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Diagnosis and control of tomato root rot disease using biological and chemical methods

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ABSTRACT

The tomato crop is exposed to a number of phytopathogens, including the fungus *Fusarium solani*, which is a widespread soil-borne pathogen, grows in a wide temperature range, facultative parasite that lives on the plants residue and other organic matter in the soil. The aim of this study was to diagnose the causal agent of tomato root rot disease based on a field-laboratory investigation during 2019- 2020. Different fields of Babil and Karbala provinces were surveyed. Samples were collected from the roots of infected plants, then fungi were determined morphologically based on taxonomic keys. Our investigations showed that *F. solani* was predominant fungus, forty nine bacterial isolates isolated from the rhizoplane of healthy tomato plants, eight of them was superior in the antagonism test against the pathogen *in vitro*. These bacteria were diagnosed as *Aneurinibacillus aneurinilyticus*, *Bacillus megaterium*, *B. pumilus*, *Brevibacillus laterosporus*, *Enterobacter cloacae*, *Lactococcus raffinolactis*, *Paenibacillus polymyxa* and *Pseudomonas alcaligenes*, two chemical elements of magnesium sulphate and sodium silicate were used in combination with biocontrol agents to control the disease. Under greenhouse conditions, the quadruple inoculum treatment up to ten inoculum exhibited significant increase of tomato seeds germination and dry weight of the plants, and exhibited significant decrease of disease incidence and severity.

Keywords: *Fusarium solani*, PGPR, Tomato root rot, Magnesium sulphate, Sodium silicate.
Article type: Research Article.

INTRODUCTION

Tomato, *Solanum lycopersicum* of the Solanaceae family is one of the most important crops in the world. The total production in Iraq was 619,543 metric tons in 2019 (FAOSTAT, 2021). The fungus *F. solani* usually colonizes the cortex of the root bark of the host. The fungus has three types of spores, microconidia elliptical in shape and part of them are cylindrical to oval produced from long monophielides bearing laterally on the airy mycelium. The second type: the spores of macroconidia are asymmetric and heterogeneous in their dimensions. Third type of spores is chlamydospores, which produce single or in pairs in small lateral branches, mycelium color is white to gray on the potato dextrose agar (PDA) culture medium (Booth 1977). The characteristic symptoms of the disease appear depending on the environmental conditions and stage of plant grow when infected. The symptoms of rotting at the bases of the stems and the cortex of the roots appear on seedling and aged plants, followed by the yellowing of the shoot system after the root system is destroyed and signs of wilting appear during the high-temperature times of the day. It also infects plants at different stages of growth and eventually cause the death of the plants (Agrios 2005). Chemical fungicides have been used to control the disease decades ago. However, it exhibits negative impact on environment and most of the effective chemical pesticides have been prohibited by the Environmental Protection Agency (EPA). Researchers recently turned to using environmentally-friendly methods to control plant disease such as chemical elements and beneficial microorganisms such as species belonging to bacteria and fungi (Ongena & Jacques 2008; Yan *et al.* 2011; Naser AL-Isawi 2022; El-Sayed *et al.*

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2022; AL- Ethawi & AL-Taae 2022). This study was conducted to diagnose the causal agent of tomato root rot disease in the provinces of Babil and Karbala in the middle of Iraq, and control it using some biological and chemical factors in the combination treatments.

MATERIALS AND METHODS

Isolation and identification of the causative agent of tomato root rot disease

Samples were collected from the fields of tomato in provinces of Babil and Karbala, Iraq. Samples were collected from the roots of infected plants, which showed symptoms of the disease represented as gradual yellowing especially on the old leaves of plants, shoot system wilting, brown discoloration and rot on the root system of the plants. Root samples were cultured on the potato dextrose agar (PDA) medium according to the method of Hussein & Ibrahim (2018). Fungal isolates diagnosed based on the taxonomic keys (Waterhouse 1967; Parmeter & Whitney 1970; Ellis 1971; Booth1977; Domsch & Gams 1980; McClenny 2005; Domsch *et al.* 2007) and the percentage of fungi appearance and frequency was calculated according to Ganzalez *et al.* (1995).

Pathogenicity test of *F. solani* isolates *in vitro*

The pathogenicity of seventy one isolates of *F. solani* was tested on sterilized water agar medium with 10 tomato seeds (cultivar of Bayader) according to the method of Hussein (2018). Percentage of seeds germination was calculated according to the formula below:

$$\text{Germination } (\%) = (\text{No. of seed germinated}/\text{Total seed germinated}) \times 100$$

Isolation of rhizobacteria

Healthy tomato plants characterized by distinct shoot and root system were selected from some fields in Babil and Karbala provinces. Bacterial samples of soil collected from the rhizoplane of the healthy plants were isolated and purified according to the method of Hussein (2019).

Antagonistic activity test of rhizobacterial isolates against *F. solani*

The antagonistic activity of the forty-nine bacterial isolates that were isolated from the rhizoplane of healthy tomato plants against the fungal pathogenic isolate Fsk12 was evaluated by dual culture technique (Hussein & Al Zubidi 2019):

Diagnosis of the rhizobacterial isolates

A gram stain test was conducted for the eight rhizobacterial isolates which exhibited significant inhibition percentage against the pathogenic isolate of *F. solani*. All of the bacterial isolates were diagnosed using Vitek2 Compact technique (produced by Biomerieux Company/ French; Hussein 2016).

Biological and chemical control of tomato root rot disease under greenhouse conditions

The pathogenic fungal isolate Fsk12 inoculum of *F. solani* was prepared by growing it on the seeds of millet, *Panicum ramosum*, by adding 5 agar discs (0.5 cm) of the Fsk12 isolate from the fresh PDA to a 250-mL flasks containing autoclaved millet seeds and 10 mL sterilized distilled water. Flasks were incubated at 25 °C for 14 days. Bacterial isolates inoculum of *Aneurinibacillus aneurinilyticus*, *Bacillus megaterium*, *B. pumilus*, *Brevibacillus laterosporus*, *Enterobacter cloacae*, *Lactococcus raffinolactis*, *Paenibacillus polymyxa* and *Pseudomonas alcaligenes* were prepared by growing them in the nutrient broth medium. Then, a loop full of bacterial colonies was added on one-day nutrient agar culture to the nutrient broth and incubated in water bath shaker at 37 °C for 5 days, thereafter the concentrations were amended to 10^8 CFU mL^{-1}. Solution of chemical factors of magnesium sulphate (Ms) and sodium silicate (Ss) were prepared at the concentration of 100 mg L^{-1} and 200 mg L^{-1} respectively. An amount of 10 g of the fungal inoculum was added to the mixture of autoclaved soil and compost in 1 kg plastic pots (1:1) then watered. After 3 days, ten tomato seeds (Bayader cultivar) uncoated with fungicides, surface sterilized with 1% sodium hypochlorite solution were planted in each pot. Afterward, 40 mL bacterial inoculum and 100 mL kg^{-1} Cc + 200 mL kg^{-1} Ss were added in the same time of seeds planting. Pots were distributed according to a completely randomized design (CRD) with four replicates. The pots were carefully watered when needed. The percentage of germination was calculated after 12 days and the disease incidence rate

and severity were calculated after 45 days of planting according to the method of Hussein (2018), Disease severity was estimated according to the disease index described by Nagao *et al.* (1994), and the percentage of disease severity was calculated according to the Mckinney (1923), followed by recording the dry weight of the plants.

RESULTS AND DISCUSSION

Isolation and identification of the causative agent of tomato root rot disease

The results of isolation and diagnosis (Table 1) depicted the number of the fungi associated with infected roots. The dominant fungus was *F. solani*, since its appearance and frequency rates were 80.0% and 51.5% respectively. *F. solani* showed a white to creamy mycelium on the PDA culture medium with a yellow to brown pigment appearing clear in the bottom side of the plates (Fig. 1). The microscopic examination exhibited the small conidia of the fungus microconidia which were undivided, while some of them were divided into two cells by septa produced from long monophilides. The macroconidia were spindle-shaped and divided by 1-7 transverse septum.

Table 1. Fungal isolates associated with infected tomato roots.

Fungus name	Appearance (%)	Frequency (%)
Alternaria alternata (Fres.) Keissler	16.00	9.50
Aspergillus niger Van Tieghem	12.00	6.75
Aspergillus sp.	12.00	7.50
Cladosporium cladosporioides (Fresen.) G.A. de Vries	8.00	5.00
Fusarium oxysporum Schlesht	24.00	10.00
F. solani (Mart.) Sacc.	80.00	51.50
Fusarium sp.	34.00	13.75
Pencilium sp.	12.00	9.00
Rhizctonia solani (Kuhn)	24.00	11.00
Pythium aphanidermatum (Edson) Fitz	20.00	10.50
Ulocladium atrum Preuss	16.00	9.25

Pathogenicity test of the *F. solani* isolates

The results indicated variation in the pathogenicity ability of the *F. solani* isolates, the percentage of tomato seeds germination ranged between 15 and 90%, compared to the control treatment (Seeds alone) which exhibited 95% (Table 2). The isolate Fsk12 was superior among the rest of the isolates exhibiting 15% seeds germination.

Antagonistic activity test of rhizobacterial isolates against *F. solani*

The results of the antifungal activity test of the forty-nine rhizobacterial isolates against the fungal isolate Fsk12 showed that eight superior isolates were Bb11, Bb14, Bb15, Bk01, Bk12, Bk21, Bk21, Bk30 respectively (Table 3), which exhibited highest antagonistic activity ranged between 91.43 and 95.71% (Fig. 2).

Diagnosis of the rhizobacterial isolates

The results of identification of the rhizobacterial isolates showed significant antifungal activities of bacterial species including *Aneurinibacillus aneurinilyticus*, *Bacillus megaterium*, *B. pumilus*, *Brevibacillus laterosporus*, *Enterobacter cloacae*, *Lactococcus raffinolactis*, *Paenibacillus polymyxa* and *Pseudomonas alcaligenes* against *F. solani* using Vitek 2 compact technique (Table 4).

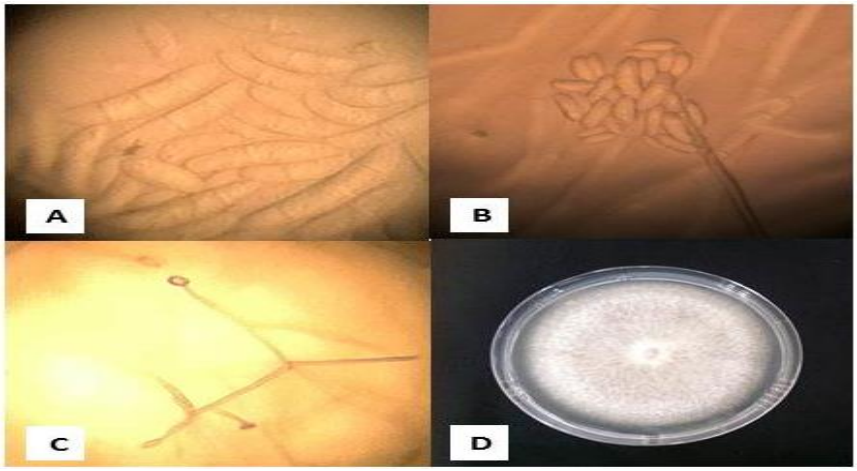

Fig. 1. Morphological characterize of the fungus *F. solani;* A.Macroconidia B. Microconidia C. Long monophielides D. Fungal colony on the PDA medium.

Table 2. Pathogenicity test of the *F. solani* isolates.

Isolate	Seed germination (%)	Isolate	Seed germination (%)	Isolate	Seed germination (%)
Control	95.0	Fsb24	45.0	Fsk19	65.0
Fsb01	47.5	Fsb25	65.0	Fsk20	55.0
Fsb02	25.0	Fsb26	47.5	Fsk21	30.0
Fsb03	25.0	Fsb27	50.0	Fsk22	37.5
Fsb04	37.5	Fsb28	50.0	Fsk23	47.5
Fsb05	52.5	Fsb29	65.0	Fsk24	50.0
Fsb06	37.5	Fsk01	47.5	Fsk25	37.5
Fsb07	72.5	Fsk02	30.0	Fsk26	30.0
Fsb08	37.5	Fsk03	47.5	Fsk27	47.5
Fsb09	45.0	Fsk04	50.0	Fsk28	40.0
Fsb10	40.0	Fsk05	52.5	Fsk29	37.5
Fsb11	67.5	Fsk06	65.0	Fsk30	57.5
Fsb12	42.5	Fsk07	62.5	Fsk31	55.0
Fsb13	62.5	Fsk08	45.0	Fsk32	47.5
Fsb14	47.5	Fsk09	82.5	Fsk33	52.5
Fsb15	77.5	Fsk10	67.5	Fsk34	62.5
Fsb16	50.0	Fsk11	35.0	Fsk35	72.5
Fsb17	72.5	Fsk12	15.0	Fsk36	50.0
Fsb18	55.0	Fsk13	35.0	Fsk37	55.0
Fsb19	42.5	Fsk14	75.0	Fsk38	57.5
Fsb20	67.5	Fsk15	82.5	Fsk39	62.5
Fsb21	45.0	Fsk16	80.0	Fsk40	42.5
Fsb22	42.5	Fsk17	72.5	Fsk41	87.5
Fsb23	52.5	Fsk18	67.5	Fsk42	77.5
L.S.D. (0.05) = 7.4					

Table 3. Antagonistic activity of the rhizobacterial isolates *in vitro.*

Treatment	Antagonistic activity (%)	Treatment	Antagonistic activity (%)	Treatment	Antagonistic activity (%)
Control (Fsk12 alone)	0.00	Fsk12 + Bb17	5.00	Fsk12 + Bk15	4.29
Fsk12 + Bb01	2.15	Fsk12 + Bb18	12.86	Fsk12 + Bk16	66.43
Fsk12 + Bb02	19.29	Fsk12 + Bb19	10.71	Fsk12 + Bk17	1.43
Fsk12 + Bb03	11.43	Fsk12 + Bk01	95.71	Fsk12 + Bk18	15.00
Fsk12 + Bb04	6.43	Fsk12 + Bk02	13.57	Fsk12 + Bk19	42.86
Fsk12 + Bb05	42.86	Fsk12 + Bk03	3.57	Fsk12 + Bk20	5.71
Fsk12 + Bb06	12.86	Fsk12 + Bk04	15.00	Fsk12 + Bk21	91.43
Fsk12 + Bb07	1.43	Fsk12 + Bk05	14.29	Fsk12 + Bk22	12.86
Fsk12 + Bb08	47.14	Fsk12 + Bk06	42.86	Fsk12 + Bk23	8.57
Fsk12 + Bb09	15.00	Fsk12 + Bk07	19.29	Fsk12 + Bk24	0.00
Fsk12 + Bb10	2.86	Fsk12 + Bk08	15.00	Fsk12 + Bk25	12.86
Fsk12 + Bb11	92.14	Fsk12 + Bk09	1.43	Fsk12 + Bk26	13.57

Fsk12 + Bb12	10.71	Fsk12 + Bk10	57.86	Fsk12 + Bk27	17.86
Fsk12 + Bb13	13.57	Fsk12 + Bk11	13.57	Fsk12 + Bk28	94.29
Fsk12 + Bb14	91.43	Fsk12 + Bk12	93.57	Fsk12 + Bk29	11.43
Fsk12 + Bb15	92.86	Fsk12 + Bk13	14.29	Fsk12 + Bk30	95.00
Fsk12 + Bb16	14.29	Fsk12 + Bk14	47.14		
		L.S.D (0.05) = 15.42			

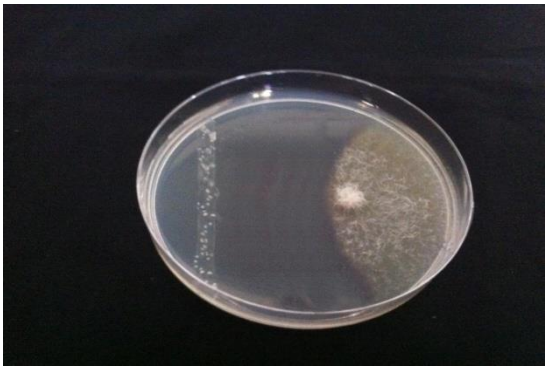

Fig. 2. Antifungal activity test between the rhizobacterial isolate and *F. solani.*

Biological and chemical control of tomato root rot disease under greenhouse conditions

The greenhouse experiment showed that the percentage of seeds germination of the single, dual and triple inoculum treatments did not record significant differences which were ranged between 57.5 and 67.5% compared to the negative control (pathogen alone) which was 60% (Table 5), while significant increase of seeds germination showed from the quadruple inoculum treatment up to ten inoculum which ranged between 70.0 and 100.0%. In addition, from the treatments of seven inoculum and upwards to ten treatments recorded highly percentage of seeds germination of 87.5-100%, however, with no significant differences compared to positive control (plant alone, 95%).

Table 4. Identification of the antagonistic bacterial isolates.

Isolate code	Gram stain	Bacterial species
Bb11	+	*Aneurinibacillus aneurinilyticus*
Bb14	+	*Bacillus megaterium*
Bb15	+	*B. pumilus*
Bk01	+	*Brevibacillus laterosporus*
Bk12	-	*Enterobacter cloacae*
Bk21	+	*Lactococcus raffinolactis*
Bk28	+	*Paenibacillus polymyxa*
Bk30	-	*Pseudomonas alcaligenes*

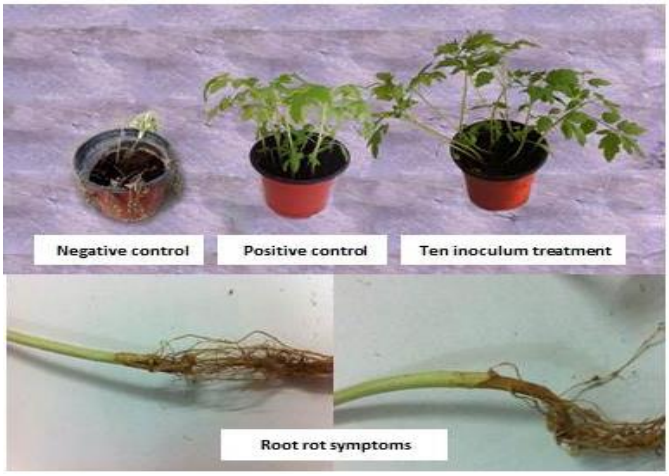

Fig. 3. Biological and chemical control of root rot disease in tomato.

Table 5. Seed germination, incidence, severity percentage and dry weight of tomato plants.

Treatment	Germination (%)	Disease incidence (%)	Disease Severity (%)	Dry weight (g/p)	Treatment	Germination (%)	Disease incidence (%)	Disease Severity (%)	Dry weight (g/p)	Treatment	Germination (%)	Disease incidence (%)	Disease Severity (%)	Dry weight (g/p)
Positive control (Plants alone)	95.0	0.0	0.0	1.67	Fsk12 + Bb11+ Bb15	62.5	67.5	44.8	0.98	Fsk12 + Bb11+ Bb14 + Bb15 + Bk01 + Bk12	70.0	32.5	22.0	1.26
Negative control (Fungus Fsk12 alone)	60.0	80.0	59.3	0.94	Fsk12 + Bb11+ Bk01	65.0	65.0	45.3	1.00	Fsk12 + Bb11+ Bb14 + Bb15 + Bk01 + Bk21	72.5	40.0	23.3	1.34
Bb11	97.5	0.0	0.0	1.78	Fsk12 + Bb11+ Bk12	67.5	62.5	41.5	0.97	Fsk12 + Bb11+ Bb14 + Bb15 + Bk01 + Bk28	72.5	30.0	20.8	1.27
Bb14	100.0	0.0	0.0	1.69	Fsk12 + Bb11+ Bk21	60.0	67.5	40.3	1.04	Fsk12 + Bb11+ Bb14 + Bb15 + Bk01 + Bk30	80.0	45.0	22.0	1.25
Bb15	95.0	0.0	0.0	1.90	Fsk12 + Bb11+ Bk28	60.0	65.0	42.5	0.98	Fsk12 + Bb11+ Bb14 + Bb15 + Bk01 + Ms	77.5	37.5	23.3	1.34
Bk01	97.5	0.0	0.0	1.71	Fsk12 + Bb11+ Bk30	65.0	65.0	42.5	0.99	Fsk12 + Bb11+ Bb14 + Bb15 + Bk01 + Ss	85.0	42.5	24.3	1.30
Bk12	100.0	0.0	0.0	1.73	Fsk12 + Bb11+ Ms	62.5	67.5	43.0	1.02	Fsk12 + Bb11+ Bb14 + Bb15 + Bk01 + Bk12 + Bk21	80.0	25.0	19.5	1.49
Bk21	97.5	0.0	0.0	1.88	Fsk12 + Bb11+ Ss	60.0	65.0	45.3	0.97	Fsk12 + Bb11+ Bb14 + Bb15 + Bk01 + Bk12 + Bk28	82.5	25.0	20.4	1.58
Bk28	95.0	0.0	0.0	1.81	Fsk12 + Bb11+ Bb14 + Bb15	62.5	60.0	31.5	1.02	Fsk12 + Bb11+ Bb14 + Bb15 + Bk01 + Bk12 + Bk30	77.5	20.0	17.0	1.60
Bk30	100.0	0.0	0.0	1.84	Fsk12 + Bb11+ Bb14 + Bk01	67.5	57.5	31.0	1.05	Fsk12 + Bb11+ Bb14 + Bb15 + Bk01 + Bk12 + Ms	85.0	20.0	11.8	1.60
Ms	97.5	0.0	0.0	1.74	Fsk12 + Bb11+ Bb14 + Bk12	67.5	60.0	32.0	1.05	Fsk12 + Bb11+ Bb14 + Bb15 + Bk01 + Bk12 + Ss	85.0	22.5	14.5	1.54
Ss	95.0	0.0	0.0	1.75	Fsk12 + Bb11+ Bb14 + Bk21	62.5	55.0	37.5	1.10	Fsk12 + Bb11+ Bb14 + Bb15 + Bk01 + Bk12 + Bk21 + Bk28	90.0	12.5	12.3	1.68
Fsk12 + Bb11	62.5	75.0	57.3	0.95	Fsk12 + Bb11+ Bb14 + Bk28	62.5	57.5	31.5	1.06	Fsk12 + Bb11+ Bb14 + Bb15 + Bk01 + Bk12 + Bk21 + Bk30	87.5	15.0	9.8	1.70

Fsk12 + Bb14	65.0	70.0	51.3	0.94	Fsk12 + Bb11+ Bb14 + Bk30	65.0	60.0	32.0	1.08	Fsk12 + Bb11+ Bb14 + Bb15 + Bk01 + Bk12 + Bk21 + Ms	87.5	10.0	10.3	1.75
Fsk12 + Bb15	60.0	67.5	54.3	0.97	Fsk12 + Bb11+ Bb14 + Ms	65.0	60.0	32.0	1.10	Fsk12 + Bb11+ Bb14 + Bb15 + Bk01 + Bk12 + Bk21 + Ss	92.5	15.0	8.8	1.73
Fsk12 + Bk01	57.5	72.5	53.0	0.99	Fsk12 + Bb11+ Bb14 + Ss	65.0	57.5	30.0	1.05	Fsk12 + Bb11+ Bb14 + Bb15 + Bk01 + Bk12 + Bk21 + Bk28 + Bk30	95.0	10.0	7.5	1.77
Fsk12 + Bk12	67.5	70.0	51.3	0.95	Fsk12 + Bb11+ Bb14 + Bb15 + Bk01	70.0	45.0	27.3	1.10	Fsk12 + Bb11+ Bb14 + Bb15 + Bk01 + Bk12 + Bk21 + Bk28 + Ms	100.0	7.5	5.5	1.84
Fsk12 + Bk21	57.5	72.5	53.0	1.01	Fsk12 + Bb11+ Bb14 + Bb15 + Bk12	72.5	55.0	25.8	1.12	Fsk12 + Bb11+ Bb14 + Bb15 + Bk01 + Bk12 + Bk21 + Bk28 + Ss	100.0	10.0	7.5	1.83
Fsk12 + Bk28	60.0	70.0	50.3	0.95	Fsk12 + Bb11+ Bb14 + Bb15 + Bk21	70.0	52.5	25.8	1.15	Fsk12 + Bb11+ Bb14 + Bb15 + Bk01 + Bk12 + Bk21 + Bk28 + Bk30 + Ms	95.0	5.0	3.0	1.96
Fsk12 + Bk30	62.5	67.5	49.0	0.99	Fsk12 + Bb11+ Bb14 + Bb15 + Bk28	70.0	47.5	24.3	1.11	Fsk12 + Bb11+ Bb14 + Bb15 + Bk01 + Bk12 + Bk21 + Bk28 + Bk30 + Ss	100.0	7.5	4.5	1.90
Fsk12 + Ms	57.5	70.0	47.8	1.01	Fsk12 + Bb11+ Bb14 + Bb15 + Bk30	72.5	42.5	23.3	1.15	Fsk12 + Bb11+ Bb14 + Bb15 + Bk01 + Bk12 + Bk21 + Bk28 + Bk30 + Ms + Ss	100.0	5.0	3.0	1.98
Fsk12 + Ss	60.0	70.0	50.3	0.96	Fsk12 + Bb11+ Bb14 + Bb15 + Ms	70.0	50.0	27.5	1.14					
Fsk12 + Bb11+ Bb14	65.0	67.5	44.5	0.95	Fsk12 + Bb11+ Bb14 + Bb15 + Ss	72.5	52.5	27.3	1.12					
L.S.D (5%)	8.5	26.5	20.6	0.22		8.5	26.5	20.6	0.22		8.5	26.5	20.6	0.22

The results shown in Table 5 indicated that there was no significant decrease in the disease incidence between the single, dual and triple inoculum treatments ranging from 55.0 to 75.0%, compared to the negative control (80.0%). Treatments of quadruple inoculum and upwards to ten showed significant decrease in the disease incidence ranging between 5.0 and 52.5% except for the treatments of Bb11+ Bb14 + Bb15 + Bk12 which exhibited 55.0%. The treatments of six and upwards to ten inoculum were superior exhibiting 5.0-25.0% disease incidence without significant differences compared to the positive control (0%; Fig. 3). The results shown in Table 5 exhibited that, the disease severity decreased significantly in the triple inoculum treatments up to ten inoculum which ranged between 3.0 and 37.5% compared to the negative control (59.3%). In addition, the treatments from six inoculum up to ten recorded highly decrease in the disease severity of 3.0-20.4% compared to the positive control (0%). The results in Table 5 displayed that, the single inoculum treatment up to quadruple treatment did not record significant differences in the dry weight of the plants which ranged between 0.94 and 1.15 g plant^{-1} compared to the negative control (0.94 g plant^{-1}), while significant increase in the dry weight was noticed in the five inoculum treatments up to ten inoculum which ranged between 1.25-1.98 g plant^{-1}. Treatment of ten inoculum was superior exhibiting 1.98 g plant^{-1}. The term plant growth promotion rhizobacteria (PGPR) is given to those bacterial isolates that inhabit the rhizosphere and rhizoplane of plants and provide benefits to plants by improving their growth parameters and fight the phytopathogen (Kloepper 2003). Most of the symptoms appeared on the plants as a result of infection with the pathogenic fungus *F. solani* are caused by the mycotoxins, which are transmitted to the root system such as Fusaric acid and Polpeptide (Hussein & Juber 2015).

CONCLUSION

The phytopathogen fungus *F. solani* is the main causal agent of the root rot disease of tomato plants in the provinces of Babil and Karbala. The rhizoplane of the healthy tomato plants is a rich source of plant growth promotion, rhizobacteria, which play significant role in protection of root system against the phytopathogen such as *F. solani*, and increasing the biomass of the plants. Eight beneficial rhizobactera isolated from the rhizoplane of healthy tomato plants included *Aneurinibacillus aneurinilyticus*, *Bacillus megaterium*, *B. pumilus*, *Brevibacillus laterosporus*, *Enterobacter cloacae*, *Lactococcus raffinolactis*, *Paenibacillus polymyxa* and *Pseudomonas alcaligenes*, that exhibited significant antifungal activity against the pathogen *in vitro*, and mixture of these isolates with chemical elements of magnesium sulphate and sodium silicate exhibited effective method of tomato root rot disease control as an alternative method of chemical pesticides using. These bacterial isolates have been shown to be effective PGPR for their significant impact on the plant growth parameter represented by dry weight of the plants.

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