirillum brasilense* Asp =، Bel = Beltanol

the soil and restore the role of elements and prepare them for the plant (Juarez et al 2005, Torres-Rubio et al 2007, Verma et al 2010).

CONCLUSIONS

The presence of cucumber root rot disease in all surveyed region in Babylon province was observed. The main pathogens of cucumber root rot are *Fusarium solani*, *Rhizoctonia solani*, and *Macrophomina phaseolina*. The use of *A. chroococcum* and *Azospirillum brasilense* as a biologic control agent against pathogenic fungi provide effective control. The two biological resistance factors *A. chroococcum* and *Azospirillum brasilense* interaction with each other achieved the best results in controlling pathogenic fungi and provided good protection for cucumber plants from infection with root rot pathogens.

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