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ORIGINAL ARTICLE

EFFICIENCY OF SOME OF BIO-FORMULAS AGAINST FUNGI CAUSED SUNFLOWER ROOT ROT DISEASE

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Abstract: The aim of this study was to isolation and identification of Sunflower root rot causes in Babylon province fields and Evaluation of the efficiency of some biological and chemical products in their control under Laboratory conditions. The results of the field survey showed the presence of Sunflower root rot disease in all the surveyed areas with disease incidence of 20-55%. Results of isolation and identification and microscopic characteristics showed the presence of some species of fungi associated with Sunflower infected plants, *Macrophomina phaseolina* was presented in all samples with a rate of 100% followed by *Fusarium solani* and *Rhizoctonia solani*. The test of Pathogencity for isolates showed that these fungi *R. solani*, *F. solani*, *M. phaseolina* were pathogenic and responsible to Sunflower root rot disease. The results appeared that effective microorganisms (EM1) formula was very effective and had high antagonistic activity against pathogenic fungi which decrease growth of the most aggressive and speediest isolate *R. solani* with inhibitory ratio 81.11%. Also inhibited growth of *Fusarium* and *Macrophomina* to 87.96 and 80.92%, respectively. Also, the results showed that Bio-Immune, Black tea and Cinnamon and Liquorice extract caused significant decrease in fungal growth in the medium. This appeared the highest antagonism against pathogens. The study ensured for the first time the activity of Effective Microorganism formula and Bio-Immune against fungi causes Sunflower root rot in the world.

***Key words*:** Sunflower, Root rot, Effective microorganisms, Bio-Immune, Beltanol, Plant extract.

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1. Introduction

Helianthus annuus L. is one of the most important economic plants in the world and Iraq. The crop is grown mainly for its seeds as it is the second source of oil in the United States, Argentina and Ukraine. It also has other uses such as soap, folk medicine. The crop area in Iraq for 2017 was estimated at 1086 donum produced 486 tons [Central Statistical Origination (2018)]. Sunflower plant is infected by many agricultural pests, including fungal diseases. In the forefront of these diseases are the damping off and root rot diseases, which is a common disease on the sunflower. *Fusarium solani*, *Rhizoctonia solani* and *Macrophomina phaseolina* are among the most dangerous causes [Dugan (2006)]. Various methods have been used to control soil fungi. Chemical control is one of the most widely used methods for its ease of use and its effect on the causes. However, its repeated use led to the emergence of many problems, including the appearance of resistance and also the environment pollution. In light of the specific factors for the use of chemical pesticides, especially those related to environmental pollution and the impact on human health and the disruption of natural balance emerged biological control as a practical solution to the prevention of plant diseases, including root causes of diseases. Researchers have increased their interest in organic pesticides and Bio-formula such as effective microorganisms (EM1), a commercial fertilizer containing a mixture of beneficial microorganisms collected from the natural environment, including photosynthetic bacteria, lactic acid bacteria,

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beneficial yeasts and actinomycetes, which have a role important in plant growth and protection from pathogens. Researchers have also increased the interest in recent decades to use plant extracts against many pathogenic fungi of the plant, because they contain these extracts of secondary metabolites effective on fungi and characterized by rapid degradation and low toxicity of Mammalians and high specialization [Chung *et al.* (2002)]. As the sunflower crop of strategic crops in Iraq and as an attempt to find ways of modern control alternative ways to reduce the use of chemical pesticides, the study aimed to identify the causes of root rot disease of the sun flower after isolation and diagnosis in some fields of Babylon province and evaluation of the effectiveness of some biological and chemical preparations and plant extracts against the causes of sunflower root rot under laboratory conditions.

2. Materials and Methods

2.1 Field survey

A field survey was carried out at six sites for the fields of sunflower cultivation in Babylon Governorate for the period from 18/7-20 / 8/2016 (Table 1). The infected and intact plants were examined within the crossroads of each site and the number of infected plants was calculated according to the symptoms shown on the plants and the disease incidence of root rot per field was estimated using the following formula:

Disease incidence (%) = Number of infected plants/Total number of tested plants × 100.

2.2 Isolation and Diagnosis

The fungi were isolated from the plants of the sunflower, which showed the symptoms of the infection the fungi grown on potato Sucrose Agar (PSA) (200 g potatoes, 10 g sucrose and 20 g sugar. In 1 liter of distilled water (tetracycline) at 200 mg/L. After sterilization of the medium, dishes placed in the incubator at 25 ± 2°C for a period of 3 days, different fungi were purified by transferring small pieces of fungal filaments and placed in the center of a petri dish containing the PSA and tested with the compound microscope. The fungus was identified depending on the morphological and microscopic characteristics of the species level [Dugan (2006)].

2.3 Detection of pathogenic isolates of *Rhizoctonia solani*, *Fusarium solani* and *Macrophomina phaseolina*

The pathogenicity of 18 isolates of *R. solani*, *F. solani* and *M. phaseolina* (6 isolates of each species) were isolated from the roots of the sunflower plants and according to Bolkan and Butler (1974) by preparing 9 cm diameter Petri dishes filed with 15-20ml of the water agar (WA) is the contain of the 20g Agar per liter of distilled and sterilized water, colony *R. solani*, *M. phaseolina* and *F. solani*, growing on the WA medium for three days and four days and seven days in a row. After three days of incubation, then 25 local cabbage seeds were planted around fungal colony after 7 days of planting. The percentage of seed germination was calculated according to the following equation:

% germination = Number of seeds grown / Total number of seeds × 100.

2.4 Effect of pathogenic isolates *Rhizoctonia solani*, *Fusarium solani* and *Macrophomina phaseolina* in germination of sunflower seeds and plants

In this experiment, 15 cm diameter plastic pots was filled with sterile soil (in Autockave at a temperature of 121°C and 1.5 kg/cm^2 for 1 hour, left for 7 days before use for ventilation. Fungus inoculum was added to the local millet seeds [Dewan (1989)] by 1% (weight/weight). Sunflower seed seeds and at a rate of 5 seeds per pot under lath house condition. The percentage of germination and disease incidence after thirty days of planting was calculated by using the following equation:

% disease incidence = Number of infected plants / Total number of tested plants.

The severity of infection was estimated using the following pathological evidence: 0 = healthy roots 1-rotting 1-25% of the root. 2-coloring rotting 26-50% of the root. 3-coloring the root by 51-75%. 4- coloring the root with dark brown color more than 75-100%. 5-Plant death and the percentage of severity was calculated using the Mckinney (1923) equation as follows:

Severity(%) = [(Plants in 1 degree ×1+… Plants in 5 degree ×5)/ all plants × 5] × 100%.

2.5 Effect test of EM-1 on the growth of pathogenic fungi in the PSA medium

The antagonism potential of Effective microorganisms (EM-1) (obtained by Dr. Kamel Salman Jabur / Baghdad University-college of Agriculture) was tested against pathogenic fungi *Rhizoctonia solani*,

Table 1: Plants used to study their effect against pathogens.

Common name	Scientific Name	Used parts	Site of collection
Cinnamon	*Cinnamomum zeylanicum*	Bark	Local markets
Sage	*Salvia officinalis*	Leaves	Al-Mussaib Technical institute
Black tea	*Camellia sinensis*	Leaves	Local markets
Licorice	*Glycyrrhiza glabra*	Leaves	Euphrates river-Al-Musaib city
Coriander	*Coriandrum sativum*	Leaves	Local markets
Cumin	*Cuminum cyminum*	Leaves	Local markets
Wild mustard	*Sinapis arvensis*	Seeds	Local markets

Fusarium solani and *Macrophomina phaseolina*. Add 10% of EM1 to the PSA. Incubate the dishes at 25 ± 2°C and after the fungal colony diameter of the control treatment to the edge of the dish. The growth diameters of the colonies were measured and the rate of inhibition was calculated.

2.6 Evaluation of the efficacy of Bio-Immune and Bettanol in the inhibition of pathogenic fungi *Rhizoctonia solani*, *Fusarium solani* and *Macrophomina phaseolina* on the PSA

The Bio-Immune (BI) pesticide was added with 15% concentration to the center of the petri dish contain PSA medium. The Beltanol (Bel) is added at 1 mL/L. The treatment of the fungus was carried out with a pathogenic fungi *R. solani*, *M. phaseolina* and *F. solani*. The results were obtained after the growth of the fungus in the control treatment to the edge of the dish. The percentage of inhibition was calculated.

3. Results and Discussion

3.1 Field survey of the root rot of sunflower

The results showed (Table 2) the presence and spread of the root rot disease of the sun flower plant in all the fields of the surveyed areas in the province of Babylon and varying rates of disease incidence ranging between 20-55%. The highest disease incidence of root rot in the samples of the areas of Alexandria / Haswa area and the district of Mahaweel/Jabla area and the Nile which was 50-55%. The reason for the increase in the incidence of these areas is that they are specialized areas in the cultivation of sunflower plant, where this crop is grown annually, which may lead to an increase in the density and accumulation of fungus pathogens and especially the Sclerotia, which remain in the soil for a long period up to five years or in the form of resistant spores or fungal filaments on plant remains. The symptoms of infection on plants appeared yellowing the leaves of the plant and some of them withered with weakness of plant growth and showed symptoms of discoloration of brown and rot on the roots and crown area and different degrees of infection. The results also revealed that the lowest disease incidence appeared in the samples. The reason may refer the Crop planting for first time or for different crop management processes.

Table 2: Areas covered by the field survey of the root rot of sunflower in Babylon Governorate.

No. district	Field districts\ Babylon	Data of sample	Disease incidence (%)
1	Alexandria / Haswa	18/7/2016	55
2	Mahaweel / Jabla	23/7/2016	50
3	Mussaib/ Jelawea	28/7/2016	35
4	Mahaweel / Badaa	4/8/2016	40
5	Mussaib/ Hamea	10/8/2016	20
6	Mahaweel / Nile	20/8/2016	50

3.2 Isolation and diagnosis of fungi associated with the roots of infected sunflower plant

The results of the microscopic assessment of the fungal growth of the infected sunflower roots on the PSA showed a number of associated fungi (Table 3). *Macrophomina phasiolina* was 100%. *Fusarium solani* was found in most samples with varying rates of recurrence at 86% and *Rhizoctonia solani* with 75%. Based on this, result was focused on the isolates of these fungi as they accompanied the condition of the target and gave an indication that it is the main responsibility for the disease of root rot of the sunflower and some were selected for subsequent tests. The results are consistent with those found by Matloob and Juber (2014) from *R. solani*, *F. solani* and *M. phasiolina*, which are the major fungi that causes sunflower plant root rot disease. Other fungal species such as *Rhizopus* sp., *Aspergillus niger* and *Penicillium* sp. But they have been shown to have low rates of recurrence and may be due to some cases of

Table 3: Fungi associated with the roots of the infected Sunflower and their location and frequency in the samples.

The fungi	No. of sample*	Average**
Macrophomina phaseolina (Tassi) Goid	1,2,4-6	100
Fusarium solani (Mart.) Sacc	1, 5	86
Rhizoctonia solani Kuhn	2,3	75
Aspergillus niger Van Tieghem	3,4	20
Rhizopus sp.	1,2,6	10
Penicillium sp.	6	5

Numbers represent sample collection areas (Table 1).*
**% repeating the fungus in the sample = number of pieces of plants in which the fungus appeared in the dishes / total number of pieces used in the sample × 100.

contamination of samples or secondary fungi that accompany the rotting of the root causes of the main causative fungi.

The isolates were given according to the priority of isolating numbers along with the symbol of the fungus distinguished from other isolates.

3.3 The Pathogenicity of fungal isolates on cabbage seeds

The results of this study (Table 4) showed that all the fungi isolated from the roots of the sunflower plant and the most frequently tested fungal isolates in *R. solani*, *F. solani* and *M. phaseolina* resulted in a significant reduction in seed germination on the water ager medium. There is a discrepancy in the susceptibility of the fungal isolates in their toxicity, if the RS2, RS3, FS1, FS2 and MP4 isolates prevent the germination of the seeds completely, causing the killing and rotting of the seeds before germination, reflecting their severe disease. Followed by RS1, RS6 and MP5 isolates. The germination rate was reduced to 2.67% compared to the control with 93.33%. While the other isolates achieved a significant decrease in the percentage of seeds germination, which ranged between 8.00-29.33%. These results are consistent with the findings of several studies that showed that most of the tested fungi causing plant root rot disease caused a significant reduction in seed germination [Al-Isawi (2010)]. The cause of the effect of the isolates is due to the level of the secretions of fungi from toxic secondary metabolic compounds such as Anhydro Fusarubin, Javanicin, Fusarubin, which kill the embryos and the ability to produce the enzymes that are responsible for the rot in the seeds and thus prevent germination.

3.4 The effect of some pathogenic fungi in the germination of sunflower seeds and plants

The results indicated (Table 5) that all tested isolates caused a significant reduction in germination of sunflower seeds under the conditions of the wooden canopy. RS2 isolates from *R. solani* inhibited the germination of whole seeds relative to the control treatment without adding the fungus, which had a germination rate of 86.7%. While the RS3 isolates caused an decrease 26.7%. The results showed that all isolates of *F. solani* and *M. phaseolina* tested caused significantly reduced seed germination rates between 13.3-73.3%, which differed significantly from the control treatment without adding the fungus. The results are consistent with what Khedri *et al*. (2014) confirm that *R. solani* fungus caused rot and kills seed and reduces seedling emergence. The results showed that all isolates were pathogenic to the sunflower plant with a high infection rate of 26.7-100% and an infection severity of 33.3% to 100% with significant differences

Table 4: Detection of pathogenic isolates of *Rhizoctonia solani*, *Fusarium solani* and *Macrophomina phaseolina* using cabbage seeds.

Isolate	% germination	Isolate	% germination	Isolate	% germination
RS1	2.67	**FS2**	0.00	**MP3**	17.33
RS2	0.00	**FS3**	8.00	**MP4**	0.00
RS3	0.00	**FS4**	12.00	**MP5**	2.67
RS4	9.33	**FS5**	9.33	**MP6**	29.33
RS5	12.00	**FS6**	21.33	**Control**	93.33
RS6	2.67	**MP1**	10.67		
FS1	0.00	**MP2**	24.00	**L.S.D.(P.0.05)**	3.82

RS = *Rhizoctonia solani*, FS= *Fusarium solani* , MP=*Macrophomina phaseolina*.

Table 5: Effect of pathogenic isolates *Rhizoctonia solani, Fusarium solani* and *Macrophomina phaseolina* in the percentage of germination, infection, severity and some growth parameters of sunflower plants under the conditions of the wooden canopy.

Isolates*	*Seed germination (%)	Disease incidence (%)	Disease severity (%)	Weight (g)			
				Wet		Dry	
				Foliage	Root	Foliage	Root
RS2	0.00	100.00	100.0	0.00	0.00	0.00	0.00
RS3	26.70	73.30	73.30	9.65	0.74	1.25	0.27
FS1	53.30	46.70	46.70	10.80	1.44	1.73	0.59
FS2	73.30	26.70	33.30	11.39	2.53	1.90	0.56
MP4	13.30	86.70	80.00	5.00	1.40	0.33	0.43
MP5	40.00	60.00	60.00	5.72	1.11	0.78	0.11
Control	86.70	0.00	0.00	13.11	4.13	2.62	0.94
LSD (*P*:0.05)	21.7	17.9	17.1	2.25	0.85	0.56	0.39

*RS = *Rhizoctonia solani*, FS = *Fusarium solani*, MP = *Macrophomina phaseolina*, the number next to the symbol represents the isolation number.

Table 6: Test of inhibitory potential of Effective microorganisms (EM-1) against pathogenic isolates *Rhizoctonia solani*, *Fusarium solani* and *Macrophomina phaseolina* on PSA.

Treatment	Growth rate (cm)	Inhibition (%)
RS2+ EM-1	1.7	81.11
FS1+ EM-1	1.1	87.96
MP4+ EM-1	1.7	80.92
RS2	9.0	0.0
FS1	9.0	0.0
MP4	9.0	0.0
LSD (*P*:0.05)	0.29	3.16

* Each number in the table represents a rate of three replicates, RS = *Rhizoctonia solan*i, FS = *Fusarium solani*, MP = *Macrophomina phaseolina*, the number next to the symbol represents the isolation number.

in the treatment of the control, in which the disease incidence and severity of infection was zero. It was observed that there are obvious signs of decomposition of the pathogens. This is one of the distinguishing signs. *R. solani* and other pathogenic fungi such as *F. solani and M. phaseolina*, which attack host seeds and cause them to be rotted and prevented from germination. Which leads to a significant reduction in the percentage of seeds grown through the killing of seeds or the weakening of the initiative and delay the emergence, and caused root rot and bases of seedling stems near the surface of the soil, causing the fall of seedling and death, forcing the farmer to patch and re-agriculture and the consequent losses and loss Season and heterogeneity of yield and productivity. The results also showed that the infection by pathogenic fungi led to a reduction in the measured plant growth parameters of the weight of the foliage and root, ranging 0.0-11.39 and 0.0-2.53g for wet weight, 0.0-1.9 and 0.0- 0.56g for dry weight, respectively (Table 4). The results of isolating the pathogen from the roots and bases of the stem infected with pathogenic fungi in this experiment showed that the phenotypic characteristics correspond to the characteristics of the fungi added to the soil and that they are the main causes of root rot disease and the bases of the stems of the sunflower plant. This was confirmed by previous studies that the fungi of *F. solani*, *R. solani* and *M. phaseolina* are among the major fungi that causes the root rot disease of the sunflower in the world. That the appearance of symptoms of rot roots and crown stems from attacking the fungal strains by direct penetration of the tissue and the extension of hyphae between the cells of the cortex or inside it sometimes causing the discoloration of brown and may occur before the arrival of fungal hyphae to it, because the fungi secrete toxic substances such as Fusaric acid, Acetic phenyl acid, P-hydroxy derivatives, and enzymes such as Pectinase, glucanase and Proteases, which assist to analyze plant roots and rot them, thereby reducing nutrient uptake and low plant growth.

3.5 Effect of EM-1 on the growth of pathogenic fungi on the PSA medium

The results (Table 6) showed that effective microorganisms (EM-1) had a high inhibitory effect on pathogenic fungi *R. solani* (RS2) and *F. solani* (FS1)

Table 7: Effect of Bio-Immune and Beltanol and inhibition of growth of pathogenic fungi on the PSA medium.

Treatment	Growth rate (cm)	Inhibition (%)
RS2	9.0	0.0
FS1	9.0	0.0
MP4	9.0	0.0
RS2+ Bi	0.0	100
FS1+ Bi	3.73	58.44
MP4+Bi	2.97	67.03
RS2+ Bel	0.0	100
FS1+ Bel	0.0	100
MP4+Bel	0.0	100
LSD (*P*:0.05)	0.34	3.67

* RS = *Rhizoctonia solan*i, FS = *Fusarium solani*, MP = *Macrophomina phaseolina*, Bi=Bio-Immune, Bel= Beltanol.

and *M. phaseolina* (MP4). Its inhibited growth of the fastest isolates of fungi tested was *R. solani* into 81.11%. *Fusarium* and *Macrophomina* fungi growth was reduced to 1.1 and 1.7 cm and inhibition rates were 87.96 and 80. 92%, respectively, compared with the control treatment (single pathogenic fungus) with a zero inhibition ratio. The results agree with Matloob and Juber (2014). Bio-product as EM-1 inhibitory effectiveness against fungus *Aspergillus niger* causes peanut crown rot disease on the PSA also provided good protection of plants under the wooden canopy conditions.

3.6 Effectiveness of Bio-Immune and Beltanol in the growth of pathogenic fungi

The results showed (Table 7) that the bio-immune and beltanol were highly effective, causing a significant reduction in the growth of pathogenic fungi on the medium. As it prevented the growth of fungus completely and with a 100% inhibition. Compared to the control treatment (fungus alone) where the growth of the fungus was normal and the rate of inhibition was 0%. The organic pesticide Bio-Immune (15% concentration) significantly reduced the growth of *F. solani* (FS1) and *M. phaseolina* (MP4) pathogens with a growth rate of 3.73-2.97 cm respectively and a high inhibition rate of 58.44- 67.03%, respectively. Bio-Immune is a natural substance, consisting of a combination of Humic and decomposing organic matter and a number of effective organic chemicals used to control of fungal diseases, especially Downey and Powdery mildews and rots, while the chemical pesticide has been inhibited For the growth of pathogenic fungi of 100%. The Beltanol (a systemic pesticide belonging to the Quinoline group) has a high ability to inhibit pathogenic and fungal pathogens. The Beltanol effect against soil-borne fungi, which is the formation of chelates compounds with copper. This makes it easy to pass into the cells of the pathogen to release and kill the pathogen [Meister (2000)].

This result is the first indication of the effectiveness of EM-1 and Bio-Immune against the fungi of root rot disease of the sunflower plant in the world.

3.7 Effect of some plant powders on the growth of pathogenic fungi in the PSA medium

The results (Table 8) showed that all the treatments used in this experiment (Black tea powder, coriander, cumin, Sage) inhibited the growth of pathogenic fungi (*R. solani*, *F. solani* and *M. phaseolina*) and a positive relation with the increased concentrations of each treatment, and significant differences are clear about the treatment of the control that was the growth rate 9 cm and the percentage of inhibition of 0%. And it achieved the treatment of black tea leaf powder concentration of 15% was significantly superior to the other treatments as it resulted in a significant reduction in the rate of growth of *R. solani* and *F. solani* and *M. phaseolina*, where the growth rate then becomes 1.5 and 2.7 and 2.3 cm, respectively, and the highest percentage of inhibition reached 83.3, 75.0 and 70.4%, respectively, followed by cumin powder, Sage, different concentration and target fungi. Coriander powder achieved the lowest effect in the growth of pathogenic fungi. The inhibitory rates at concentrates 15% were 11.1-5.5%. The results showed a difference in the sensitivity of pathogenic fungi and their different kinds to the different plant powders. The most affected fungi of the plant powder were the *R. solani* and lesser in the effect with *F. solani* and the least affected by the plant powder is *M. phaseolina*. This is due to the difference between species fungal structures formed by the fungus as in the case of fungus *M. phaseolina*, especially sclerotia formed by greater density and speed compared with those formed by the fungus *R. solani*. That is known to sclerotia objects is one of the structures of resistance to fungi. The difference in fungal sensitivity to these plant powders may be due to the nature of fungus in terms of cell composition, wall thickness, fat content and protein of fungi, and may be due to the mechanistic and efficacy of the active ingredients of these plant extracts that may alter the shape and composition of the fungus. The cause of the effect of

Table 8: The effect of the some plant powders, black tea, and coriander and cumin and sage in inhibiting the growth of pathogenic fungi on the PSA.

*Treatments	Concentrates (%)	Growth rate (cm)	Inhibition (%)	*Treatments	Concentrates (%)	Growth rate (cm)	Inhibition (%)
RS2	0	9.0	0.0	**Cumin + FS1**	5 10 15	8.0 6.7 4.4	11.1 25.2 51.5
RS2+Black tea	5 10 15	7.8 2.0 1.5	12.9 77.4 83.3	**Sage+FS1**	5 10 15	7.8 7.9 6.7	13.3 12.2 25.9
RS2+ coriander	5 10 15	8.0 6.2 4.4	11.1 31.5 51.5	**MP4**	0	9.0	0.0
RS2+ cumin	5 10 15	8.0 3.9 2.3	11.1 56.3 74.1	**Black tea + MP4**	5 10 15	8.0 6.3 2.7	11.1 30.0 70.4
RS2+ Sage	5 10 15	8.0 5.1 2.4	11.1 43.3 73.3	**MP4 + Coriander**	5 10 15	8.0 8.0 8.0	11.1 11.1 11.1
FS1	0	9.0	0.0	**Cumin +MP4**	5 10 15	8.0 7.3 7.2	11.1 18.5 20.4
FS1+ Black tea	5 10 15	8.0 5.8 2.3	11.1 35.9 75.0	**Sage + MP4**	5 10 15	8.0 7.2 6.2	11.1 20.4 31.5
FS1+ coriander	5 10 15	8.0 7.8 8.0	11.1 12.9 11.1	**LSD (*P*:0.05)**	-	0.71	7.85

*RS= *R. solani*, FS= *F. solani*, MP = *M. phaseolina*.

the black tea powder is due to its containment of many chemical compounds that inhibit the growth of some microorganisms, including fungi, which contains many compounds of flavonoids, flavoids, caffeine, ascorbic acid, Catechin, Epigallocatechin, tannin and others Cumin contain of many of the compounds and alcoholic Alaldehidah also contains such cuminicalcohol cuminaldihyde against many microorganisms fungal and bacterial [Dua *et al*. (2013)].

3.8 Effect of water extract of some plants on the growth of pathogenic fungi on the PSA medium

The results showed (Table 9) the efficiency of the water extract of the studied plants and the lichens at the concentration of 1000 ppm in inhibiting the growth of *R. solani* where the inhibitory rate was 60-100%. The wild mustard seed extract did not achieve high inhibition and there was no significant difference in treatment *F. solani* and *M. phaseolina*. The inhibition ratio was 0% at the concentrations of 250 and 500 ppm and 1000 ppm in the case of *F. solani*. The results showed that the addition of the cinnamon extract to the plant medium with concentration of 500 and 1000 ppm reduced the growth of the fungus to 5.3 and 8.0 cm with 11.11 and 41.29% inhibition, while the concentration did not achieve 250 ppm concentration inhibition of pathogenic growth relative to control treatment.

The results showed that the water extract of the tested plants was not effective at the concentration of 250 and 500 ppm against targeted fungi. This may be due to the low concentration of active antifungal elements or that the low rate of inhibition in the transactions and lack of others may be due to the inefficiency of the method of water extraction in the extraction of active substances from plant tissues, and this is consistent with the findings of several researchers of the water extract of the plants used in their researches had low inhibitory effectiveness against many pathogenic fungi such as *R. solani.* Or the effect

Table 9: Effect of the Water Extracts of Cinnamon, licorice and Wild Mustard in Inhibiting the Growth of Pathogenic Pathogens on the PSA.

*Treatments	Concentrates (%)	Growth rate (cm)	Inhibition (%)
RS2	0.00	9.0	0.0
RS2+ CI	250	9.0	0.0
	500	8.17	9.26
	1000	3.60	60.0
RS2+ LI	250	9.0	0.0
	500	9.0	0.0
	1000	0.0	100
RS2+ MS	250	9.0	0.0
	500	9.0	0.0
	1000	8.0	11.11
FS1	0.00	9.0	0.0
RS2+ CI	250	9.0	0.0
	500	8.0	11.11
	1000	5.3	41.29
RS2+ LI	250	9.0	0.0
	500	9.0	0.0
	1000	3.7	59.25
RS2+ MS	250	9.0	0.0
	500	9.0	0.0
	1000	9.0	0.0
MP4	0.00	9.0	0.0
RS2+ CI	250	9.0	0.0
	500	8.0	11.11
	1000	7.5	16.66
RS2+ LI	250	9.0	0.0
	500	9.0	0.0
	1000	1.17	87.3
RS2+ MS	250	9.0	0.0
	500	9.0	0.0
	1000	8.7	3.7
LSD (*P*:0.05)	-	4.44	0.399

*RS= *R. solani*, FS= *F. solani,* MP = *M. phaseolina*, CI = cinnamon extract, LI = licorice, MS = Mustard.

of the small effect may be due to the lack of concentration used, and this is consistent with what it found by Khedri *et al*. (2014) which appeared that the concentrations 2.5, 5, 7.5% of the aquatic extract of the plants used in the research (Betony leaves, Colocynth and pomegranate rind). In the growth of (*Rhizoctonia* sp.), while the concentration 10% has a high inhibitory effect (equivalent to 10000 ppm compared to the current study).

The reason for inhibition to contain the mustard plant at high concentrations of the compound Glucosinolate effective against many Pathogenic fungi of the plant. As for the plant of the cinnamon, its extracts had an efficiency in the plant. The growth of the target fungi is due to the fact that it contains some active substances against a number of fungi species, such as cinnamon oil and cinnamaldehyde, which act on cytoplasm and the synthesis of cytoplasmic membrane and the synthesis of cellular enzymes. The results are agreement with Hantoosh (2016). Effect of different concentrations of cumin and cinnamon extract against *R. solani* causing cotton damping off disease and inhibition rates ranged from 44-78% and 50-70% for both extracts, respectively. Licorice contains many active substances including Glycerrhizic, Glycerrhizin acid, Flavenoid, Saponins, Oestrogen, Progesterone, Steroids, Atropine, monoterpene, triterpenoid and other substances, many of which are currently known to be against of pathogenic fungi.

4. Conclusion

The study ensured the presence of Sunflower root rot disease in all the surveyed areas in Babylon. And the presence of some species of fungi associated with Sunflower infected plants, *Macrophomina phaseolina*, *Fusarium solani* and *Rhizoctonia solani*. were pathogenic and responsible of Sunflower root rot disease. The results appeared that Effective microorganisms (EM1) formula was very effective and had high antagonistic activity against pathogenic fungi and the results showed that Bio-Immune and some plant extract caused significant decrease in fungal growth in medium. The study ensured for first time the activity of Effective Microorganism formula and Bio-Immune against fungi causes Sunflower root rot in the world.

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