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CONTROL OF GEOTRICHUM SOUR ROT OF LIME FRUITS BY ESSENTIAL OILS AND SOME CONSTITUENTS

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ABSTRACT

Five essential oils of different plants ,i.,e., thyme ,lemon grass , grapefruit , sour orange, lime and two constituents of essential oil ,.i. e., nerol and citral were tested for their inhibitory effect on *Geotrichum candidum* growth , spore germination , peel colonization and reducing sour rot incidence during 45 days of storage at 20C ^{0}. Essential oils of thyme , lemon grass and grapefruit at 4 ml/l caused complete inhibition of growth , spore germination , peel colonization with *G. candidum* by 100 %. Meanwhile, sour orange and lime essential oils caused 90 - 100 % reduction at the same conc.. Nerol and citral compounds at 4ml/l caused complete also inhibition of *G. candidum* growth, spore germination and peel fruit fungal colonization by *G. candidum*, but nerol gave the best results at low conc. compared with the other compounds. On the other hand, essential oils of thyme, lemon grass and grapefruit caused 100 % reduction in sour rot incidence and rotted part of infected fruits during 30 days of storage and by 94, 90, 96 % respectively after 45 days of storage . Meanwhile, nerol at 4 ml/l gave complete protection and caused 100% reduction in sour rot incidence after 45 days of storage and by 80 % at 3 ml/l . After 7, 15, 30 days of storage nerol was the best compound in controlling sour rot of lime fruits at 3 ml / l, where it caused 96, 90 and 86 % reduction at such dates respectively. These results suggested that nerol as a constituent of essential oil or thyme, lemon grass, grapefruit as crude essential oils may be safely used commercially as fruit coating to control post harvest pathogenic fungi of citrus fruits

Key words: Essential oil, Sour rot, Citrus, *Geotrichum candidum*, Nerol, Citral

INTRODUCTION

Sour rot of lime fruits have been reported as an important post harvest disease at several areas and it is caused by the citrus race of *Geotrichum candidum* Link (**Butler *et al* 1965; Mahmoud, 1978; Brown, 1979; Eckert *et al* 1981; Morris, 1982; Brown and Eckert, 1988; Morsy and Abd El-Kader, 1994**). Sour rot of lime fruit could not be efficiently controlled with the known post harvest treatments. Moreover, *G. candidum* is resistant to organic fungicides developed for the control of Penicillium rot (**Brown, 1984; Eckert *et al* 1981; Morsy and Abd El-Kader 1994**). Treating lime fruit with biphenyl and sodium O-

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phenylphenat (SOPP) has been proved to be effective to control sour rot of lime fruits **(Bussel and Shavit, 1975)**, but these chemicals have not been used in many countries, because they were found to be not effective and SOPP often injured the peel citrus fruit **(Eckert *et al* 1981)**. There is a growing need to develop alternative approaches for controlling post harvest disease of citrus fruits. Efforts to find alternative compounds to control citrus post harvest diseases as natural essential oils and some of their constituents which proved to be biotoxic to several pathogenic post harvest fungi **(Caccioni and Deans, 1993; Stange *et al* 1993; Singh *et al* 1993; Caccioni *et al* 1995 a, b; Rodov *et al* 1995; Wannissorn *et al* 1996; Gegoi *et al* 1997 and Suprapta *et al* 1997)**. Lemon grass, thyme and citrus essential oils or some their constituents such nerol and citral were more active when they vapors or solution were used against *Aspergillus fumigatus, A. niger, Fusarium solani, Penicillium expansum, P. digitatum, P. italicum Rhizopus oryza, R. stolonifer, Botrytis cinerea, Alternaria citri, A. alternata, Phytophthora tracheiphila* and *Geotitrichum candidum* **(Arass and Picca 1994; Arras *et al* 1995 and 1998; Inonye *et al* 1998; Ragab *et al* 2001 and El-Mohamedy *et al* 2002)**.

In Egypt, the citrus industry depends on synthetic fungicides as standard practice for control of post harvest citrus rots. However, loss of efficacy of some fungicides, increasing public concern over food safety and constant reviewing of residue limits, are a challenges for the industry.

The objective of this work is to use some essential oils i.e., thyme, lemon grass, grapefruit, sour orange, lime and some of their constituents i.e., nerol, citral as natural chemicals compounds and substitute of fungicides for controlling Geotrichum sour rot of lime fruits.

MATERIAL AND METHODS

Essential oils and Constituents

Five essential oils of three differences plant genera i.e. thyme (*Thymus capitatus*), lemon grass (*Cymobogon citratus Stapf*), sour orange (*Citrus aurantium* L.), grapefruit (*Citrus paradisi L.*), lime (*Citrus aurantifolia* L.) and two constituents of these oils, i.e., nerol and citral were used in this study. All compounds were purchased from Giza Aromatic Com. Giza. Egypt.

Fungal isolate

Geotrichum candidum Link was isolated from naturally infected lime fruits with sour rot disease. The purified isolated fungi were identified according to their cultural and microscopic characters as described by **Kenneth *et al* 1968; Ellis, 1971 and Barnett and Hunter, 1972)**.

Antifungal activity of essential oils and constituents

Antifungal activity of five essential oils and two constituents was studied by determining their inhibitory effect on linear growth and spore germination of *Geotrichum candidum* on PDA medium.

Effect on linear growth

Five concentrations *i.e.*, 0.5, 1.0, 2.0. 3.0 and 4.0 ml / l for each essential oil or

constituent were tested. The essential oils or constituents were dissolved individually in tween 80 (0.01%) and then added to PDA medium before solidifying. Discs (5 mm diam) obtained from 8 days old of *G. candidum* cultures were aseptically transferred to the center of five Petri dishes of each treatment as a replicates. Five Petri dishes containing PDA medium with tween 80 (0.01%) not amended with any constituents or essential oil were used as control. Plates were incubated at 25°C. The colonies diameter. in mm was measured after colonies in non treated PDA plates were about 90 mm. The average linear growth of each treatment was recorded and the percentage of reduction in linear growth was calculated.

Effect on spore germination

A 100-ml portion of spore suspension (10^6 / ml) of *G. candidum* was streaked onto PDA amended with various concentrations of essential oils or constituents by use of sterile glass rod (**Suprapta *et al* 1997**). Five plates were used for each concentration of each compounds. The plates were incubated at 25°C for 24 hours in the dark, then germinated spores per plate (100 spores) were determined microscopically. The percentages of germinated spores of each treatment and control were recorded and reduction in spore germination was calculated.

Effect of essential oils and constituents on colonization of lime fruits peel discs by *G. candidum*

Discs (1.0cm) of lime fruits peel were taken from healthy fruits by use of a sterile cork borer. The discs were dipped in 95 % ethanol for a bout 10 sec, then washed with sterile distilled water three times. The peel discs were then placed in volatile solution of essential oil or constituents (1.0 ,2.0, 3.0 and 4.0 ml/L concentrations) for 1.0 min , then the discs of lime fruit peels were dipped in spore suspension of *G. candidum* (10^6 / ml) for about 10 sec. The peel discs were then placed in petri dishes (5 peel discs / dish) that had been moistened with sterilized moistened filter paper and incubated at 25°C for 72 hours in the dark . Fungal colonization on peel discs was determined according to **Suprapta *et al* 1997.**

Effect of essential oils and some constituents on controlling Geotrichum sour rot on lime fruit during storage

Fresh lime fruits cv. Baladi apparently free of physical damage and diseases were used in this experiment. Fruits were surface sterilized with 5 % sodium hypocholrite for about 30 sec. The fruits were dipped in water emulsion containing 1, 2, 3 and 4 ml of essential oils or constituents per liter for 1.0 min. The fruits were then inoculated with spore suspension of *G. candidum* (10^6 spore / ml). The inoculation was carried out by making a scrach 1.0 cm long and 1.0 mm deep on both sides of fruits ,and then applying the spores of *G. candidum* collected from 10 days old cultures to the scrach with a sterilized pins. Fruits were then incubated (stored) at 20°C and about 90 % RH for decay development. Each treatment consisted of 5 replicates, and 10 fruits were used for each replicate .Inspection of decayed fruits (Geotrichum sour rot) was carried out after 7, 14 , 30 and 45 days of storage. The number of

decayed fruits was counted and the percentages of infected (decayed) fruits were calculated .Fresh weight of rotted tissue part of infected fruits in each treatment and its percentage were recorded and calculated .

Statistical Analysis

Tukey test for multiple comparisons among means was utilized (**Neler *et al* 1985**)

RESULTS

Effect of essential oils and some constituents on growth and spore germination of *G. cadidum*

Five essential oils and two constituents (nerol-citral) at different concentrations were tested for their inhibitory effect on growth and spore germination of *G. candidum* (Tables 1 and 2). Results in Table (1) indicate that all tested essential oils and constituents reduced growth of the pathogen. This reduction was increased by increasing concentration of all compounds. Essential oils of thyme, lemon grass, grapefruit, nerol and citral reduced linear growth of *G . candidum* by 100 % at 4 ml/l and by 90 - 100 % at 3 ml / l, 73 - 95 % at 2 ml/l and by 56.2 - 86.1 % at 1.0 ml/l of all compounds. Sour orange and lime essential oils gave less effect at all concentrations. At 0.5 ml/l of all compounds, linear growth was reduced by 35.3 - 59.4 %. Nerol amd thyme, lemon grass, citral gave the best result in reducing growth at all concentrations of all compounds.

Concerning the effect of essential oils and constituents on spore germination of *G.candidum*, data in Table (2) show that essential oil of thyme, lemon grass, grapefruit and constituents nerol , citral inhibited completely spore germination of *G. candidum* at 3, 4 ml/l conc., whearase essential oil of sour orange and lime caused 80.0, 70:0 % and 95.0, 92.5 % reduction of spore germination at 3, 4 ml/l respectively for the two oils. At 1, 2 ml/ l of thyme, lemon grass and grapefruit essential oils caused a reduction by more than 61.0, 75.0 % and by more than 55.0, 68.0 % with citral and nerol at the same concen:rations. All tested compounds caused 22.5 -52.4 % reduction of spore germination at 0.5 ml / l concentration

Effect of essential oils and some thier constituents on fungal colonization of peel discs

The number of colony forming unties (cfu) recoverd from lime fruits peel discs treated with different concentrations of essential oils or constituents and the inhibitory effect (IE) of *G. candidum* colonization are presented in Table (3). These results indicate that the inhibitory effect was increased by increasing concentration of all compounds . Essential oil of thyme, lemon grass, grapefruit and nerol &citral caused 100 % inhibition of fungal colonization at 4 ml/l conc. Sour orange and lime essential oils caused 95.0 % and 92. % reduction at the same concentrations. Two and 3 ml/l concn. of all compounds caused inhibitory effect more than 50.0 % and 65.2 % respectively. Meanwhile lime essential oil show the least effect at same conc.

In general, the number of cfu recovered from lime fruit peel discus treated with thyme, lemon grass, grapefruit

Table 1. *Geotrichum candidum* linear growth mm (A) reduction percentage(B) at different concentrations of essential oils and some their constituents.

Essential oil / constituent	Concentration ml/l											
	0.0		0.5		1.0		2.0		3.0		4.0	
	A	B	A	B	A	B	A	B	A	B	A	B
Thyme	90.0	0.0	48.7	45.9	21.2	76.4	11.8	86.9	3.5	96.1	0.0	100
Lemo grass	90.0	0.0	44.0	51.1	22.8	74.7	12.2	86.1	4.2	95.3	0.0	100
Sour orange	90.0	0.0	51.5	42.8	38.2	57.6	26.0	71.1	15.0	83.3	4.2	95.3
Grapefruit	90.0	0.0	48.5	46.1	25.0	72.2	12.8	85.8	6.5	92.8	0.0	100
Lime	90.0	0.0	58.2	35.3	47.2	47.6	32.5	63.9	20.2	77.6	8.2	90.9
Nerol	90.0	0.0	36.5	59.4	12.5	86.1	4.0	95.6	0.0	100	0.0	100
Citral	90.0	0.0	50.0	44.4	39.4	56.2	24.3	73.0	9.0	90.0	0.0	100

Table 2. *Geotrichum candidum* spore germination (A), reduction percentage (B) at different concentrations of essential oils and some their constituents.

Essential oil / Constituent	Concentration ml/l											
	0.0		0.5		1.0		2.0		3.0		4.0	
	A	B	A	B	A	B	A	B	A	B	A	B
Thyme	100	0.0	58.5	41.5	30.8	69.2	20.0	80.0	0.0	100	0.0	100
Lemon grass	100	0.0	60.6	39.4	35.0	65.0	22.5	77.5	0.0	100	0.0	100
Sour orange	100	0.0	70.0	30.0	58.8	41.2	45.0	55.0	20.0	80.0	5.0	95.0
Grapefruit	100	0.0	62.5	37.5	39.0	61.0	25.0	75.0	0.0	100	0.0	100
Lime	100	0.0	77.5	22.5	63.8	36.2	55.5	44.5	30.0	70.0	7.5	92.5
Nerol	100	0.0	47.6	52.4	25.0	75.0	15.0	85.0	0.0	100	0.0	100
Control	100	0.0	64.0	36.0	45.0	55.0	32.0	68.0	0.0	100	0.0	100

A : average no. of spores (10^6 / mm^2)

Table 3. Inhibitory effect (IE%) of different concentrations of essential oils and some their constituents on fungal colonization of lime fruits peel discs with *Geotrichum candidum* .

Essential Oil /constituent	Concentration ml/l									
	0.0		1.0		2.0		3.0		4.0	
	Cfu	IE	Cfu	IE	Cfu	IE	cfu	IE	Cfu	IE
Thyme	40.0	0.0	16.8	58.0	12.8	68.0	5.6	86.0	0.0	100
Lemon grass	40.0	0.0	18.0	55.0	14.0	65.0	6.5	83.8	0.0	100
Sour orange	40.0	0.0	25.0	37.5	20.0	50.0	13.5	66.3	2.0	95.0
Grape fruit	40.0	0.0	19.8	50.5	16.4	59.0	9.2	77.0	0.0	100
Lime	40.0	0.0	23.4	41.5	21.0	47.5	15.8	60.5	3.2	92.0
Nerol	40.0	0.0	17.2	57.0	10.4	74.0	4.0	90.0	0.0	100
Citral	40.0	0.0	22.2	44. 5	19.4	51.5	12.0	70.0	0.0	100

Cfu : colony forming unites .

essential oils or nerol at 1 ml/l revealed IE more than 50.0 %.

Effect of essential oils and some constituents on controlling Geotrichum sour rot of lime fruits

The volatile compounds with inhibitory effect more than 50.0 % on colonization lime fruits peel discs by *G. candidum* at 1.0 ml/l concentration were tested for their ability to prevent Geotrichum infection and to protect lime fruit during different periods of storage. Data in Table (4) indicate that all tested compounds reduced the percentage of infected lime fruits at all concentrations during 45 days of storage compared with untreated fruits. The percentage of infected fruit was increased by increasing storage periods. At 4 ml/l of thyme, lemon grass, grapefruit essential oils or nerol, the infected lime fruits was reduced by 100 % after 30 days of storage (Plate 1), but thy were reduced by 94.0, 90.0, 96.0, 100.0 % for such oils after 45 days of storage respectively. Whereas, 3 ml/l conc. of nerol reduced number of infected fruits by 96.0, 90.00, 86.0, 80.0 % after 7, 15, 30 and 45 days of storage. At 3 ml/l conc. of essential oils of thyme, lemongrass, grapefruit caused a reduction in infected lime fruits by more 92.0, 86.0, 76.0 and 64.0 % was detected at the same periods of storage respectively. Nerol was the best compound to protect lime fruit at 2 ml/l ,where ,the number of infected fruit was reduced by 60.0 % after 45 days of storage. Thyme, lemon grass and grapefruit essential oils at 2 ml / l caused 50.0 % reduction at least after 45 days of storage. All tested compounds caused a reduction in infected lime fruit by more than 50.0 % after 30 days of storage at 3 ml / l conc.

Concerning the effect of essential oils and some their constituents on rotted parts of infected lime fruits, similar results were obtained as the percentage of infected fruits. Results in Table (5) indicate that nerol at 4 ml/l concentration completely reduced the percentage of rotted parts of lime fruits and caused complete protection of lime fruits during 45 days of storage. Thyme, lemon grass and grapefruit essential oils at 4 ml/l caused a reduction of rotted parts by 100 % after 7, 15 and 30 days of storage and by 95.1, 91.2 and 96.4 % after 45 days of storage. After 45 days, nerol at 3 ml/l concentration gave the best results in reducing rotted parts of fruits followed by thyme, lemon grass and grapefruit essential oils, where, rotted parts were reduced by 84.4% with nerol and by 76.7, 71.8 and 67.2 % with thyme, lemon grass and grapefruit essential oils respectively. Thyme, lemon grass and grapefruit essential oils caused a reduction by more than 99.4, 95.4 and 85.1 % at 3 ml / l conc. At 1 and 2 ml / l concentrations nerol gave the best results following by thyme, lenon grass and grapefruit essential oils during 45 days of storage compared with untreated fruits (control).

DISCUSSION

Post harvest decay of lime fruits are mainly caused by sour rot *(Geotrichum candidum* Link.) **Butler *et al* 1965; Morris, 1982; Eckert and Brown, 1986; Brown and Eckert, 1988; Morsy and Abd El-Kader, 1994.** Essential oils consist of various volatile compounds including mono and sesquiterenoids , aldehydes, esters, acids, ketones, alcohol's

Table 4. Percentage of infected lime fruits with *G. candidum* treated with different concentrations of essential oils or constituents during storage at 20 C^0.

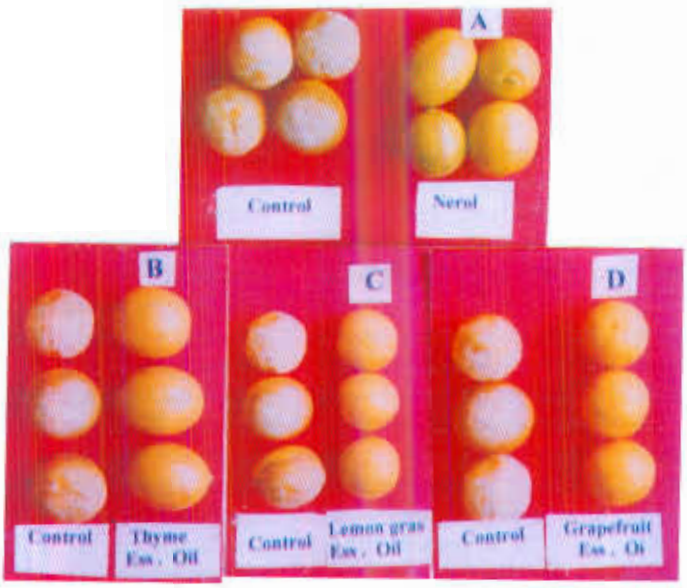
Essential oil / Constituent	Geotrichum sour rot incidence %															
	1 ml/l				2 ml/l				3 ml/l				4 ml/l			
	7 day	15 day	30 day	45 day	7 day	15 day	30 day	45 day	7 day	15 day	30 day	45 day	7 day	15 day	30 day	45 day
Thyme	16*	36*	54*	90	8	24	36	52	6	12	18	30	0	0	0	6
Lemon grass	24	44	60	76	14	30	40	64	8	14	20	32	0	0	0	10
Grape fruit	22	42	62	80	18	34	46	72	8	16	24	36	0	0	0	4
Nerol	10	30	44	66	4	20	30	40	4	10	14	20	0	0	0	0
Control	44	80	100	100	44	80	100	100	44	80	100	100	44	80	100	100

*Percentage of infected lime fruits (out of 50 fruit of each treatment) during pierods of storage

Table 5. Percentage of rotted parts of lime fruits with *G. candidum* treated with different concentrations of essential oils or some their constituents during storage at 20°C.

Essential oil Constituent	Geotrichum rotted part %															
	1 ml/l				2 ml/l				3 ml/l				4 ml/l			
	7 day	15 day	30 day	45 day	7 day	15 day	30 day	45 day	7 day	15 day	30 day	45 day	7 day	15 day	30 day	45 day
Thyme	1.0*	7.9	29.6	64.8	0.5	5.3	19.8	421	0.4	2.6	9.9	23.3	0	0	0	4.9
Lemongrass	1.7	11.9	36	66.9	1	8.1	24	56.3	0.6	3.8	12	28.2	0	0	0	8.8
Grape fruit	1.7	12.1	38.4	72.8	1.4	9.8	28.7	65.5	0.6	4.6	14.9	32.8	0	0	0	3.6
Nerol	0.6	6.3	23.8	51.5	0.2	4.2	16.2	31.2	0.2	2.1	7.6	15.6	0	0	0	0
Control	4.4	28.8	70	100	4.4	28.6	70	100	4.4	28.8	70	100	4.4	28.8	70	100

* Percentage of rotted parts of infected lime fruits.



Plat 1. Protective effect of different essential oils and nerol as fruit coating on Geotrichum sour rot of lime fruits under artificially inoculation with *G. candidum* after 30 days of storage.

A. Nerol (constituent of essential oil) Control (untreated fruits) on the left..
B. Thyme essential oil Control (untreated fruits) on the left..
D. Grapefruit essential oil Control (untreated fruits) on the left..
C. Lemon grass essential oil Control (untreated fruits) on the left..

and coumarins. The biological activity of these compounds is due to the single compounds acting alone and in combination **Deans, 1990**. The volatile oils from the exocarpe of fresh citrus fruit exhibited strong toxicity towards several fungal pathogens being more than several commercial fungicides. These compounds have a high activity against several pathogenic fungi **Davis and Smoot, 1972; Asthana *et al* 1988; Arras *et al* 1995 and 1998 ; Ben-Yehashua *et al* 1992 and 1995; Caccioni *et al* 1995 a, b; Rodov *et al* 1995; Suprapta *et al* 1997 and Rio del *et al* 1998.**

In the present study five essential oils of thyme, lemon grass, grapefruit ,sour orange and lime caused an inhibition of growth, spore germination and colonization of lime fruits peel discs with *G. candidum* by 100% at 4 ml/l , except sour orange and lime essential oils, they caused 95.3, 90.0 % of growth, 95.0, 95.5% of spore germination and 95.0, 92.0 % of fungal colonization at 4 ml/l respectively. Such compounds has a considerable effect at 2 , 3 ml/l concn. However, , Sour orange and lime essential oils has less effect.

Essential oils differed with each other in their action against post harvest fungi . These differences are due to the constituents compounds of oil **Knobloch *et al* 1989; Ben-Yehoshua *et al* 1995; Rodov *et al* 1995 and Rio del *et al* 1998. Caccioni *et al* 1995 a and 1998** noted that citrus essential oil contain a high quantity of oxygenated monoterpines that have a high action a ganist citrus post harvest fungi. Because these compounds are highly soluble in water, so their diffusion in agar and capacity to penetrate the cell wall of the pathogen are high compared with the other constituents. **Davis and Smoot, 1972** noted that essential oils contain a high quantity of alchols such, nerol but not aldehyde compound such, citral showing high antifungal activity against several post harvest fungi. The antifungal action of essential oils seem to be correlated to their solubility and capacity to interfere with enzymatic reaction of the cytoplasmic membrane of fugal cells **Knobloch *et al* 1989**. The limited activity of sour orange and lime essential oils in this study ,may be ascribed to the fact that such oils contain some compounds are insoluble so their diffusion in agar and capacity to penetrate the cell wall are limited. Meanwhile, Thyme, lemon grass and grapefruit essential oils had more antifungal effect, because these oils may be contain a high quantity of alchols (nerol) but not aldehyde compound. Similar results were reported by many investigators **Caccioni *et al* 1998; Ben-Yehoshua *et al* 1995; Arras *et al* 1995 and 1998.**

In this study nerol and citral caused complete reduction of *G. candidum* growth, sporulation and peel colonization at 4 ml/l. Meanwhile, nerol gave best results at low concentration . Such results were similarly reported by **French *et al* 1978; Arras *et al* 1995, 1998; Caccioni *et al* 1995 a, b and 1998; Rio del *et al* 1998; El-Mohamedy *et al* 2002.** The differences between constituents of each others is due to their structure, solubility and capacity to penetrate cell wall .In this respect, **Knobloch *et al* 1989** noted that the antimicrobial characteristic of essential oil constituents seemed to be correlated with their solubility and capacity to interfere with the enzymatic reaction of the cytoblasmic membrane . **Davis and Smoot, 1972** found that alco-

hol's compounds of shorter (C6) or longer chain length (C11 or C12) had a high inhibitory effect probably related to the volatility and solubility of the compounds. **Rodov *et al* 1995 and Suprapta *et al* 1997** noted that citrus fruit treated with alchols or citral a constituents of citrus essential oil prior to inoculation reduced colonization and maceration of lemon fruit peel discs with *G. candidum* by 70 % or more. **Caccioni and Guizzardi, (1994)** noted that oxygenated monoterpene such nerol seem to posses greater antifungal activity than hydrocarbon monoterpene.

Also, essential oils of thyme, lemon grass ,and grapefruit caused high reduction in sour rot incidence and rotted parts of lime fruits during storage at 20°C. Nerol at 4 ml/l gave complete protection and caused 100 % reduction in sour rot incidence after 45 days and by 80.0 % at 3 ml/l . The mechanism of essential oil or nerol in reducing sour rot of lime fruit appears to be related to its fungicidal property **Singh *et al* 1993; Rodov *et al* 1995; Knobloch *et al* 1989; Caccioni & Deans, 1993 and El-Mohamedy *et al* 2002**. In this respect, **Ix *et al* 1995; GIGO *et al* 1997 and Raga *et al* 2001** noted that the antifungal mechanism of the essential oil is the synthetic inhibition of DNA, RNA, protean and polysaccharides, more than the oil emulsion damaged cell wall and cell membrane of pathogenic fungi.

In conclusion, this work confirming the results obtained that nerol and /or thyme, lemon grass essential oils were the most effective than other compounds . It could be suggested that essential oils or some their constitutes might be safely used commercially as fruit coating as substitute of traditional fungicides to control post harvest diseases of citrus fruits.

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مقاومة عفن الجيوتريكم (العفن المر) في ثمار الليمون باستخدام الزيوت النباتية الطيارة وبعض مكوناتها

[٦٠]

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يعتبر مرض عفن الجيوتريكم (العفن المر) الذي يصيب ثمار الليمون والمتسبب عن *الفطر Geotrichum candidum* من اخطر أمراض ما بعد الحصاد التى تصيب ثمار الليمون . تم اختبار مقدرة ٥ زيوت نباتية طيارة لنباتات الزعتر –حشيشة الليمون– الجريب فروت – النارنج – الليمون وكذلك اثنين من مكونات هذه الزيوت . nerol - citral على تثبيط النمو ,إنبات الجراثيم ,وكذلك مقدرة الفطر على إصابة واستبطان أجزاء قشور ثمار الليمون المعاملة بهذه المركبات . كذلك تم اختبار فاعلية هذه المركبات في مقاومة المرض تحت ظروف التخزين لمدة ٤٥ يوم على درجة حرارة ٢٠°م. وجد أن كل من زيت الزعتر – حشيشة الليمون –الجريب فرت عند تركيز ٤ مل / لتر تسبب تثبيط كامل ١٠٠% للنمو وانبات الجراثيم وعدم مقدرة الفطر على إصابة أجزاء قشور الثمار للعاملة. بينما سبب زيت كل من النارنج والليمون تثبيط بمقدار ٩٠ % أو اكثر عند هذا التركيز . حدث تثبيط كامل لنمو الفطر وانبات الجراثيم واستبطان قشور الثمار عند تركيز ٤ مل /لتر من مركب nerol أو citral . لكن كان مركب nerol من احسن المركبات فاعلية عند التركيزات المنخفضة. أدت معاملة ثمار الليمون بزيت الزعتر أو حشيشة الليمون أو الجريب فروت إلي انخفاض تام ١٠٠% في أعداد الثمار المصابة وكذلك حماية الثمار لمدة ٣٠ يوم من التخزين على درجة حرارة ٢٠ م٠ بينما انخفضت نسبة الثمار المصابة بالمرض نتيجة المعاملة بهذه المركبات بنسبة ٩٤ و٩٠ ,٩٦ % على الترتيب بعد ٤٥ يوم.

كذلك أدت معاملة الثمار بمركب nerol تركيز ٤ مل / لتر آلي حماية كاملة للثمار

حيث انخفضت نسبة الثمار المصابة بنسبة ١٠٠ % & ٨٠ % عند تركيز ٣ مل / لتر حتى ٤٥ يوم من التخزين على ٢٠ م ٠ كان مركب الـ nerol من أحسن المركبات في مقاومة المرض بعد ٧ و ١٥ , ٣٠ يوم من التخزين مقارنة بالمركبات الأخرى.

تشير هذه الدراسة آلي إمكانية استخدام بعض مكونات الزيوت النباتية الطيارة مثل nerol آو بعض هذه الزيوت مثل زيت الزعتر - حشيشة الليمون - الجريب فروت بصورة آمنة وتطبيقية على نطاق واسع بدلاً من المبيدات في مقاومة أمراض ما بعد الحصاد في ثمار الموالح.

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