Role of Some Volatile Oils and Antioxidants in Management of Peanut Pod-Rots

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Abstract: Volatile oils of basil, cumin, lemon grass and marjoram as well as the antioxidants salicylic and citric acid were evaluated for their effect on the linear growth of *Fusarium oxysporum*, *Macrophomina phaseolina*, *Rhizoctonia solani* and *Sclerotium rolfsii* in vitro and on incidence of pod-rot and the pod yield. Their effects on total sugars, proteins and phenolic compounds of peanut primordial pods were determined. The volatile essential plant oils as well as the two antioxidants caused significant inhibitory effect on linear growth of the tested pathogenic fungi after incubation at 28± 1ºC. The degree of inhibition was proportional to concentration. Field experiments in 2012 and 2013 revealed that soaking peanut seeds in the tested plant oils and antioxidants preparations before sowing resulted in significant decrease in the natural infection by fungi causing pod-rots and significantly increased the pod yield . However, the treatment with the fungicide Rizolex-T was the superior treatment in this regard. The tested oils and antioxidants as well as the fungicide Rizolex-T resulted in considerable increase in the chemical composition of primordial pods as total sugars, proteins and phenolic compounds in comparison with the control treatment.

Keywords: Peanut, antioxidants, volatile essential plant oils, pod-rot and chemical components.

Introduction

Peanut (*Arachis hypogaea* L.), a member of the family Fabaceae, is an important food and oil crop. It is grown mainly for human consumption, which has several uses as whole seeds or processed to make peanut butter, oil and other products. Peanut seeds contain 25- 30% protein and 42-52% oil. It is liable to infection by many fungal diseases (**El-Wakil and Ghonim, 2000 and Eissa *et al.*, 2007)** and the pod-rots are the most constraining ones, under adverse planting conditions such as excessive moisture and heat as well as drought. Seeds can be covered with masses of black spores, appear reddish brown and / or water-soaked depending on the fungus responsible.

The use of plant extracts and antimicrobial components have been used as alternatives for fungicides in plant disease control **(Sagdic *et al.*, 2003 and Mohamed *et al.*, 2006)**. The essential oils could be used as alternative anti-bacterial and anti-fungal treatments **(Jenny, 2000)**. On the other hand, **Ranasinghe *et al.* (2002); Paranagama *et al*. (2003) and Abdel-Kader *et al.* (2013)** mentioned that some plant extracts and essential oils exhibited antifungal properties. Regarding to the inhibition by essential oils often involves induction of changes in cell wall composition **(Ghfir *et al.*, 1997)**, plasma membrane disruption, mitochondrial structure disorganization **(de Billerbeck *et al.*, 2001)** and interference with enzymatic reactions of the mitochondrial membrane, such as respiratory electron transport, proton transport, and coupled phosphorylation steps **(Knobloch *et al.*, 1989).** Moreover, **Paranagama *et al*. (2003); Bahl *et al*., (2000) and Faleiro *et al*., (2003)** reported that citral and geraniol are the major components in essential oils of lemongrass and palmarosa, respectively, which Linalool is a major component in essential oil of thyme and both limonene and linalool are the minor components in essential oils derived from different plants.

The majority of these essential oils and their components have proven valuable in protection against postharvest fungal diseases which cause buildup of toxic fungal metabolites in stored foods **(Kishore and Pande, 2004)**. Moreover, many reports stated that induced systemic resistance encourage the plant to response accumulation of phytoalexin, phenols and lignin **(Abd El-Magid *et al*., 2004 and Walters *et al*., 2007)**.

The present study was undertaken to investigate the potential of some volatile essential oils extracted from basil, marjoram, lemon grass and cumin; and the antioxidants salicylic and citric acid as antifungal agents for management of peanut pod-rots. Also, studying the effect of these compounds on the total sugars, protein content and phenolic compounds content.

Materials and Methods

1. Laboratory experiments

1.1. Preparation and extraction of volatile essential oils

The desired plant materials of basil, marjoram, cumin that contain volatile oils were collected in plastic bags in the form of essential oils using hydro-distillation technique **(Gunther 1960).**Weight of 500g of each desired plant materials was used. Only lemon grass (*Cymbopogon flexuosus*) oil was obtained from Medicinal and Aromatic Plant Res. Lab., El-Kanater El-Khairia Stat., Hort. Res. Inst., ARC, Egypt . The extracted oils were taken, dried over anhydrous sodium sulphate to remove traces of moisture and stored in a dark bottles till used.

Table 1: Chemical composition of plant parts used.

English name	Scientific name	Plant part	Known chemical composition *
Basil	*Ocimum basilicum*	Herb	Ocimene,eugenol,terpens, sesquterpenes, cineole and linalol.
Cumin	*Cuminum cyminum*	Seeds	Pinene, phellendrene, cymene, dipineneandM.limonine.
Lemon grass	*Cymbopogon citrates*	Leaves	Citral, myrcine, geranol and Nerol.
Marjoram	*Marjorana hortensis*	Herb	Carvacrol, camphor, terpinol, thymol and p.cymene.

*Chemical composition according to **Guenther (1960), Mahran (1967)** and **Balbaa (1976).**

1.2.Source of the tested fungi :

Fusarium oxysporum, Macrophomina phaseolina, Rhizoctonia solani and *Sclerotium rolfsii* were kindly provided by Onion , Garlic and Oil Crop Diseases Dept, Plant Path. Res. Institute, ARC.

1.3.Effect of volatile essential oils, and antioxidants on linear growth of the target fungi:

The efficacy of volatile essential oils on the mycelial growth of the tested pathogenic fungi was evaluated according to **Adjou Euloge *et al.*(2012)**. PDA medium amended with different concentrations of the volatile essential oils (0.1,0.2,0.3,0.4 and 0.5 %) of basil, marjoram, lemon grass and cumin was used. The antioxidants salicylic acid (SA) and citric acid (CA) at 0.005, 0.01, 0.015 and 0.02% were also prepared. Ten ml. of the amended medium were poured into each Petri-dish and was inoculated at the center with a mycelial disc (5 mm. in diameter) taken from the periphery of 5-day old cultures of the tested fungi colonies. Three replicates were used for each treatment. The plates were incubated at 28 ±1°C. Mycelial growth was measured when fungal growth covered the surface of the plates of any treatment. Diameter of fungal colonies of treatment and control sets was measured, and percentage of inhibition (PI) of fungal growth was calculated as follows:

% Inhibition = C-t / C x100

Where:

C = Linear growth in control treatment and

t= Linear growth in each treatment.

2.Field experiments

Field experiments were carried out at Sers El lyain Res. Stat., Minofiya Governorate, Egypt during 2012 and 2013 growing seasons. The experiments aimed to study the effect of peanut seed treatment with any of basil, cumin, lemon grass and marjoram volatile oils as well as the antioxidants salicylic acid (SA) and citric acid (CA) in comparison with the fungicide Rizolex-Ton pod-rots and the produced pod yield. The selected field has a past history of high infestation by the causal pathogens of peanut pod-rods.

Peanut seeds (cv. Giza 6) were soaked in the aforementioned oils at the rate of 1 and 2% 30 minutes before sowing. Meanwhile, they soaked in the antioxidants at the rate of 0.02% for the same period.

These treatments were also used as a foliar application 35 days after sowing, where Tween 80 was added at the rate of 20 ml. / 100 L. water for the sprayed materials. Rizolex-T (Toclofosmythl+ Thiram) was used only as seed treatment at the rate of 3g./kg seed and 3kg/ fed. as soil treatment . The experiment of each growing season was arranged in a complete randomized block design with plots of (1/400 fed.; 3 X 3.5 m for each replicate) and three replicates per each treatment were applied. All agriculture practices, *i.e.* irrigation, fertilization, hoeing, weed and pests management were carried out as the recommended by Min. of Agric. and Land Reclamation. At harvesting, the percentages of colored pods (infected with pod-rot) and uncolored (apparently healthy) were calculated. Also, the produced pod yield was weighted for each plot and the average was recorded.

3. *Specific biochemical changes associated with the tested essential oils and chemical inducers treatment:*

A study was conducted to identify some biochemical changes associated with induced resistance by the various essential oils and chemical inducer treatments. Activity of total phenolic compounds , total sugars and protein content (%)were determined in the treated and untreated plants.

Primordial pods (15 days old) samples were extracted according to **Goldschmidt *et al.* (1968)**. Total phenols were determined using the colorimetric method of Folin Denis as described by **Snell and Snell (1953)**. Total sugars and protein content (%) were determined according to **Thomas and Dutcher (1924)** and **Moore and Stein (1954)**, respectively. Phenolic compounds, sugars content and protein content (%) were calculated as milligrams /g fresh weight using spectrophotometer at 520,540 and 595 respectively.

4.*Statistical analysis:*

Data were statistically analyzed using M-state C program to calculate the LSD at 5% according to **Snedecor and Cochran (1981)**.

Results

1. *Effect of different concentrations of basil, cumin, lemon grass and marjoram oils on the linear growth of fungi:*

Data of the inhibitory effect of the tested volatile oils on the tested fungi are shown in Table (2).

Results show that lemongrass oil exerted the highest inhibitory effect on the mycelial growth of *Fusarium oxysporum*, recording 45.92% reduction in the linear growth, followed by cumin marjoram and basil, producting 39.93, 32.09 and 28.95 % reduction in linear growth, respectively. The same trend was recovered with linear growth of the other tested fungi. Moreover, *Macrophomina phaseolina* and *Rhizoctonia solani* showed greater sensitivity compared with the other tested fungi.

In general, it was noted that the inhibitory effect of any of the oils tested was gradually increased by increasing the concentration of these oils from 0.1 up to 0.5%.

2. *Effect of two antioxidants on the linear growth of the tested fungi:*

The inhibitory effect of both salicylic and citric acid on the tested fungi are shown in Table (3). It is observed that salicylic acid completely inhibited the mycelial growth of all fungi at 0.02% .Also, the treatment with citric acid inhibited the mycelial growth of the tested fungi, with exception of *F. oxysporum* which recorded 94.81% reduction. Moreover ,data cleared that *S. rolfsii*: was the most sensitive to both of salicylic and citric acid.

Table 2: Effect of different concentrations of Basil, Cumin ,Lemon grass and Marjoram oils on the linear growth and reduction percentage of *F. oxysporum, M. phaseolina, R. solani* and *S. Rolfsii*.

Treatment Oils	Concentration	*F. oxysporum*		*M. phaseolina*		*R. solani*		*S. Rolfsii*	
		Linear growth (mm)	% reduction	Linear growth (mm)	% reduction	Linear growth (mm)	% reduction	Linear growth (mm)	% reduction
Basil	0.1%	90.00	00.00	73.00	18.89	90.00	00.00	55.00	38.89
	0.2%	81.00	9.67	59.00	34.44	69.00	23.33	42.00	53.33
	0.3%	74.67	17.00	39.00	56.67	40.33	55.18	26.67	70.36
	0.4%	53.33	41.44	00.00	100.00	00.00	100.00	11.00	87.78
	0.5%	21.33	76.67	00.00	100.00	00.00	100.00	00.00	100.00
Mean		64.07	28.95	34.20	62.00	39.87	55.71	26.93	71.18
Lemon grass	0.1%	83.67	7.44	71.00	21.11	63.00	30.00	24.00	73.33
	0.2%	63.33	29.63	34.00	62.22	30.33	66.30	8.00	91.11
	0.3%	50.00	44.44	00.00	100.00	00.00	100.00	00.00	100.00
	0.4%	27.00	70.00	00.00	100.00	00.00	100.00	00.00	100.00
	0.5%	00.00	100.00	00.00	100.00	00.00	100.00	00.00	100.00
Mean		44.39	45.92	21	76.67	18.67	78.53	6.40	92.89
Marjoram	0.1%	90.00	00.00	67.00	25.55	87.33	2.96	90.00	00.00
	0.2%	79.67	11.55	61.00	32.22	63.33	29.33	68.00	24.44
	0.3%	70.00	22.22	31.00	65.55	20.33	77.41	43.66	51.48
	0.4%	50.67	43.33	00.00	100.00	00.00	100.00	21.66	75.93
	0.5%	15.00	83.33	00.00	100.00	00.00	100.00	00.00	100.00
Mean		61.20	32.09	31.80	64.66	34.19	61.94	44.66	50.37
Cumin	0.1%	90.00	00.00	81.00	10.00	80.00	11.11	90.00	00.00
	0.2%	71.33	20.74	55.00	38.88	49.00	45.56	61.66	31.49
	0.3%	61.00	32.22	19.00	78.88	10.00	88.89	36.00	60.0
	0.4%	37.00	58.89	00.00	100.00	00.00	100.00	8.00	91.11
	0.5%	11.00	87.78	00.00	100.00	00.00	100.00	00.00	100
Mean		54.01	39.93	31.00	65.55	27.80	69.11	39.13	56.52
Control		90.00	-----	90.00	-----	90.00	----	90.00	----
Mean (0.1)		88.33	1.48	80.67	15.11	82.07	8.81	69.80	22.44
Mean 0.2%		77.07	17.89	59.87	33.55	60.33	32.90	53.93	40.07
Mean 0.3%		69.13	28.97	36.00	60.22	32.13	64.29	39.27	56.37
Mean (0.4)%		51.60	53.42	18.00	80.00	18.00	80.00	26.26	70.96
Mean 0.5%		27.47	86.95	18.00	80.00	18.00	80.00	18.00	80.00
L.S.D. at 5% for Treatment (T)		1.83		1.81		2.82		1.59	
Concentration C)		1.83		1.81		2.82		1.59	
T×C		4.1		4.02		6.31		3.56	

Table 3: Effect of the two antioxidants on the linear growth and reduction percentage of *F. oxysporum, M. phaseolina, R. solani* and *S. Rolfsii*.

Treatment Oils	Concentration	*F. oxysporum*		*M. phaseolina*		*R. solani*		*S. Rolfsii*	
		Linear growth (mm)	% reduction	Linear growth (mm)	% reduction	Linear growth (mm)	% reduction	Linear growth (mm)	% reduction
Salicylic acid	0.005%	62.00	31.11	48.00	46.67	17.67	80.37	23.67	74.08
	0.01%	46.33	48.52	21.33	76.30	8.33	90.74	00.00	100.00
	0.015%	19.33	78.52	00.000	100.00	00.00	100.00	00.00	100.00
	0.02%	00.00	100.00	00.00	100.00	00.00	100.00	00.00	100.00
Mean		31.92	64.54	17.33	80.74	6.50	92.78	5.91	93.43
Citric acid	0.005%	64.33	28.52	54.67	39.25	47.67	47.03	44.33	50.74
	0.01%	46.33	48.52	41.33	54.08	26.67	69.26	11.00	87.87
	0.015%	27.67	69.26	33.00	63.33	11	87.78	00.00	100
	0.02%	4.67	94.81	00.00	100.00	00.00	100.00	00.00	100
Mean		35.75	60.27	32.50	64.17	21.34	76.02	13.58	84.65
Control		90.00	-----	90.00	------	90.00	-----	90.00	-----
Mean (0.005)		72.11	11.92	64.22	28.64	51.78	42.47	52.67	41.61
Mean 0.01%)		60.89	32.35	50.89	43.46	41.67	53.33	33.67	62.59
Mean(0.015)%		45.67	49.26	41.00	54.44	33.67	62.59	30.00	66.67
Mean (0.02)%		31.56	64.94	30.00	66.67	30.00	66.67	30.00	66.67
LSD at 5% for									
Treatment (t)		0.91		1.63		1.12		0.57	
Concentration (c)		1.05		1.89		1.29		0.66	
T×C		1.84		3.25		2.23		1.14	

3. *Effect of the tested volatile oils and Rizolex –T fungicide on peanut pod rots and pod yield during 2012 and 2013:*

Results shown in Table (4) describe the effect of basil, cumin, lemon grass and marjoram volatile oils at 1 and 2 % and the fungicide Rizolex –T on peanut pod rots, as well as the pod yield in 2012 and 2013 growing seasons.

In 2012, results indicated that the treatment with lemon grass oil gave the best results in reducing the percentage of infected pods , where the infection rate was 16.0% at the concentration of 2.0% and 21.0% at the concentration of 1%. Meanwhile, basil came in the second order, recording 17.0 and 23.67 % infection percentage at the same concentrations followed by cumin (17.67, and 26.33 %, respectively) then marjoram oils (19.76, 24.76%, respectively). Generally, a positive relationship between the effect of the tested essential oils as antifungal effect and their concentrations was realized. Also, a positive relationship was found between reducing infection and yield production.

The same trend was observed during 2013 growing seasons. The fungicide Rizolex – T showed superior effect which recorded 5.33 and 8.0 % pod infection ,respectively and resulted in 1.25 and 1.17 ton / fed estimated yield during the growing seasons of 2012 and 2013, respectively.

4. *Effect of antioxidants and Rizolex –T fungicide on peanut pod rots and produced pod yield during 2012 and 2013 growing seasons:*

Data in Table (5) show the effect of salicylic acid and citric acid compared to Rizolex-T fungicide on peanut pod rot infection and the pod yield in 2012 and 2013 . All treatments significantly decreased pod rot infection compared to control, which was positively reflected on the produced pod yield. In general, Rizolex-T was the best treatment followed by salicylic acid then citric acid during the two successive seasons.

Table 4: Effect of essential oils in comparison with Rizolex –T fungicide on the incidence of peanut pod-rot pod yield under field conditions during 2012 and 2013 growing seasons at Sers El lyain Res. Stat., Minofiya governorate.

Treatments	Conc. (%)	2012			2013		
		% Colored pods (infected)	%Un Colored pods (apparently healthy)	Yield (ton/ fed.)	% Colored pods (infected	%Uncolored pods (apparently healthy)	Yield (ton/fed.)
Basil	1	23.67	76.33	0.96	27.00	73.00	0.85
	2	17.00	83.00	0.98	18.33	81.67	0.96
Mean		20.33	79.67	0.97	22.66	77.34	0.91
Cumin	1	26.33	73.67	0.93	26.33	73.67	0.83
	2	17.67	82.33	0.98	20.33	79.67	0.94
Mean		22.00	78.00	0.95	23.33	76.67	0.86
Lemon grass	1	21.00	79.00	0.96	22.67	77.33	0.88
	2	16.00	84.00	0.99	17.67	82.33	0.97
Mean		18.50	81.50	0.975	20.17	79.83	0.93
Marjoram	1	24.67	75.33	0.89	27.67	72.33	0.80
	2	19.67	80.33	0.97	21.00	79.00	0.91
Mean		22.17	77.83	0.93	24.34	75.66	0.86
Rizolex –T	3 g/kg seeds	5.33	94.67	1.25	8.00	92.00	1.17
Control		47.33	52.67	0.71	50.00	50.00	0.68
Mean	1	24.73	75.27	0.95	25.92	74.08	0.87
	2	20.50	79.50	0.98	22.56	77.44	0.93
L.S.D at 5% for:							
Treatment (T)		2.22	2.22	0.07	3.4	2.18	0.10
Concentration (C)		1.22	1.22	n.s.	1.95	1.27	0.06
T× C		2.98	2.98	n.s.	n.s.	3.09	n.s.

Table 5: Effect of antioxidants and Rizolex –T on the incidence of peanut pod-rot produced pod yield under field conditions, during 2012and 2013 growing seasons at Sers El lyain Res. Stat., Minofiya governorate.

Antioxidants	% Concentration	2012			2013		
		% Colored pods (infected)	% Uncolored pods (apparently healthy)	Pod yield (ton/fed .)	% Colored pods (infected)	% Uncolored pods (apparently healthy)	Pod yield (ton/fed.)
SA	0.02	12.00	88.00	0.97	13.67	86.33	0.88
CA	0.02	17.33	82.67	0.89	19.67	80.33	0.83
Rizolex –T	3 g/kg seeds	5.33	94.67	1.25	8.00	92.00	1.17
Control		47.33	52.67	0.71	50.00	50.00	0.68
LSD at 5 %		2.32	2.32	0.24	5.10	5.10	0.20

5. *Effect of essential oils and antioxidants compared to Rizolex –T fungicide on the chemical constitutents of primordial pods:*

Table (6) reveals that the volatile essential oils and antioxidants as well as Rizolex-T fungicide resulted in considerable increase in the chemical constitute of peanut primordial pods, *i.e.* total sugars, protein content and phenolic compounds content of peanut primordial pods in comparison with control treatment. In addition, this increase was more higher at the high concentration of the tested essential oils than at the low concentration. Moreover, the fungicide Rizolex-T resulted in the highest figures of these compounds.

Table 6: Effect of the tested essential oils and antioxidants in comparison with the fungicide Rizolex –T on total sugars, protein content and phenolic compounds content of peanut primordial pods.

Treatments	% Concentration	Total sugars(mg/g fresh weight)	Protein content (%)	Total phenols (mg/g fresh weight)
Basil	1	6.00	10.88	11.50
	2	7.52	11.22	14.44
Cumin	1	6.40	11.19	14.64
	2	8.12	13.78	17.45
Lemon grass	1	6.44	13.88	15.76
	2	9.55	14.02	18.56
Marjoram	1	6.11	10.02	13.38
	2	7.82	12.42	16.12
SA	0.02	8.11	12.92	17.64
CA	0.02	7.23	10.69	14.92
Rizolex-T	3 g/kg seed	10.13	17.52	19.52
Control		5.92	8.52	11.41

Discussion

Healthy food free from toxic agrochemical substances is a main target for all the agricultural researchers especially the plant pathologists . To avoid the use of hazardous chemicals against diseases, certain protective procedures could be conducted using different non-toxic chemicals at reasonable concentrations to management of such diseases.

Essential oils and antioxidants had been used successfully to control some plant diseases such as Fusarium wilt in tomato **(Mohamed *et al.*, 2006 and El-Khallal, 2007)**, root rot and leaf blight in lupine **(Abdel-Monaim, 2008)** damping- off in pepper **(Rajkumar, and Freitas 2008)** and peanut root rot **(Mahmoud *et al.*, 2013).** At the same time, **Abd-EL-Hamed (2006)** reported that application of antioxidants, *i.e.* ascorbic, salicylic, coumaric, benzoic acids and propylgalate as seed soaking or soil drench proved sufficient protection against cumin wilt caused by *Fusarium oxysporum*, f. sp. *cumini* or *Acreromonium egyptiacum*.

In the present study, four essential plant oils of basil, cumin, lemon grass and marjoram and two antioxidants, *i.e.* salicylic acid and citric acid were evaluated for their inhibiting potentials on the linear growth of *F. oxysporum, M. phaseolina, R. solani* and *S. rolfsii* as well as management of peanut pod-rot .Their effect on total sugars, total amino acids and phenolic compounds content were also considered.

All the tested materials caused significant reduction to the linear growth of the tested pathogenic fungi., *i.e. F. oxysporum, M. phaseolina, R. Solani* and *S. rolfsii*, after incubation at 28± 1ºC. This inhibition was gradually increased by increasing their concentration. **Abd El-Hai *et al.* (2009)** found that both salicylic acid and citric acid reduceded linear growth of *R. solani* and *M. phaseolina in vitro* conditions. Similar results were, also, obtained by **Saad *et al.* (2014)**.

Essential oils are a rich source of broad-spectrum antifungal plant derived metabolites that inhibit both fungal growth and production of toxic metabolites **(Kishore and Pande, 2004)**. This study evaluated the antifungal activity of selected essential oils and for management of *F. oxysporium, M. phaseolina, R. solani* and *S. rolfsii*, which cause pod rot diseases of peanut. In this concept **Bauiomy (1997) and Adjou Euloge *et al.* (2012)** studied the effect of many plant oils such as lemon grass, basil, cumin as antifungal substances against *F. oxysporum, M. phaseolina, R. solani, S. rolfsii,Aspergillus flavus* and *A.parasiticus* and stated that the majority of the essential oils are more fungistatic than fungicidal. Also, **Hussein (2011)** stated that, the essential oils are containing of bioactive chemicals, which have antifungal and antimicrobial activities .

Concerning the mode of action of essential oils on/ in the fungal cell in order to promote fungistatic or fungicidal effect. The tested essential oils were found to have natural mixtures of hydrocarbons(monoterpen) ,and oxygen(alcohols, aldehydes, ketones, carboxylic acids, esters, and lactones) .These constituents and their derivatives have a long history of application as antimicrobial agents in the areas of food preservation and medicinal antimicrobial production **(Lahariya and Rao 1979)**.

In fact basil essential oil has mono-terpenes alcohol as the major components **(Adjou Euloge *et al.*, 2012)**. Terpenes are a hydrocarbons produced from combination of several isoprene units (C_5H_8) and have a hydrocarbon back bone which can be rearranged into cyclic structures by cyclases, thus forming monocyclic or bicyclic structures **(Caballero *et al.*, 2003)**.

Data of the field experiments during 2012 and 2013 growing seasons revealed that soaking peanut seeds in the tested essential plant oils and antioxidants preparations before sowing resulted in significant

reduction to the natural infection by fungi causing pod-rod and caused significant increase to the produced pod yield compared with control treatment . However, the treatment with the fungicide Rizolex-T was the superior treatment in this regard. **Burt (2004)** demonstrated that essential oils have been shown to possess antibacterial, antifungal, antiviral insecticidal and antioxidant properties. In addition, **Abd-EL-Hamed (2006)** reported that soaking cumin seeds or soil drenching with antioxidant solutions (salicylic, ascorbic, coumaric, benzoic acids, and propylgalate) before planting resulted in resistant cumin seedlings against infection with the *Fusarium oxysporum cumini* and *Acremonium egyptiacum*. **Abdel-Monaim (2008)** showed that soaking lupine seeds in antioxidant solutions (reduced the damping-off and root rot diseases caused by *Fusarium solani* and *Macrophomina phaseolina*. *In vitro* all antioxidants show less effect on dry weight. Propylgalate had the highest effect on spore formation, especially at highly concentration (200 ppm).

The antioxidants mode of action was reported in many host-pathogen interactions, *i.e.* many oxidative enzymes such as peroxidase, catalase, ascorbate oxidase and polyphenol oxidase were detected as a result of infection with many pathogens **(Clark *et al.*, 2002)** or as a result of treatments with various antioxidants **(Takahama and Oniki, 1994, El-Khallal, 2007and Abdel-Monaim, 2008)**. Moreover, **Rasooli *et al*. (2008)** confirmed the antimicrobial action of essential oils in model food systems, where they are a rich source of biologically active compounds and potential sources of novel antimicrobial compounds.

The tested volatile essential oils and antioxidants as well as the fungicide Rizolex-T resulted in considerable increase in the chemical constitute of peanut primordial pods, *i.e.* total sugars, protein content and phenolic compounds content in comparison with control treatment . This increase may be due to the effect of these compounds on the composition and activity of these components. Many reports indicated that essential oils containing carvacrol, eugenol and thymol (phenolic compounds) had the highest antibacterial performances **(Kim *et al.*, 1995)**. These compounds sensitize the phospholipid bilayer of the microbial cytoplasmic membrane causing increased permeability and unavailability of vital intracellular constituents **(Juven *et al.* 1994)**. **Abd El-Magid *et al* (2004)** using citric acid, sodium salicylate, sodium citrate,tartaric acid and ammonium tartarate as inducers to control white rot of onion and garlic compared with the infected ones and concluded that higher content of total free amino acids,total sugars and phenols in the healthy plants may be due to the depletion of these substances by the invading fungus as well as may be having to producing some proteins related control. The obtained results are in a harmony with the obtained data by **Abd El-Magid *et al* (2004); Walters *et al*. (2007**) and **Mahmoud *et al*. (2009)**.

Conclusion

The present study demonstrated that the essential oils of basil, cumin lemongrass and marjoram as well as the two antioxidant salicylic acid and citric acid have an inhibitory effect against the mycelial growth of *F. oxysporum, M. phaseolina, R. solani* and *S. rolfsii* under *in vitro* conditions. Moreover, under field condition ,soaking peanut seeds before sowing in these compounds resulted in significant reduction to pod rot incidence with significant increase to the produced fruit yield based on their antifungal and or antifungistatic effects. These results could contribute singly or as a part of an IPM program combined with other methods, *i.e.* agricultural practices, biological control ,chemical control…. etc in management of pod rots in peanut .

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دور بعض الزيوت الطيارة ومضادات الأكسدة في مكافحة عفن قرون الفول السوداني

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الملخص العربى

تم تقييم فعالية أربعة زيوت نباتية طيارةهى الريحان وحشيشة الليمون والبردقوش والكمون وكذلك اثنين من مضادات الاكسده هى حامض السالسيلك وحامض الستريك تحت ظروف المعمل على تثبيط النمو الطولي للفطريات فيوزاريوم اكسيسبورم وماكروفومينا فاسيولينا وريزوكتونيا سولانى وسكليروشيوم رولفزياى المسببة لعفن قرون الفول السودانى . كما تم اختبارها في الحقل على ظهور عفن القرون ومحصول القرون الناتج .أيضا تم دراسة تأثير هذه المواد على مكونات القرون الحديثة التكوين من السكريات الكلية والبروتين الكلى ومحتواها من المركبات الفينولية.

أدى إضافة أى من الزيوت المستخدمة وكذلك المستحثات إلى بيئة النمو إلى تثبيط النمو الميسليومى للفطريات المختبرة بدرجات متفاوتة ، وكان زيت حشيشة الليمون أكثرهم تاثيرا تلاه زيت الكمون كذلك كان تاثير حمض السالسليك أفضل من حمض الستريك. وبصفة عامة كان الفطر سكليروشيوم رولفزياى أكثر الفطريات حساسية تجاة تاثير المواد المستخدمة بينما كان الفطرفيوزاريوم اكسسبورم أقلهم حساسية وكانت نسبة التثبيط تزداد مع زيادة التركيز المستخدم.

فى تجارب الحقل موسمى ٢٠١٢، ٢٠١٣ أدت المعاملة بالزيوت الطيارة المختبرة عند تركيزى ١ و ٢ % والمستحثات الكيماوية عند تركيز ٠,٠٢ % وكذلك مبيد الريزولكس تى بمعدل ٣جم /كجم بذرة إلى خفض النسبة المئوية للقرون المصابة بالعفن وكذلك زيادة وزن المحصول الناتج للفدان مقارنة بالكونترول . وبصفة عامة كان تاثير المبيد الفطرى أكبر من باقى المعاملات وكان تاثير الزيوت الطيارة المستخدمة يزيد بزيادة التركيز المستخدم خلال موسمى التجربة .

أدى استخدام المواد المختبرة إلى زيادة فى محتوى القرون حديثة التكوين من الفينولات الكلية ونسبة السكريات وكذلك نسبة البروتين بدرجات متفاوتة مقارنة بالكونترول الغير معامل .