Original Research Article

Efficiency of some herbicides and fungicides on management of common bean damping-off and root-rot diseases

ABSTRACT

The three tested herbicides and fungicides caused significant inhibitory effect on the growth of *Fusarium solani* and *Rhizoctonia solani* the causal of common bean damping-off and root-rot diseases compared with control treatment. This inhibition was gradually increased by increasing the concentration of the tested herbicides and fungicides. Moreover, the fungus *F. solani* was greatly affected by the tested herbicides and fungicides than the fungus *R. solani*. Furthermore, the tested fungicides were more efficient than the herbicides in this regard.

There was significant decrease in both damping-off and root-rot severity with significant increase in the survived plants due to the treatment with the tested herbicides and fungicides. No damping-off and root-rot were recorded in case the tested herbicides, fungicides and noninfested soil. Highest percentages of damping-off, root-rot and lowest survived plant were recorded in case of soil infested with any of the two pathogens. In addition, the combination between the tested herbicides and fungicides with any of the tested pathogens resulted in significant reduction to damping-off and root-rot severity with significant increase in the survived plants compared to plants grown in soil infested with any of the two tested pathogens and did not receive such a treatment.

The treatment with any of the tested herbicides and fungicides and grown in soil infested with any of the two pathogens resulted in remarkable increase in the total phenolic compounds compared to the values of plants grown in soil infested with any of the two causal fungi (control plants). Gradual increase in the values of total phenolic compounds was occurred by increasing the time of inoculation with the pathogens and the highest increase in the total phenolic compounds was occurred by the tested fungicides compared with the tested herbicides.

The percentages of the estimated nitrogen and protein content in common bean green seeds were increased due to the treatment with the tested herbicides and fungicides compared with the green seeds of plants grown in soil infested with any of both pathogens. The tested fungicides caused considerable increase in the percentages of total nitrogen and protein when compared to the tested herbicides.

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Key words: Common bean, damping-off, root-rot, fungicides, herbicides , phenolic compounds, total nitrogen, protein.

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1. INTRODUCTION

Common bean (*Phaseolus vulgaris* L.) is considered one of the most important legume crops worldwide. Common bean production is challenging by many adverse biotic and abiotic factors. Damping-off and root-rot diseases are the most challenge factors [1]. In Egypt, dry and green beans are among the most important leguminous crops grown for local consumption and exportation. The area planted with dry and green beans in Egypt in 2018 amounted to about 120728 feddan, producing about 122871 tons of both commodities [2].

The bean crop is a vital food legume for direct human consumption and accounts for 50% of the legumes consumed worldwide [3]. Also, bean crop is a cheap source of protein, carbohydrates, unsaturated fatty acids, vitamins and minerals [4,5]. Also, bean helps in providing fodder for feeding livestock in addition to improving soil fertility through atmospheric nitrogen fixation [6]. Therefore, improving the productivity of this crop is one of the priorities in agricultural policy all over the world.

Pre-emergence damping-off occurs when seeds decay prior to emergence. This can occur (i) before seed germination, or when (ii) the germinating seeds are killed by biotic stresses while shoot tissues are still below ground. Meanwhile, post-emergence damping-off occurs when seedlings decay, wilt and die after emergence. In most cases, all symptoms result in the collapse and death of at least some seedlings in any given seedling population [7,8].

As a result of the increase in the costs of manually removing weeds from the bean fields as a result of the increase in the wages of agricultural workers, preventing the growth of weeds as a result of spraying pesticides before and after weed growth has become an economically important process to increase farmer's profits. Therefore weed management remains one of the major production problems for common bean growers and is necessary to improve the productivity of this non-competitive crop. Chemical control of weeds is important to scale back weed infestation and cause rapid and desirable control of weeds and today it's considered one of the most popular methods for controlling weeds [9] and using of herbicides to manage weeds is another choice to hand weeding [10,11].

2. MATERIALS AND METHODS

2.1. Source of the Causal Pathogens:

Virulent isolates of *F. solani* (Mart) Sacc. and *R. solani* Kuhn. (The anamorph of *Thanatephorus cucumeris* (Frank) Donk to common bean roots were kindly provided by Prof. Dr. K.A. Abada, Emeritus Prof. of Plant Pathol., Plant Pathol. Dept., Fac. Agric., Cairo Univ., Egypt.

2.2. Effect of the tested herbicides and fungicides on the linear growth of the two tested pathogens in vitro:

A stock solution was prepared for each of the tested herbicides, .*i.e*., Basagran 48% AS (bentazon), Inpul 75% WG (halosulfuron-methyl) and Stomp Extra 45.5% CS (pendimethalin) and fungicides *i.e*., Moneceren (Pencycuron 250 SC (22.9%), Mon-Cut 70 WP (flutolanil) and Rizolex-T 50% WP (tolclofos–methyl) in glass bottle depending on their active ingredient.

The concentrations of 250, 500, 750 and 1000 ppm of the tested herbicides were prepared. Also, the concentrations of 50, 100, 250 and 500 ppm of the tested fungicides were prepared.

The calculated amounts of the herbicides and fungicides were mixed with PDA medium after sterilization, just before solidification. The poisoned medium of each concentration was then poured into the Petri-dishes (20 ml/plate).

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After solidification the medium, Petri-dishes were inoculated with 5 mm. discs of any of the two tested pathogens which cut from five days old culture under aseptic conditions, then incubated in an incubator at 28±2°C. Five replications were prepared for each concentration. The fungal growth of the tested two fungi was measured and the average was recorded. Inhibition percentage of the mycelial growth of the two tested pathogens was calculated using the following formula:

$$\% I = (C - T)/C \times 100$$

Where:

I = Inhibition percentage for growth of the test pathogen.

C = Linear growth of the pathogen (mm) in control.

T = Linear growth of the pathogen (mm) in treatment.

2.3. Effect of the tested herbicides (soil treatment) and fungicides (seed treatment) on damping-off and root-rot severity in addition to some crop parameters:

Clay soil and plastic pots (25 cm. in diameter) sterilized by 5% formalin were used. The inoculum of each of *F.solani* and *R.solani* was culturing on corn–sand medium for 15 days in glass bottles (500 ml).

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The soil was infested with 2% inoculum level of any of the two pathogenic fungi, mixed well and distributed in the pots. One hundred ml of any of the three tested herbicides were then added to each pot and irrigated twice with one week interval in order to avoid the toxic effect of the herbicides on the sown common bean seed. Control treatment was prepared by the same manner but adding tap water only.

Five common bean seeds (Pronco, cv) were treated with the tested fungicides *i.e.,* Moneceren (ml/kg seed), Mon-Cut (3g/kg seed) and Rizolex-T 50% ((3g/kg seed) then sown in each pot either infested with any of the tested two fungi or not and irrigated.

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Eight pots were used for each treatment, where disease severity was assessed in three randomized pots 75 days after sowing to estimate the severity of the disease and the remained five pots of each treatment were left to the end of the experiment to estimate plant height (cm) and the yield of the green pod yield.

The incidence of pre-and post-emergence damping-off in addition to root-rot severity were calculated 10, 21 and 75 days after sowing, respectively. Also, plant height (cm), the number and weight of pods/plant were estimated and recorded at the end of the experiment (100 days).

2.4. *Disease Assessment*

The incidence of pre-and post-emergence damping-off were counted 10 and 21 days after sowing. Also, root-rot severity was assessed 75 days after sowing, the plants of each pot were carefully uprooted, washed in water and the roots were measured, disease severity was estimated using the devised scale (0-5) adopted by Salt [12] and then disease severity percentage was estimated using the following formula:

$$\text{Disease severity } \% = \sum (n \times v) / 5N \times 100$$

Where:

n = Number of infected roots in each category.

v = Numerical values of each category.

N = Total number of the infected roots.

2.5. *Biochemical assessment:*

2.5.1. *Total phenolic compounds:*

Common bean leaves (5 g) representing each treatment were extracted with 50 ml of 80% methanol at 70 °C for 15 min. Reaction mixture contained 5 ml of methanolic extracts, 25 ml of distilled sterilized water and 250 *µl* of Folin–Ciocalteu reagent. This solution was kept at 25±1°C. The absorbance of the developed blue color was measured using a spectrophotometer at 725 nm. Gallic acid was used as the standard. Determination was carried out 20, 40 and 60 days

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after the inoculation with the tested pathogens. The amount of phenolic compounds was expressed as mg gallic acid /g plant material [13].

2.5.2. *Determination of protein content in common bean green seeds:*

A random samples of common bean pods were taken from the yield of each treatment. The nitrogen amount in the seeds was determined according to the method described by Hafez and Mikkelsen [14]. Protein content was calculated by multiplying nitrogen amount value by 6.25.

2.6. *Statistical analysis:*

The obtained results were statistically analyzed using the standard procedures for complete randomized block and split designs as mentioned by Snedecor and Cochran [15]. The means were compared at 0.05 level of probability using the least significant differences (L.S.D) according to Fisher [16].

3. RESULTS

3.1. *Effect of herbicides and fungicides on the linear growth of the tested pathogens*

Results shown in Table (1) reveals that the three tested herbicides caused significant inhibitory effect on the growth of the tested pathogens compared to control treatment, being 50.6 (43.8% efficiency), 45.6 (45.6% efficiency), 50.2(50.2% efficiency) and 90.0 mm linear growth, on the average, respectively. This inhibition was gradually increased by increasing the concentration of the tested herbicides, being 83.1, 62.6, 13.2 and 11.1 mm linear growth, on the average, respectively. In addition, complete inhibition on the growth of the pathogen *F. solani* was occurred by the Basagran 48% and Stomp Extra 45.55 herbicides at the concentration of 1000 ppm. Moreover, the pathogen *F. solani* was greatly affected by the tested herbicides than the other pathogen, being 43.6 and 49.1 mm, on the average, respectively. Likewise,
data presented in Table (2) show that the tested fungicides resulted in significant reduction on the growth of the tested pathogens when compared to control treatment, being 38.9 (56.8% efficiency), 37.1 (58.8% efficiency), 35.8 (60.2% efficiency) and 90.0 mm linear growth on the average, respectively. Complete inhibition to the growth of both pathogens was recoded at the concentration of 1000 ppm. In addition, gradual increase in the inhibition to the growth of both pathogen was occurred by increasing the concentration of the tested fungicides, being 73.6, 53.5 and 21.1 mm linear growth, on the average, respectively. Also, *F.solani* was greatly affected by the tested fungicides than *R.solani*, being 37.7 and 36.7 mm, on the average, respectively.

3.2. *Effect of herbicides soil treatment and fungicides seed treatment, alone or in combination with any of the tested pathogens, on the damping-off, root-rot severity and survived plant:*

Results shown in Table (3) show the effect of the tested herbicides and fungicides on the percentages of damping-off, root-rot severity and survived plants. The obtained results indicate that there was significant decrease in both damping-off and root-rot severity with significant increase in the survived plants. No damping-off and root-rot were recorded in case the tested herbicides, fungicides and noninfested soil. Meanwhile, the highest percentages of damping-off, root-rot and lowest survived plant were recorded in case of soil infested with such pathogens, being 25.0, 52.0, 50.0% for *F. solani* and 52.0, 55.0 and 44.0% for *R.solani*, respectively.

Table 1. Effect of herbicides on the linear growth of *F. solani* and *R. solani*, five

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Day s after incubation at 28 ±2ºC

Herbicides	Pathogens	concentrations (ppm) 250	500	750	1000	Mean	General mean	% efficiency
Basagran 48%	*F.solani*	80.6	61.2	32.4	0.0	48.6	49.0	45.6
	R. solani	82.4	62.6	34.2	18.2	49.4		
Inpul 75%	*F.solani*	85.4	64.4	32.6	18.2	50.2	50.6	43.8
	R. solani	86.0	65.0	33.2	19.4	50.9		
Stomp Extra 45.5%	*F.solani*	82.8	60.0	30.0	0.0	43.2	45.1	50.2
	R. solani	83.4	62.0	31.8	10.4	46.9		
Control*	*F.solani*	90.0	90.0	90.0	90.0	90.0	90.0	-----
	R. solani	90.0	90.0	90.0	90.0	90.0		
Mean	*F.solani*	82.9	61.9	31.7	6.1	43.6	-	---
	R. solani	83.9	63.2	33.1	16.0	49.1		---
General mean		83.1	62.6	13.2	11.1	-	-	---

* The mean was not concluded the control.

L.S.D. at 0.05 for: Herbicides (H) = 3.9, Concentrations (C) = 2.8, Fungi (FG) = n.s, F × C = 3.0, H × FU = 2.2, C × FG = 1.9, H × C × FG = 3.7.

Table 2. Effect of fungicides on the linear growth of *F. solani* and *R. solani*, five days after incubation at 28 ±2ºC

Herbicides	Pathogens	concentrations (ppm) 50	100	250	500	Mean	General mean	% efficiency
Monceren SC	*F.solani*	76.6	56.2	24.6	0.0	39.4	38.1	56.8
	R. solani	75.0	54.0	23.4	0.0	38.3		
Mon-Cut WP	*F.solani*	73.6	54.0	22.2	0.0	37.5	37.1	58.8
	R. solani	72.4	53.0	21.2	0.0	36.7		
Rizolex-T WP	*F.solani*	72.8	51.0	20.8	0.0	36.2	35.6	60.2
	R. solani	71.2	50.0	18.8	0.0	35.0		
Control*	*F.solani*	90.0	90.0	90.0	90.0	90.0	90.0	----
	R. solani	90.0	90.0	90.0	90.0	90.0		
Mean	*F.solani*	74.3	53.7	22.5	0.0	37.6	----	
	R. solani	72.9	52.3	21.1	0.0	36.7		---
General mean		73.6	53.0	21.8	0.0	-	-	---

* The mean was not concluded the control.

L.S.D. at 0.05 for: Fungicides (F) = 3.9, Concentrations (C) = 2.8, Fungi (FG) = n.s, F× C = 2.2, C × FG = 1.9, H × C × FG = 3.7.

The combination between the tested herbicides and fungicides such pathogens resulted in significant reduction on damping-off and root-rot severity with significant increase in the survived plants compared with plant grown in soil infested with any of the two tested fungi and did not treated with any treatment.

Nontreated soil and infested with any of *F.solani* and *R. solani* recorded the highest percentages of damping-off and root-rot severity, being 44.0 and 52.0% damping-off and 46.8 and 47.8%

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root-rot severity, respectively. No apparent symptoms of damping-off or root-rot were noticed in case of control plants. In addition, the treatments of MO+FS, MO+RS and MC+RS caused similar and the lowest percentages of damping-off and root-rot severity in addition to the highest percentages of survived plants, being 8.0, 20 and 84.0%, respectively. Meanwhile, the combination of B+FS and B+RS caused similar and the highest percentages of damping-off and root-rot severity in addition to the lowest percentages of survived plants compared to the other combinations, being 14.0, 24.2 and 72.0 %, respectively. The other combinations recoded intermediate values of damping-off, root-rot severity and survived plants.

Table 3. Effect of the tested herbicides and fungicides, each alone or in combination with any of the tested pathogens, on the percentages of damping-off, root-rot severity and survived plants in greenhouse.

Treatments	% Damping-off			% Root-rot severity	% survived plants
	Pre-emergence	Post-emergence	Mean		
Basagran 48% (B)	0.0	0.0	0.0	0.0	100
Inpul 75% (I)	0.0	0.0	0.0	0.0	100
Stomp Extra 45.5% (S)	0.0	0.0	0.0	0.0	100
Monceren (MO)	0.0	0.0	0.0	0.0	100
Mon-Cut (MC)	0.0	0.0	0.0	0.0	100
Rizolex-T (R)	0.0	0.0	0.0	0.0	100
B+FS	20.0	8.0	14.0	24.2	72.0
B+RS	20.0	8.0	14.0	24.2	72.0
I+FS	20.0	4.0	12.0	26.0	76.0
I+RS	20.0	4.0	12.0	26.0	76.0
S+FS	16.0	4.0	10.0	21.0	80.0
S+RS	16.0	4.0	10.0	21.0	80.0
MO+FS	8.0	8.0	8.0	20.0	84.0
MO+ RS	8.0	8.0	8.0	20.0	84.0
MC+FS	12.0	8.0	10.0	21.0	80.0
MC +RS	8.0	8.0	8.0	20.0	84.0
R+FS	12.0	8.0	10.0	21.0	80.0
R+RS	12.0	8.0	10.0	20.5	80.0
F.solani (FS)	28.0	22.0	50.0	52.0	50.0
R. solani (RS)	32.0	24.0	52.0	55.0	44.0
Control	0.0	0.0	0.0	0.0	100
L.S.D. at 0.05	2.0	3.0	5.0	3.0	4.0

3.3.*Effect of herbicides and fungicides, each alone or in combination with any of the tested pathogens, on plant height and the green pod yield/plant:*

Table (4) reveals the increase in the plant height, number of pods and green pods/ plant of common bean. In addition, the combination between any the two pathogenic with any of the tested herbicides and fungicides resulted in marketable increase in those parameters when compared to plants grown in soil infested with such pathogens. In addition, the tested fungicides were more efficient in this regard, being 70.1, 70.6 and 70.6 cm plant height; 23.0, 23.8 and 24.2 pod/ plant and 78.9, 80.4 and 80.9 g/ plant for Monceren, Mon-Cut and Rizolex-T, respectively. Meanwhile, the herbicides recorded 65.8, 66.0 and 66.9 cm; 19.8, 21.0 and 22.0 pod/plant and 73.6, 74.0 and 75.5 g/ plant for Inpol 75%, Basagran 48% and Stomp Extra 45.5%, respectively. The combination between and/or the tested herbicides and fungicides with such a resulted in an increase in plant height and number and weight of green pods when compared to any of such pathogens. Control plants grown in un-infested soil recorded 64.3 cm, 19.8 pod/plant and 73.2 g/ plant respectively.

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Table 4. Effect of the tested herbicides (soil treatment) and fungicides (seed treatment), each alone or in bi-combination with any of the tested pathogens, on plant height and the produced green pod yield / plant, greenhouse experiment

Treatments	Plant height (cm)	Average No. of pods /plant	Average weight of pods (g) /plant
Basagran 48% (B)	66.0	21.0	74.0
Inpul 75% (I)	65.8	19.8	73.6
Stomp Extra 45.5% (S)	66.9	22.0	75.5
Monceren (MO)	70.1	23.0	78.9
Mon-Cut (MC)	70.6	23.8	80.4
Rizolex-T (R)	70.7	24.2	80.9
B+FS	51.6	16.0	60.6
B+RS	51.0	15.4	59.4
I+FS	51.0	14.0	56.5
I+RS	50.8	15.0	57.8
S+FS	53.0	16.2	61.1
S+RS	52.8	16.8	62.8
MO+FS	55.0	17.6	63.5
MO+ RS	54.0	17.0	63.2
MC+FS	52.0	16.6	62.9
MC +RS	51.7	16.4	62.4
R+FS	53.3	17.0	64.0
R+RS	52.0	16.4	62.3
F.solani (FS)	36.2	8.2	34.1
R. solani (RS)	34.6	7.8	33.0
Control	64.3	19.8	73.2
L.S.D. at 5 %	2.1	0.9	2.3

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3.4. *Biochemical assessment:*

3.4.1. *Total phenolic compounds:*

The treatment with the tested herbicides and fungicides and grown in soil infested with such a pathogen resulted in a remarkable increase in the total phenolic compounds compared to the control (Table, 5). Gradual increase in the values of total phenolic compounds was occurred by increasing the time of plant age, *i.e.*, 20, 40 and 60 days, being 0.43, 0.57 and 0.66 mg/g in plant leaves, respectively. In addition, fungicides treatment enhanced the amount of total phenolics

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when compared to those of herbicides, being 0.59, 0.60 and 0.60 mg/g in plant leaves , on the average for the fungicides were 0.55. 0.56 and 0.58 mg/g in plant leaves, respectively.

On the other hand, control plants recorded 0.54 mg/g in plant leaves, on the average and inoculated plants with *F.solani* and *R.solani* recorded 0.48 and 0.4 mg/g in plant leaves, respectively.

3.4.2. *The percentages of nitrogen and protein content in common bean seeds:*

Table (5) reveals the percentages of the determined percentages of total nitrogen and protein content in common bean green seeds were increased due to the treatment with the tested herbicides and fungicides compared to plants grown in soil infested with any of the two pathogens and control treatment. The increase of % total nitrogen ranged between 1.53% (Basagran 48%)- 1.59% (Mon-Cut and Rizolex-T). The seeds of control plants recorded 1.52 % total nitrogen and 9.5% protein content.

Table 5. Effect of herbicides and fungicides on the total content of phenolic compounds in the leaves and the percentages of nitrogen and protein content in common bean (Pronco cv) green seeds

Treatments	Gallic acid mg/g plant leaves after several intervals (days) of inoculation.			Mean	% Total nitrogen	% Protein
	20	40	60			
Basagran 48%	0.42	0.57	0.67	0.55	1.53	9,6
Inpul 75%	0.43	0.58	0.68	0.56	1.54	9.6
Stomp Extra 45.5%	0.44	0.59	0.69	0.57	1.55	9.7
Monceren SC	0.46	0.60	0.70	0.59	1.57	9.8
Mon-Cut WP	0.47	0.61	0.71	0.60	1.59	9.9
Rizolex-T WP	0.47	0.62	0.71	0.60	1.59	9.9
F.solani	0.38	0.49	0.58	0.48	1.36	8.5
R.solani	0.37	0.48	0.56	0.47	1.34	8.4
Control	0.43	0.54	0.65	0.54	1.52	9.5
Mean	0.43	0.56	0.66	---	----	----

DISCUSSION

Leguminous crops are indispensable to human being and animals, Common bean as a member of legumes is considered one of the largest constituent of the human diet all over the world. It is liable to infection by many diseases through its growing season. Damping-off and root-rot are the most constrains that face the plant in the early stage. Three different herbicides as well as three different fungicides either alone or in combination were tested in the presence or absence of two candidates of damping-off and root-rot pathogens.

The three tested herbicides and fungicides caused inhibitory effects on the growth of the two tested pathogens when compared to the control treatment. This inhibition was gradually increased by increasing the concentration of the tested herbicides and fungicides. Moreover, *F. solani* was greatly affected by the tested herbicides and herbicides than *R. solani*. In addition, the tested herbicides and fungicides gave significant decrease in both damping-off and root-rot severity with significant increase in the survived plants. No damping-off and root-rot were recorded in case the tested herbicides, fungicides and non-infested soil. Highest percentages of damping-off, root-rot and lowest survived plant were recorded in case of soil infested with such

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pathogens. Likewise, the combination between the tested herbicides and fungicides with any of the tested pathogens resulted in significant reduction of damping-off and root-rot severity with significant increase in the survived plants when compared to their respective control. The application of the fungicides Rizolex-T, Vitavax-200, Benlate,Topsin-M70 and Moneceren were the most effective treatments for controlling wilt and root-rot diseases caused by *R. solani, F. solani, F. oxysporum, Sclerotium rolfsii* and *F. moniliforme* under greenhouse conditions [17,18].

Also, Mahmoud *et al.* [19] found that Rizolex-T and Mon-Cut were the most effective fungicides in reducing the percentages of pre- and post-emergence damping-off caused by *F. solani* and *R. solani* in faba bean. El-Kholy *et al.* [20] indicated that chemical fungicides were more effective than the bio-fungicides, and all the tested compound particularly Rizolex-T 50% WP, Tendro 40% FS and Maxim XL 3.5% FS were significantly reduced pre- and post-emergence damping-off, rotted roots, increased survival plants and subsequently increase biological, seed and straw yields in comparison with the control,

The use of herbicides in bean fields to control weeds competing for their growth is useful in controlling weeds, in addition to having an inhibitory effect on the growth of soilborne pathogens, the cause of damping-off and root-rot diseases. El-Kady *et al.*[11] obtained good control to bean weeds by using of the herbicides Basagran 48%, Inpul 75%, and Stomp Extra 45.5%.

Common bean seedlings treated with tested herbicides and fungicides and grown in soil infested with such a pathogen resulted in an increase in the total phenolic compounds compared to their respective control. The tested herbicides gave a more significant increase in the total phenolics than the tested fungicides through the time course of infection.

Common bean plants treated with tested herbicides and fungicides showed an increase in the percentage of the amount of nitrogen and subsequently the protein contents. Control plants showed a significant decrease of the both parameters, However, plants treated with the tested fungicides showed significantly more percentages of total nitrogen and protein when compared to those treated with the tested herbicides.

It is well known that phenolic compounds content are the compounds whose quantity is raised when a plant comes under invade by a pathogen [21]. Free phenolic compounds are likely to be considerably more toxic to the invading organism than the bound forms [22]. Moreover, antifungal phenolic compounds are present in healthy plants at levels that are anticipated to be antimicrobial, their levels may increase further in return to challenge by pathogens. The participation of an endogenous outfit of phenol compound in the plant disease resistance is dependent upon active phenol oxidase system [22,23,24].

Metabolic changes that occur in host tissues during a necrotrophic plant/fungal interaction have been poorly investigated. Whereas carbon metabolism reprogramming and photosynthesis disturbances have been studied, data on plant amino acids stores during infection are scarce [25]. In this regard, Reddy *et al.* [26] reported that the increase in soluble nitrogen may be associated to increase hydrolysis of proteins. Moreover, there was considerable increase in the percentages of total nitrogen and protein content of faba-bean and pea seeds due to controlling damping-off and root-rot diseases compared with untreated plants [27,28].

CONCLUSIONS

Comment [L34]: .

Common bean damping-off and root-rot diseases mostly cause great decay for germinating seeds, kill young seedlings, and rot the roots, which represent for the growers the most important yield constraints. In order to obtain adequate management of damping-off and root-rot of the common bean, it requires the deployment of a number of strategies, fungicides, biocides, resistant cvs., IRCs, organic manure or compost, agricultural and sanitary method, which could be used in combination to give efficacy in managing damping-off and root-rot. Therefore, it requires combining all or most of these items within IPM.

Ethical approval and consent to participate

Applicable

Consent for publication

Not applicable.

Availability of data and materials

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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