Minia J. of Agric. Res. & Develop.
Vol. (37), No. 2, pp. 141-156, 2017

FACULTY OF AGRICULTURE

CONTROL OF ROOT ROT AND WILT DISEASES OF MARJORAM BY USING SOME MINERAL COMPOUNDS AND ANTIOXIDANTS

***Heba Z. Ahmed*[(1)] *, Hanaa A. H. Armanious*[(2)]*, Maisa L. Abdel-Moneim*[(1)]*, Anwar A. Galal*[(2)]**

[(1)] Central Lab. Organic Agric., (Plant Pathol.) A. R.C, Giza, Egypt.
[(2)]Plant Pathol. Dept., Fac. Agric., Minia Univ., Egypt.

This work is a part of M. Sc. Studies for the 1st author

Received: 4April (2017) **Accepted: 19 April. (2017)**

ABSTRACT

The infection of marjoram (*Hortnesis* cv.) plants with root rot/wilt diseases was surveyed in three districts belong to El-Minia Governorate. The diseases are distributed in all tested fields of marjoram. The infection increase annually, in 2014 was more than in 2013 season. The highest infection was recorded in El-Edwa, followed with Beni Mazar, while the least one was recorded in Maghagha district.

Naturally infected marjoram plants were collected from different localities in El-Minia Governorate. *Rhizoctonia solani, Fusarium oxysporum, Sclerotinia sclerotiorum, Alternaria* sp. and *Helminthosporium* sp. were isolated from damped-off seedlings, root rotted and wilted plants. The frequency of isolated fungi was differed depending on the localities. *Fusarium oxysporum* was the major one, followed with *Rhizoctonia solani.* The highest disease incidence was recorded in El-Edwa followed by Beni-Mazar, El-Minia Governorate.All isolates of *R. solani, F.oxysporum* and *S. sclerotiorum* were able to infect seedlings of marjoram causing damping-off, and infect plants causing root rot and wilt symptoms. In the same time, pre-planting seedlings treated with H_2O_2, potassium silicate, ferric chloride, ascorbic acid, salicylic acid and citric acid reduced the disease incidence and increased the fresh and dry weight of plants grown in artificially inoculated soil.

Keywords: marjoram, *R. solani, F. oxysporum, S. sclerotiorum,* H_2O_2, potassium silicate, ferric chloride and antioxidants,

INTRODUCTION

Sweet marjoram (*Origanum majoranum* L.) plant, belonging to Family *Lamiaceae*, is an aromatic perennial herb. Marjoram is one of Egyptian most exported crop after basil as an aromatic perennial herb. So, it has a very strategic importance for Egypt's economy.The cultivated area of sweet marjoram in Egypt is about 4000–5000 feddan according to the National Agriculture Income (2003). Plants of marjoram are commonly found in the Mediterranean region or grown in gardens around the world. In its varied forms of marjoram essential oil, fresh or dried marjoram leaves, or marjoram powder (ground up marjoram), it has many advantageously uses and numerous health benefits (Charles, 2013). Its essential oil is used as antimicrobial, antispasmodic, digestive, better tonic, diuretic, antidiabetic and antiparalytic drug (Yadava and Khare, 1995). Marjoram has a strong antioxidant activity, mainly because of its high content of phenolic acids and flavonoids, which useful in health supplements and food preservation (Vagi*et al*., 2005)

Root-rot and wilt symptoms have been observed in marjoram plantations which resulted in reduction in plant stand, vegetative growth, and consequently low essential oil yield of harvested plants.

The causal pathogens of root-rot and wilt diseases are mainly soil-borne and can be transmitted by seeds. Percentage of occurrence of these diseases always increased in the absence of the control measures in nursery or field.

Several methods were suggested for controlling root rot and wilt, i.e. improving the sanitation procedures, agricultural practices, chemical and biological control. There are a number of compounds that do not have direct antimicrobial activity increase resistance or at least decrease symptoms in some host-pathogen interaction **(**Elad, 1992, Galal and Abdou, 1996 and Hammerschmidt and Smith, 1997).

This study aimed to investigate the occurrence and distribution of root-rot and wilt diseases on marjoram cultivated in El-Minia Governorate, isolate and identify the causal pathogens, and to develop fungicide alternatives for the control of these diseases.

MATERIAL AND METHODS

1- Survey of marjoram root rot and wilt.

At 90 days old, root rot/wilt diseases of marjoram plants (Hortensis cv.) that grown at 3 different districts belong to Minia governorate, namely El-Edwa, Beni-Mazar and Maghagha were surveyed during the growing seasons of 2013 and 2014. Three fields each district were concerned and the diseased plants showing typical symptoms of root rot/wilt were surveyed in the exact location. Sampling sites were determined with a field map, five sampling sites were designated per field tested, one of each of the four corners plus one in the center of the field. Sampling sites were

located at least 5 meter from the edge of the field (Ray and McLaughlin, 1942). At least 200 planted holes were examined per each sampling site. The data were used to calculate disease incidence (the frequency of infected plants) for each sampling site, from which the field average was calculated.

2- Frequency of fungi associated with marjoram root rotted / wilted plants.

Naturally infected marjoram plants showing typical wilt and root rot symptoms, were collected from El-Adwa, Maghagha and Beni-Mazar districts, El-Minia Governorate, during spring 2013 growing season.

Infected roots of 90 days old plants were separated, washed thoroughly with running water and cut into small segments (2- 5 cm) were takenfrom area between infected and healthy tissues, surface sterilized by 2 % sodium hypochlorite solution for 3 minutes then washed several times with sterilized water and plated onto Petri plates containing potatoes dextrose agar (PDA) medium without or with antibiotics (Penicillin 20 units/plate). The plates were incubated for 5 days at 25 C^{o}. Hyphal tip and single spore isolation techniques were carried out to obtain pure cultures of the developed fungi.

The established fungal isolates were identified on the basis of culture morphology and microscopic characteristics according to Gilman (1957), Booth (1971) and Barnett and Hunter (1972) and was further verified by Division of Fungal Taxonomy, Plant pathology Research Institute, Agriculture Research Center, Giza, Egypt.

Inoculated test tubes containing slants of PDA medium were incubated and kept in refrigerator at 5^{o}C as stock cultures of the isolated fungi for further studies.

The frequency of isolated fungi was calculated according to following formula:

$$\text{Frequency \% of the fungus} = \frac{\text{No of isolated fungus colonies}}{\text{Total Number of all isolates}} \times 100$$

3- Pathogenicity test:

The pathogenic properties of the isolated fungi were determined using marjoram (Hortensis cv.) seeds. Sterilized clay pots (30 cm in diameter) filled with sterilized loamy clay soil. Soil sterilization was carried out by drenching with commercial formalin solution (5%), treated soil was covered with polyethylene sheet for one week, and then aerated for two weeks. The fungal inocula were prepared by growing each fungus on autoclaved sand-barley medium in 250 ml Erlenmeyer flasks (each contained 60gm barley grains, 40gm water - washed sand and covered with distilled water) then incubated for 2 weeks at 25^{o}C. These inocula were used for soil infestation at rate of 2.5% (w/w). Pots were irrigated and left for aweek to ensure even distribution of fungi in soil. Sterilized pots were filled with sterilized soil, mixed with autoclaved sand-barley medium at the same rate, were used as control treatment. Three pots were used as a replicates, each replicate contains five plants.

Seeds of marjoram were sterilized using sodium hypochlorite solution (2%) for 3 minutes then washed several times with sterilized water and then were sown The pots were kept under careful observation in the open field of Plant Pathology Dept., Fac. Agric., Minia University, and examined for pre- and post-emergence damping-off for 2 and 4 weeks after sowing respectively. While root rot and wilt have examined at 12 weeks

Reisolation was carried out from some of the artificially diseased plant to fulfill Koch's postulations and the developed fungi were confirmed with the original isolates.

The percentages of disease incidence for root rot and wilt were calculated according to the following formula:

$$\text{Disease Incidence (\%)} = \frac{\text{Number of infected plants}}{\text{Total No. plant}} \times 100$$

4- Control trials:

4.1. The effect of antioxidant and mineral compounds on disease incidence:

Pot experiments were carried out in the greenhouse of the Plant Pathology Dept., Faculty of Agriculture at El-Minia, during summer seasons 2013. Pots (30 cm in diameter) and soil sterilization, seed disinfectation, and were made as described before in pathogenicity test. Inoculum also was carried out as described before in pathogenicity test part. Six compounds, i.e. Ascorbic acid (AA), Salicylic acid (SA), Citric acid (CA) at 100, 150,200 ppm and hydrogen peroxide (H_2O_2), Ferric chloride($FeCl_3$) and Potassium silicate (K_2SiO_3) at 25,50, 100 ppm, were tested as seedlings soaking for controlling the disease. Seedlings were soaked in the tested solutions, 3 hours before replanting. Seedlings were soaked in distilled water for the same period and were performed as control treatment. Three replicates (i.e. pots) were used per each variant treatment. Five seedlings were replanting in each pot. The percentages of root-rot/wilt incidence were recorded, 90 days after replanting. Meantime, either fresh or dry weights of treated plants were assayed.

Statistical analysis

Data were analyzed statistically using analysis of variances, and were compared according to the LSD test (Gomez and Gomez, 1984).

RESULTS

1- The marjoram root rot/wilt distribution in different districts of El-Minia Governorate.

In the surveyed fields, wilt symptoms usually developed on plants showing symptoms of root-rot, therefore incidence of both diseases was expressed as total natural infection percentages. Data in Table (1) show that the marjoram root rot/wilt diseases are very spread in all districts under study of El-Minia Governorate. There is, generally, a gradual increase in disease incidence in different locations from year to year, while the disease

incidence ranged from 12.7 to 2.01% in 2013 in the first season to 15.0-3.2% in the second one.

Table (1): Percentages of naturally infected marjoram plants grown in El-Minia governorate:

Districts	Cultivated areas/ feddan	% of infection in 2013 season	% of infection in 2014 season
El Edwa	55	12.7	15.0
BeniMazar	18	5.5	7.1
Maghagha	695	2.01	3.2

In This respect, the highest mean percentage of infection in El Minia localities was observed in El Edwa (12.7 and 15.0 %), followed by Beni-Mazar (5.5 and 7.1%), whereas the lowest infection was recorded in Maghagha (2.01 and 3.2%).

2- Frequency percentages of fungi isolated from marjoram plants showing root rot/wilt symptoms.

Seven isolates of different soil borne fungi, belonging to five genera, namely *Rhizoctonia solani*; two isolates, *Fusarium oxysporum*, two isolates; and one isolate of each *Alternaria* sp., *Helminthosporium* sp. and *Sclerotinia sclerotiorum*, were isolated from damped-off seedlings and wilted marjoram plants showed stunting, yellowing, dried shoots, wilt, root-rot symptoms collected from different fields in El-Edwa, Maghagha and BeniMazar districts at El-Minia Governorate.

Data in Table (2) show that frequency of fungi associated with marjoram rotted roots /wilted plants Maghagha and Beni-Mazar districts (El Minia Governorate) showed high frequency to *Rhizoctonia solani* (42%) while come next *Fusarium oxysporum* which recorded (31%) frequency followed by *Sclerotinia sclerotiorum* (23%),Whereas *Helminthosporium* sp. and *Alternaria* sp. gave the lowest frequency (2%). *Fusarium oxysporum* was the highest frequented fungus (32.5%) isolated from El Edwa district, followed by *Helminthosporium* sp.(30.7% frequency), while *Alternaria* sp., *Rhizoctonia solani* and *Sclerotinia sclerotiorum* were recorded 14, 12.8 and 10%, respectively.

3- Pathogenicity test:

Results presented in Table (3) reveal that all isolates of *Rhizoctonia solani*, *Fusarium oxysporum* and *Sclerotinia sclerotiorum* infect marjoram plants causing damping–off, root rot and wilt symptoms. Whereas, isolates of *Alternaria*sp. and *Helminthosporium* sp.failed to infect marjoram plants. The highest percentages of pre-emergence damping off were recorded by isolate R1 (62.5%) followed by isolate F1 (44.5%).

Isolate S1 caused 35.8% and isolate F2 caused 22.8% pre

emergence damping-off. Whereas, isolates F1, R1 and S1 caused 6.1, 5.1, 4.1.and5.5% of seedling post-emergence damping off, respectively. Isolate F2 of *Fusarium oxysporum* caused the lowest percentage (1.4%) post emergence damping off. On the other hand, Isolate F1of *F. oxysporum* caused the highest percentage of root rot/wilt (33.1 %), followed by isolate R1 of *R. solani*(28.3%) while isolates S1 and F2 recorded 25.2 and 16.6 %, respectively. Isolate No. R2 showed a weak ability to cause root rot /wilt which recoded (12.1%). Table (3) also show that *Rhizoctonia solani* (isolate R1), *Fusarium oxysporum* (isolate 1) then S1 of *S. sclerotiorum* were the most virulent isolates where they recorded the higher percentages of infected plants (95.9 and 83.7% and 65.1%, respectively) and the lowest survival plants. According to this data, isolates R1, F1 and S1 were chosen to carry out the future studies based on their pathogenic ability.

Table (2): Frequency of fungi associated with diseased marjoram plants.

Fungi	El-Minia Governorate		Mean
	Maghagha, BeniMazar Districts	El-Edwa District	
R. solani	42.0	12.8	27.4
F.oxysporum	31.0	32.5	31.8
Helmintho-sporium sp.	2.0	30.7	16.4
*Alternaria*sp.	2.0	14.0	8.0
S.sclerotiorum	23.0	10.0	16.5
Mean	100	100.0	100.0

4- Greenhouse experiment:

4-1- Effect of some mineral compounds and antioxidants on root rot/wilt on marjoram incidence:

Effect of Hydrogen peroxide, two mineral compounds, namely ferric chloride, potassium silicate and three antioxidants, i.e. salicylic acid, ascorbic acid and citric acid, on root rot and wilt incidence was demonstrated under greenhouse conditions. Data presented in Tables (4 and 5) show that all treatments significantly reduced root rot/wilt of marjoram artificially inoculated with tested pathogens when comparing with control. The percentages of disease incidence decreased with increasing the concentration of tested compounds.In general, the inducer chemicals were more effective in reducing root rot/wilt disease than the mineral compounds. The lowest percentage of root rot/wilt infection was 17, 14 and 16% caused by *R.solani*, *S. sclortiorum* and *F. oxysporium*, respectively, when treated with 200 ppm of citric acid.

Potassium silicate and ferric chloride were the second inducing 18.6 and 19.0% infection caused by *R. solani* and 16.3 and 16.1% with *S.sclerotiorum*. No significant differenced were shown between treatment with ascorbic acid and potassium silicate at 200 and 100 ppm, respectively, for reducing infection induced by *F. oxysporum and S.sclerotiorum.* Hydrogen peroxide

was the least affected one against all tested pathogens in this respect.

Table 3: Pathogenicity test of fungi isolated from the roots of marjoram diseased plants.

Fungi and Isolate No.	Daming-off (%)		Root rot/wilt (%)	Total infection (%)	Survival plants, (%)
	Pre-emergence	Post-emergence			
Rhizoctonia solani, R1	62.5	5.1	28.3	95.9	4.1
Rhizoctonia solani,R2	34.6	0.0	12.1	46.7	53.3
Fusarium oxysporum,F1	44.5	6.1	33.1	83.7	16.3
Fusarium oxysporum,F2	22.8	1.4	16.6	40.8	59.2
Sclerotinia sclerotiorum, S1	35.8	4.1	25.2	65.1	34.9
Helminthisporum sp., H1	0.0	0.0	0.0	0.0	100.0
Alternaria sp. A1	0.0	0.0	0.0	0.0	100.0
Control	0.0	0.0	0.0	0.0	100.0
Mean	42.2	1.3	15.8	56.9	43.1
LSD (0.05)	1.44	1.04	1.15	2.26	

4-2- Effect of Hydrogen peroxide, two mineral compounds and three antioxidants on fresh and dry weight of marjoram plants:

The effect of soaking marjoram seedlings in the tested mineral and inducer chemicals on plant yield under greenhouse condition during season 2014 were recorded in Tables (6 and 7). Results indicate that soaking of seedlings in any of the tested compound significantly improved the growth and branching when comparing with control. In most cases, increasing the compound concentration increased the weight of plants. In general, hydrogen peroxide and mineral compounds, ferric chloride and potassium silicate gave the best results than antioxidant compounds tested. The maximum plant weight was recorded when seedlings were soaked in H_2O_2 at 100 ppm, followed by potassium silicate. No significant differences were recorded when potassium silicate were used at 25,50 and 100 ppm. The highest plant fresh weight was recorded when seedlings were soaked in ascorbic acid at 200 ppm (5.23 g) with *Rhizoctonia solani*, and salicylic acid at 200 ppm with *Fusarium oxysporum* (6.27 g), whereas, no significant differences between salicylic acid and ascorbic acid at 200 ppm in case *Sclrotinia sclerotiorum* (recording 5.12 and 5.10 g/plant). All treatments led to increasing dry weight/plant in comparing with control. The highest dry weight was showed when seedlings of marjoram was soaked in hydrogen peroxide at 100 ppm (yielded 1.4,1.3 and 1.22 g/plant) and ascorbic acid at 200 ppm (yielded 2.21, 2.10, and 3.21 g/plant when planted in soil infested with *R. solani*, *S. sclerotiorum* and *F. oxysporum*, respectively).

Table (4): Effect of some mineral compounds and antioxidants on root rot/wilt on marjoram incidence:

Compound	Conc. (ppm)	% of root rot/wilt incidence		
		R. solani	*S. sclerotiorum*	*F. oxysporum*
Hydrogen peroxide (H_2O_2)	25	26.4[*)]	25.1	34.2
	50	23.5	25.6	25.7
	100	22.3	20.8	28.2
Ferric chloride (Fe Cl_3)	25	24.9	27.2	26.1
	50	20.5	21.5	30.2
	100	19.0	16.1	22.8
potassium silicate (K_2SiO_3)	25	28.1	24.9	21.6
	50	23.7	18.2	22.6
	100	18.6	16.3	16.7
Salicylic acid	100	38.4	32	38.4
	150	31.5	26.4	30
	200	21	18	25
Ascorbic acid	100	33	28	33
	150	25.3	22	22.6
	200	20	15	17
Citric acid	100	28	23	31
	150	21	17.6	21
	200	17	14	16
Control	0	86	48.3	66.2
Infected	0	73.4	54.6	66.8

[*)] Each reading is an average of three replicates.

Table (5): Different between variances (LSD) at 0.05

Factor	For mineral compounds	For antioxidants
Compound(A)	2.32	2.28
Fungus (B)	1.92	1.20
Concentration	0.82	0.36
(AxB)	4.14	3.91
(AxC)	3.24	2.46
(BxC)	1.60	1.70
(AxBxC)	5.40	5.23

DISCUSSION

Sweet marjoram (*Origanum majoranum L.*) plant is one of the most important aromatic plant crops in Egypt, which planted in many locations in different Governorates. The cultivated area planted with marjoram in El-Edwa, Maghagha and Beni-Mazar Districts, El-Minia Governorate, is about 768 feddan from about 4500 feddan in Egypt, presented 17.1% of all area cultivated with marjoram. Seedling damping off and root rot/wilt diseases have been observed in marjoram plantations which resulted in reduction in plant

stand and vegetative growth, and consequently low essential oil yield of harvested plants (Hilal *et al*. 1990, Garbagnoli and Gaetan, 1994, El Gebaly,1998 and Hassanin, 2007). The disease incidence reached between 1.31- 12.7% in 2013 and 2.3 -15.0 in 2014 seasons, showing gradual increase in different locations from year to year. The disease is very spread in all fields cultivated with marjoram. Root rot/wilt disease is distributed in El-Minia Governorate. It seems warm weather might be favorable for infection and development of these diseases. This results agree with those obtained by Hilal *et al.* (1990) and Hassanin (2007).

Seven fungi belonging to five genera, namely *Rhizoctonia solani, Fusarium oxysporum, Sclerotinia sclerotiorum, Alternaria* sp. *and Helminthosporium* sp. were isolated from naturally infected plants. *Rhizoctonia solani and Fusarium oxysporum* were the most common isolated fungi. The other isolated fungi (*Helminthosporium* sp., *Alternaria* sp. and *S. sclerotiorum*) occurred, however, in lower frequencies.

Table (6): Effect of hydrogen peroxide, two mineral compounds and three antioxidants on fresh and dry weight of marjoram.

Compound	Conc. (pp)	Fresh weight (g)			Dry wight of mycelium (g)		
		R. solani	*S. sclerotiorum*	*F. oxysporum*	*R. solani*	*S. sclerotiorum*	*F. oxysporum*
Hydrogen peroxide (H_2O_2)	25	5.67	4.90	5.39	1.36	1.1	0.78
	50	5.50	4.96	6.44	1.6	0.92	0.88
	100	6.33	6.00	7.30	1.4	1.3	1.22
Ferric chloride ($Fe\ Cl_3$)	25	4.00	4.61	5.12	0.88	0.78	0.98
	50	4.41	5.46	5.29	0.93	1.01	0.99
	100	4.64	5.51	6.36	1.01	1.01	1.20
potassium silicate (K_2SiO_3)	25	5.83	6.40	5.87	1.11	0.87	0.77
	50	5.85	7.33	5.88	1.14	0.92	0.98
	100	5.89	7.76	5.73	1.21	.1.2	1.01
Salicylic acid	100	2.90	3.44	3.50	0.56	0.99	1.05
	150	3.25	4.34	4.43	1.21	1.89	2.14
	200	4.57	5.12	6.27	1.40	2.07	2.37
Ascorbic acid	100	3.48	4.01	4.00	1.13	1.11	2.09
	150	4.43	4.81	5.10	1.27	1.81	2.96
	200	5.23	5.10	5.71	2.21	2.10	3.21
Citric acid	100	2.76	3.02	4.66	0.71	1.02	0.78
	150	3.03	3.72	4.81	1.01	1.50	1.81
	200	3.92	4.15	6.87	1.81	1.99	2.87
Control	0	2.51	3.00	2.77	0.54	0.98	0.77

* Each reading is an average of three replicates.

According to the available literatures, *R. solani* and *F. oxysporum* were recorded for the first time on marjoram plants in Egypt by Ali *et al.* (1972), and they were isolated by Hilal *et al.* (1990), and Hassanin (2007). On the other hand, *Sclerotinia sclerotioum* was isolated in this study for first time in Egypt according to our Knowledge. This Fungus was isolated form

Origanum vulgare (wild marjoram), in Italy at 2007 by Garibaldi *et al.*, while the other fungi such as *Fusarium oxysporium* and *F. solani* were isolated by Gaetan *et al.* (2007), in Argentina and Garibaldi *et al*.(2007), in Italy. Also, *Rhizoctonia solani* was isolated in Italy at 2013 by Garibaldi *et al.*

Table (7): Different betweenvariances (LSD) at 0.05

Factor	Mineral compounds		Antioxidants	
	For plant fresh weight	For plant Dry weight	For plant frish weight	For plant Dry weight
Compound(A)	1.50	1.10	0.31	0.21
Fungus (B)	2.50	1.99	0.19	0.14
Concentration	0.33	.= 0.30	0.18	0.12
(AxB)	2.61	2.41	0.44	0.24
(AxC)	1.20	1.10	0.51	0.31
(BxC)	2.05	2.00	0.5	0.2
(AxBxC)	3.11	3.01	1.60	1.00

Pathogenicity of the identified fungi on marjoram seedlings indicated that *R. solani* and *F. oxysporum*were the major wilt fungi against plants, while both *R. solani* and *S.sclerotioum* were the most aggressive fungi caused pre-and post-emergence damping off as well as root rot. These results are somewhat similar to those reported by El-Gebaly (1998). Also the present results are in agreement with those reported by Hilal *et al.*(1990) and Hassanin (2007). Some of the identified fungi which reported in the present study were previously reported as pathogens on mint and basil (Elshazly, 1996), rosemary Conway *et al*.(1997), and sweet basil (Ghebrial and Emen, 2005) and Hilal (1985). On *Pelargonium graveolens*. In Poland, Zimowska (2015). Studied the diversity of fungi occurring and damaging the under and above ground parts of herbs belonging to family *Lamiaceae*. These fungi were *Alternaria* sp, *Rhizoctonia solani* and *Fusarium oxysporium.* These fungi were reported by Garibaldi *et al*.(2013). On marjoram and by Takeuchiand Horie (2006) on oregano. The present study revealed that *R. solani, F. oxysporum and S.sclerotiorum* infected basil, rosemary, anise, mint, thyme, fennel, sage and lavender plants causing root rot and/or wilt disease with different degree of infection. *Rhizoctonia solani* was the more aggressive one causing the highest percentages of disease incidence.

Due to its medicinal and aromatically properties, marjoram plants must grow under clean weather and free from chemical residues particularly fungicides. Thus using antioxidants and/or biocides became a good target as fungicides alternatives (Galal and El-Bana, 2002 and El-Deeb *et al*., 2002.)

Traditionally, plant diseases are controlled by the application of synthetic fungicides (Eckert and Ogawa, 1988). However, the potential impact on environment as well as on human health largely limits their application (Eckert *et al*., 1994). It is reported that some microbes become fungicide-resistant (Holmes and Eckert, 1999), and thus a fungicide effect on controlling fungal infection may be greatly reduced so, a trail to induce systemic resistance against root rot / wilt in marjoram without using fungicides was carried out through this investigation.

Pre-planting seedlings of marjoram treatment with H_2O_2, mineral compounds and antioxidant compounds significantly reduced root rot/wilt artificially inoculated with tested pathogens when comparing with control. Disease incidence decreased with increasing the concentration of tested compounds. The antioxidant compounds decreased the disease incidence more than mineral compounds Citric acid, ascorbic acid, potassium silicate and ferric chloride, in descending order, caused the lowest percentages of root rot/wilt infection induced by *R. solani, S. sclortiorum* and *F. oxysporium*. Whereas, the effect of H_2O_2 to control marjoram root/wilt was nearly similar to that of antioxidants. These results are on line with those reported previously (Peng and Kue, 1992; Abdou and Galal, 1997 and Abdou *et al*., 1999).
Potassium silicate, which gave a high effect for controlling marjoram root rot/wilt, was mentioned by Ma (2004). Who reported that silicon is effective in controlling various pests and diseases caused by both fungi and bacteria in different plant species. Silicon (Si), also, exerts alleviative effects on various abiotic stresses including salt stress, metal toxicity, drought stress, radiation damage, nutrient imbalance, high temperature, freezing and so on. **(**Guntzer, *et al*. 2012**).** Mentioned the benefits of silicon are well demonstrably when plants are exposed to abiotic and biotic stresses. The defense mechanisms provided by Si are far from being understood, but evidence for explain in plant processes are given indicating multiple combined effects rather than one single effect. The antioxidants can be used to induce systemic or local resistance. It was used to control root rot /wilt of cowpea caused by *Fusarium* sp. **(**Galal, and Abdou,1996). Gray mold of tomato caused by *Botrytis* sp. (Elad,1992). And tomato blight caused by *A. solani* and tomato wilt caused by *F. oxysporum* **(**Mostafa,1999). Abbas (2004). Reported that soaking of pea seeds in some antioxidant solutions (i.e. ascorbic and salicylic acids, at 0.1, 1.0 and 10.0 mM decreased the diseased severity caused by *F. oxysporum* and *R. solani*. The application of salicylic acid (SA) has been reported to induce tolerance of plants to many biotic and abiotic stresses including fungi, bacteria and viruses (Delany *et al.* 1994). It appears that SA has a regulatory effect on activating biochemical pathways associated with tolerance mechanisms

in plants (Sticher *et al*., 1997 and Klessig*et al*., 1998). Moreover, antioxidants such as salicylic acid work as a signal of systemic acquired resistance in plants (Molina *et al*., 1998). In addition, the antioxidant treatment induces the accumulation of pathogenesis-related (PR) protein (Kessmann and Ryals 1993;Malamy *et al*.,1990 and Métraux*etal*.1990). Several studies report that SA pre-treatment enhances the subsequent response to elicitor treatment (Draper, 1997). Salicylic acid, also, has an effect on the very early responses that lead to the oxidative burst, cell death and its own synthesis. Salicylic acid can induce the expression of a number of defense-related genes and proteins (Hunt and Ryals, 1996; Schneider *et al*., 1996; Sticher *et al*., 1997; van Loon, 1997 and Yang *et al*., 1997).

According to our data, could recommend using potassium salicylate, citric and ascorbic acids as seedling treatment for controlling marjoram root rot/wilt.

Acknowledgment: The authors wish to express their gratitude to Prof. Dr. Marzouk R. Abdel-Latif for his critical reviewed this manuscript.

REFERENCES

Abbas, A.H. (2004). Pathological and physiological studies on pea root rot.M. Sc.Thesis, Fac. of Agric., Minia Univ., Egypt. 1- 108pp.

Abdou,El-S. and A.A.Galal (1997). Sensitivity of *Fusarium moniliform*, *F.oxysporum* and *F.solani* to superoxide anion and hydrogen peroxide *in vitro*..Egypt. J.Microbiol.,31:523-535

Abdou,El-S.; H.M Abd-Alla. and A.A. Galal (1999). Influence of hydrogen peroxide on sunflower rust infection. Arab Univ.J.Agric.Sci., Ain Shams University.,7:289-302.

Ali,M.D.H.; Morsi, A.A. and El-Sherif, M.A. (1972). Identification of Agricultural Research carried out in Egypt (1900-1970). I. Plant pathology. N.I.D.C.,Nat. Acad. Sci.Tech,489 pp. (in Arabie).

Barnett, H.L and Hunter, B.B. (1972). Illustrated genera of imperfect fungi.Burgess Pub.CC.Minneapolis, Minnesota, pp. 241.

Booth, C. (1971). The Genus *Fusarium*.1-237 pp, Commonwealth mycological Institute.Kew, Surrey, England.

Charles, D .J. (2013). Antioxidant Properties of Spices, Herbs and Other Sources, DOI 10.1007/978-1-4614-4310-0_37.@ Springer Science Business Media New York 2013.

Conway, K.E.; N.E. Maness and J.E. Motes (1997). Integration of biological and chemical controls for *Rhizoctonia* aerial blight and root rot of rosemary. Plant Dis., 81 (7) ; 795-798.

Delany,T.P;Uknes,S.;Vernooij,B.;Friedrich,L.;Weymann,K.;Negrotto, D.;Gaffiney,T.;GutRella,M.;Kessmann,H.;Ward,E.and Ryals,J.(1994). A central role of salicylic acid in plant disease

resistance.Science., 266:1247-1250.

Draper, J. (1997). Salicylate, Superoxide Synthesis and cell suicide in plant defense.Trends in plant Science,2:162-165.

Eckert,J.W. and Ogawa,J.M. (1988). The chemical control of postharvest diseases: deciduous fruits,berries,vegetabls and root rot/tuber crops. Ann. Rev. Phytopathol., 25:433-446.

Eckert,J.W.; Sievert,J.R. and Ratnayake,M. (1994). Reduction of imazalil effectiveness against citrus green mold in California packin house by resistant biotypes of *Penicillium degitatum*.Pl.Dis., 78:791-794.

Elad, Y. (1992). The use of antioxidants (Free radical scavengers) to control gray mould (*Botrytis cinerea*) and white mould (*Sclerotinia sclerotiorum*) in various crops. Plant Pathol.,41:417- 426.

El-Deeb, A.A.; Abd El-Momen, S.M. and Hanafi, A. (Awatef) (2002). Effects of some fungicides and alternative compound on root and pod rots in peanut .Egypt .J. Agric. Res., 80 (1): 71-82

El- Gebaly, M.M (1998). Studies on root-rot and wilt disease of marjoram Ph.D. Thesis, Fac.Agric., Al-AzharUniv.,Cairo,Egypt.

El- Shazly, A.M.A.(1996). Studies on certain fungal diseases on some medicinal plants of family *Labiatea*.Ph.D.Thesis, Fac. Agric., Al –Azhar Univ., 188pp

Gaet´an, S.A.; Madia M. S.; Perez A. (2007). Recent outbreak of Fusarium crown and root rot caused by *Fusarium solani*on marjoram in Argentina. Australasian Plant Disease Notes, 2, 15–16.

Galal, A.A. and Abdou, El-S. (1996). Antioxidants for the control of fusarial diseases in cowpea. Egypt. J. Phytopathol.,24:1-12.

Galal,A.A. and El-Bana A. (2002). Inhibition of carpogenic germination of sclerotia of *Scelrotini asclerotiorum* (Lib.) De Bary by cinnamic acid derivatives. Egypt. J.phytopathol.,30(1):67-79

Garbagnoli,C. and Gaetan,S.A. (1994). Wilting of marjoram (*Origanum vulgare*L.) caused by species of the genus *Fusarium* in Argentina. Fitopathologia, 29 (2): 150-155 (c.f.Rev.PI. Pathol., 74:2349,1995).

Garibaldi, A.; Bertetti, D.; Pensa, P.; Poli, A. and Gullino, M. L. (2013). First Report of Web Blight on Oregano (*Origanum vulgare* L.) caused by *Rhizoctonia solani* AG-1-IB in Italy Plant Disease, 97(8): 1119.

Garibaldi, A.; Minuto, A. and Gullino M. L. (2007). First report of white mold caused by *Sclerotini asclerotiorum* on *Origanum vulgare* and *Taraxacum officinale* in Italy. *Plant Disease,* 91(10): 1360.

Ghebrial, A. and Emen, W. R. (2005). Pathological studies and control evaluation of sweet basil disease

caused by *Fusarium oxysporum* f.sp.*basilici*. M .Sc.Thesis,Fac.Sci., Cairo Univ.,1-177pp.

Gilman, J.C. (1957). A manual of Soil Fungi, 2nded. The Iowa State College Press.

Gomez, K.A. and Gomez, A.A. (1984). Statistical procedures in agricultural research, by New York, Chichester, etc.: Willy, 2nd ed., Paperback, PP. 1- 680.

Guntzer, F.; Keller, C.; Meunier, J-D. (2012). Benefits of plant silicon for crops .Agron.Sustain. Dev. 32:201-213.

Hammerschmidt, R. and Smith J.B. (1997). Acquired resistance to disease in plants. Hort. Rev., 18: 247-289.

Hassanin, M. (2007). Pathological studies on some important fungal diseases of marjoram and their management .M.Sc.Thesis, Fac. of Agric., Al- Azhar Univ., Egypt.

Hilal, A.A. (1985). Pathological studies on some medicinal and aromatic plants in Egypt.Ph.D. Thesis , Fac. Agric., Suez Canal Univ.,Ismailia,Egypt,236 pp

Hilal, A.A.; Heweidy, M.A.; El-Deeb, A.A. and El- Ghareeb, L.A. (1990). Root–rot and wilt diseases affecting marjoram in Egypt. Proc. 6 th.Cong. Phytopathol.,Cairo, Egypt,3:402-417

Holmes,G.J.; Eckert,J.W. (1999). Sensitivity of *Penicillium digitatum* and *P.italicum*to postharvest citrus fungicides in California. Phytopathology, 89,716-721

Hunt,M.D.and Ryals J.A. (1996). Systemic acquired resistance signal transduction critical. Review in plant Science,15:583-606.

Kessmann,H. and Ryals,J. (1993). Requirement of salicylic acid for the induction of systemic acquired resistance.Science,261:754-756.

Klessig, D.F.; Durner, S.J.; and Yang, J.Y.(1998). Salicylic acid mediated signal transduction in plant disease. In:Verpoorte, R.(ed) Phytochemical signals and plant-microbe Ma, J.F.(2004) Role of silicon in Enhancing the Resistance of Plant to Biotic and Abiotic Stresses. Soil Sci. Plant Nutr., 50 (1), 11-18.

Kauss,H.;Theisingerhinkel,E.; Minderman,R. and conrath,U. (1992)**.** Dichloroisonicotinic and salicylic acid, inducers of systemic acquired resistance, enhance fungal elicitor responses in parsley cells. Plant Journal, 2:655-660.

Kauss,H.;Jeblick,W.;Ziggler,J. and Krabler, W. (1994). Pretreatment of parsley (*Petroselinum crispum* L.) suspension cultures with methyl jasmonate enhances elicitation of disease resistance. Plant Molecular Biology.109-122.

Ma, J.F. (2004). Role of silicon in Enhancing the Resistance of Plant to Biotic and Abiotic

Stresses.Soil Sci. Plant Nutr., 50 (1), 11-18,2004

Malamy,J.; Carr,J.P.; Klessig,D.F. and Raskin,I.(1990). Salicylic acid : A likely endogenous signal in the resistance response of tobacco to viral infection.Science,250:1002-1004.

Métraux,J.P.; Signer, H.; Ryals, J.; Ward, E.; Wyss-Benz, M.; Gaudin, J.; Raschdorf,K.; Schmid,E.; Blum, W. and Inveradi,B. (1990). Increase in salicylic acid at the onest of systemic acquired resistance in cucumber. Science,250:1004-1006.

Molina, A.; Hunt, M. D. and Ryals,J.A.(1998). Impair fungicide activity in plants blocked in disease resistance signal transduction. The Plant Cell, 10:1903-1914.

Mostafa,Y.M.M. (1999). Improving the productivity of tomato by producing F1 hybrids and using some antioxidants treatments. M.Sc. Thesis, Fac. Of Agric. Minia Univ., 1-132 pp.

National Agriculture Income (2003). *Ministry of Agriculture and Land reclamation, Economic Affairs Sector (EAS), Agriculture Planning Central Administration, General administration of Agr., Economic Resources*.

Peng,M. and Kuc, J.(1992). Peroxidase-generated hydrogen peroxide as source of antifungal activity *in vitro* and on tobacco leaf disks. Phytopathology, 82:696-699.

Ray, W.W. and McLaughlin, J.H.(1942). Isolation and infection tests with seed and soil-borne cotton pathogens. Phytopathology, 32: 233-238.

Schneider,M.; Schweizer,P.; Meuwly,P.; Métraux,J.P.(1996). Systemic acquired resistancein plants.International Journal of Cytology, 168:303-340.

Sticher,L.; Mauch-mani,B. and Metraux,J.p.(1997). Systemic acquired resistance.Annu.Rev. Phytopathol.,35:235-270.

Takeuchi J.; Hore H. (2006). First report of stem and root rot of rocket and leaf blight of Oregano by *Rhizoctonia solain* in Japan.Tokyo Metropolitan Agriculture and Forestry Research Center , 3-8-1 Fujimicho, Tachikawrashi, Tokyo 190-0013, Japan. Annual Report of the Kanto-Plant Protection Society.No.53

Vagi, E.; Rapavi, E.; Hadolin, M.; Blazovics, A. and Simandi, B. (2005). Phenolic, triterpenoid antioxidants from *Origanum majoranum* L. herb and extracts obtained with different solvents. J. Agric. food Chem.,12: 17-21.

Van Loon, L.C.(1997). Induced resistance in plant and the role of pathogenesis-related proteins. European Journal of Plant Pathology,103: 753-765.

Yadava,R.N. and Khare,M.K. (1995). A triterpenoid from *Majorana hortensis*. Fitoterapia., 66 (2) : 185.

Yang,Y.O.; Shah,J. and Klessig,D.F. (1997). Signal perception and transduction in defense responses. Genes and Development, 11: 1621-1639.

Zimowska,B. (2015). Fungi threatening the cultivation of oregano (*Origanum vulgare* L.) in south-eastern Poland. Acta Sci. Pol. Hortorum Cultus, 14(4): 65-78

مقاومة مرضي عفن الجذور والذبول في البردقوش بإستخدام بعض المركبات المعدنية ومضادات الأكسدة

هبه زين العابدين أحمد[1]، هناء عياد حليم أرمانيوس[2]، مايسه عبد المنعم[1]، أنورعبد العزيز جلال[2]

[1] المعمل المركزى للزراعة العضوية (امراض النبات)، مركز البحوث الزراعية وقسم أمراض النبات [2]– كلية الزراعة جامعة المنيا

تم حصر إصابة نباتات البرقوش (صنف Hortensis) بمرض عفن الجذور والذبول فى ثلاث مراكز من محافظة المنيا وبينت الدراسة انتشار الإصابة بهذا المرض فى جميع حقول زراعة البردقوش وتزداد الإصابة بها سنويا حيث كانت الإصابة عام 2014 أكثر حدوثا عنها عام2013وقد سجلت أعلى إصابة بالمرض فى مركز العدوى يليه مركز بنى مزار وأقلها فى مركز مغاغة. جمعت نباتات بردقوش مصابة طبيعياً من الحقول بالمراكز الثلاثة المذكورة لعزل المسببات المرضية المصاحبة للأعراض وكانت "ريزوكتونيا سولاني، فيوزاريوم اوكسيسبورم ، سكليروتينيا سكليروتيورم ونوع من كل من الالترناريا وهلمنثوسبوريوم من بادرات ميتة ، جذور متعفنة ونباتات ذابلة. واختلفت قيمة تكرارات الفطريات المعزولة تبعا للمنطقه. وكان الفطر فيوزاريوم اوكسيسبورم متبوعاً بالفطر ريزوكتونيا سولاني أكثر هذه الفطريات تكراراً كما سجلت أكثر إصابات بالمرض في مركز العدوة ، يلية مركز بني مزار التابعين لمحافظة المنيا ، وثبت أن جميع عزلات الفطريات ريزوكتونيا سولاني، فيوزاريوم اوكسيسبورم ، سكليروتينا سكليروتيورم قادرة علي إصابة بادرات البردقوش مسببه حدوث تعفنها ، وتصيب جذور النباتات المسببة تعفنها مع حدوث أعراض الذبول . قللت المركبات فوق أكسيد الهيدروجين، سيليكات البوتاسيوم ، كلوريد الحديديك، حمض الأسكوربيك ، حمص السلسليك وحمض الستريك معنوياً موت البادرات وعفن الجذور والذبول كما زاد الوزن الطازج والوزن الجاف للنباتات المزروعة في تربه ملوثة بالفطريات المختبرة .