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EFFICIENCY OF SOME FUNGICIDE ALTERNATIVES TO CONTROL DATE PALM DISEASES

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ABSTRACT

Several alternative control methods were evaluated against some important date palm diseases *i.e.* false leaf smut, inflorescence rot, black scorch, basal leaf rot and leaf spot . Results revealed that, using plant extracts and essential oils in addition to some biocontrol agents gave similar control capacity as fungicides. Using plant extracts of Neem, swamp mahogany, garlic and jasmine suppressed infection with studied diseases at 100 ppm while, Nigella and rocket were the most effective oils at the same concentration. *T. harzianum* , *T. viride* and *B. subtilis* isolate (1) were the most effective in reducing diseases incidence. Data show that, Diathen M was the most effective fungicide in controlling all studied diseases at dose 1.5 g/liter except black scarch where Daconil was the most effective at the same dose.

INTRODUCTION

Date palm (*Phoenix dactylifera* L.) is considered one of the most important fruit crops in Egypt and Middle east in general. In Egypt date palm is cultivated all over the country especially in New valley, Aswan, Sinai, Sharkia, Giza and Behera Governorates. Date palm trees are subjected to attacking by several fungal diseases in grown areas and nurseries at different regions around the world. Field surveys of date palm diseases revealed that, most serious diseases are false smut caused by *Graphiola phoenicis*, black scorch caused by *Thielaviopsis paradoxa*, inflorescence rot and diplodia leaf spot caused by *Diplodia phoenicum* (El-Deeb 1994,Ohr and Carpenter 1997,Omamor 1998,Rashed 1998 and El-Zawahry *et al*. 2000). Omamor (1998) isolated *Botrydiplodia theobromae* from decaying dates in Nigeria which caused black rot of date fruit. According to Livingston *et al*. (2002) leaf spots caused by *Alternaria* spp. have become a threat to date palm cultivation in recent years in Sultanate of Oman. Several experiments were conducted to find out a suitable chemical spray program to control diseases affecting date palm. Several attempts have been made for controlling such fungi especially by using fungicides. Because of the extensive use of such toxic chemicals ,unexpected and undesirable results occurred ,e.g. fungi have become more resistant to fungicides and higher concentrations have to be applied leading to pollution problems; fungicide alternatives ,which are biologically compatible became widely used for controlling date palm pathogens.

Some researchers suggest that biological control of date palm diseases is expected to provide significant advantages over chemical control (Sedra and Masloushy 1994 and 1995 and Sallal *et al*. 1996). They reported that, increasing protection saves money and labor in addition reducing risks of pollution. Plant extracts and essential oils showed fungistatic and fungicidal activities in controlling incidence of some fungal diseases in addition to increasing yield production (Qasem and Abu-Blan 1996, Carpirella *et al*.

1999 and O'gera *et al*. 2000).Literature reported examples of essential oils that have inhibited the development of fungal growth and effective results have been obtained with thyme oil (Eloff 1998 and El-Safwan and Aly 2003), mint oil (Zambonelli *et al*. 1996) and lavender oil (Zambonelli *et al*. 1996 and Daferera *et al*. 2000).

The main objective of this study is to evaluate some fungicide alternatives for controlling date palm pathogens. The alternatives include using some biocntrol agents , plant extracts and essential oils compared with fungicides.

MATERIALS AND METHODS

Laboratory experiments:

Pathogenic fungi:

An isolate of each of *Thielaviopsis paradoxa* causing black scorch , *Botrydiplodia theobromae* causing bending head *, Diplodia phoenicum* causing inflorescence rot *and Alternaria alternate* causing leaf spots were chosen from many isolates previously isolated in former survey study of date palm diseases and proved to be aggressive for inducing false leaf smut, inflorescence rot , black scorch ,basal leaf rot and leaf spot, respectively in previous study.

Preparation of plant extracts:

A leaf weight 250 g of each of different plant species shown in Table (1) were washed thoroughly in sterile distilled water then dried. Dried leaf sample were ground into fine powder. The powder was soaked in distilled water at rate of 1 g / 4ml and kept for 20 - 24 hours at room temperature. The mixture was blended for 5 minutes then filtered through cheese cloth. The resulted solution was kept in refrigerator at 5 ^{o}C until usage. In case of garlic, the juice of mature fresh cloves was obtained by crusing them in blender then filtered as mentioned before. The extracts was centrifuged at 1200 rpm for 30 min. then sterilized by filtering through Seitz filter to avoid any bacterial or fungal contamination. The crude extracts were considered 100 % conc. then diluted with sterilized distilled water to prepare serial concentrations 50,100,150 and 200 ppm

Table (1): English name, scientific name, family name and plant part which its extract were used to control date palm diseases.

English name	Scientific name	Family name	Plant part
Swamp mahogony	*Eucalyptus robusta* Sm.	Myrtaceae	Leaves
Neem	*Melia azadirachta* L.	Meliaceae	Leaves
Garlic	*Allium sativum* L.	Lilaceae	Cloves
Jasmine	*Jasminum officinale* L.	Oleaceae	Leaves
Worm wood	*Artemisia hebaalba* Asso.	Asteraceae	Leaves
Ploughman's	*Conyze dioscoridis* L.	Asteraceae	Leaves
Mint	*Mentha microphylla* L.	Lamiaceae	Leaves
Egyptian Acacia	*Acacia nilotica* Del.	Leguminosae	Leaves

Essential oils:

Five commercial oils shown in Table (2) were evaluated for its ability to inhibit mycelial growth of date palm pathogens. Dilutions of these oils were prepared by mixing 5 ml. of each oil with 0.5 ml. acetone, then emulsified in sterilized distilled water to obtain concentrations of 25,50,75,100 ppm.

Table (2): English and scientific name to some tested oils.

English name	Scientific name	Family name
Black cumin	*Nigella sativa* L.	Ranunculaceae
Peppermint	*Mentha piperita* L.	Lamiaceae
Lemon grass	*Cymbopogon citrates* Stapf.	Poaceae
Rocket	*Eruca sative* Mill.	Brassicaceae
Clove tree	*Eugenia caryophyllata* Thunb.	Myrtaceae
Common Fennel	*Foeniculum vulgar* Mill.	Apiaceae

Effect of plant extracts and essential oils on mycelial growth of date palm pathogenic fungi:

Obtained plant extracts and oils were separately mixed with PDA medium before solidification, then poured in sterile (9 cm- diam.) Petri dishes. Three plates for each concentration were inoculated at the center by fungal disc (5 mm-diam.) cutted out from the periphery of 7days old culture of each tested pathogenic fungus. Control treatment was mixed with only sterilized distilled water. The plates were incubated at 27±1^{o}C. Linear growth of the tested pathogens was measured when each particular control filled the plates. Percentage of reduction in the linear growth of the pathogenic fungi was recorded according to the formula suggested by Dikshit *et al.* (1989) as follows:

Reduction % = (A - B) / A X 100

Whereas A= Growth diameter in check treatment

B= Growth diameter in plant extracts or oil treatments

Effect of some antagonistic microorganisms on linear growth of pathogenic fungi affecting date palm:

In this study three isolates of *Bacillus subtilis* , three isolates of actinomycetes in addition to *Trichoderma harzianum*, *T. hamatum* and *T. viride* were investigated to their ability to control a number of pathogenic fungi affecting date palm. Fungal , bacterial and actinomycetes bioagents were isolated from date palm rhizosphere and phylosphere. Fungal isolates were identified in Mycology Research and Diseases Survey Dept. while bacteria and actinomycetes in Bacteria Dept., Plant Pathology Research Institute ,A.R.C, Giza, Egypt. Both pathogenic and antagonistic fungi were grown on PDA medium for 10 days also bacterial isolates were grown on nutrient broth for 48 hr. while actinomycetes were grown on Jensen medium (Allen 1953) for 7 days. In case of Fungal and actinomycetes bioagents Petri dishes (9 cm- diam.) containing PDA medium were divided into equal halves. The first was inoculated ,at periphery of the plate, by a disc of (5 mm - diam.)of 7 days old culture *Trichoderma harzianum*, *T. hamatum*, *T. viride* and actinomycetes. The second half was plated by an equal disc of new culture of

each of the pathogenic fungi. In case of bacterial bioagents , also Petri dishes (9cm- diam.) containing PDA medium were streaked by the bacterial growth (24 hour old culture) at opposite sides at the periphery of plate using loop needle. After 24 hr. of incubation at 27±1°C, plates were inoculated by one disc of each tested pathogenic fungi at the center of each plate. Each treatment was replicated three times. Plates inoculated only with the pathogenic fungi served as control. The plates were incubated at 25±2°C for 7 days. When growth of the tested pathogens covered the whole plate surface of control treatment , percentage of reduction in the linear growth of the pathogenic fungi on the sides nearest to the biocontrol agents (fungi, bacteria and actinomycetes) was calculated according to Fokemma (1973) as follows:

Reduction in linear growth % = $(R_1 - R_2) / R_1 \times 100$

Where $R_{1=}$ The radius of normal(control)growth .

$R_{2=}$ The radius of inhibited growth.

Chemical control:

A laboratory study was performed to examine the sensitivity of the pathogenic fungi to the tested fungicides presented in Table (3). Five concentrations of each fungicide , *i.e* 100,200,400,800 and 1000 ppm were used. The required concentrations were obtained by adding the appropriate amount of stock solution used to 100 ml portions of autoclaved PDA medium cooled to about 45 °C. Three Petri dishes (9cm-diam.) were used as replicates for each concentration. After solidification of the medium, each dish was inoculated centrally with a disc of (5mm-diam.) taken from new cultures of each pathogen. Plates were incubated at 28 °C for 7 days and colony diameters were measured till the untreated plates reached the maximum growth. Inhibition percentage (I %) were calculated according to the following equation :

$$I\ \% = A-B/A \times 100$$

Where I= Percent of inhibition.

A= Mean diameter growth in the control.

B= Mean diameter growth in a given treatment.

Table(3): Tested fungicides, their chemical structure, active ingredients and recommended doses.

Fungicides	Chemical structure	Active ingredients	Recommended dose
Apron	N(2,6-Dimethylphenyl)-N-(Methoxyactyl	3.5 %	2.5
Daconil	Phthalamide	75 %	2.5
Kocide 101	Copper hydroxide	75 %	5.0
Elosal	Sulphur	75 %	2.5
Privecur N	Propyl-z-(dimethylamino)	75 %	2.5
Ridomil mancozeb	10%metalaxyl+ 48%mancozeb	58 %	2.5

Field experiments:

Field experiments were carried out in Kalabshou agriculture research station , Dakahlya Governorate, A.R.C. The experiments were done on trees of date palm c.v Zaglool cultivar naturally infected with the studied diseases.

Effect of selected bioagents on diseases incidence and yield:

Flasks (1000 ml) in capacity contained 250ml of sterilized PD liquid medium were inoculated with discs (5mm- diam.) of 7days old cultures of each of *Trichoderma* species. Flasks contained Kings B liquid medium were inoculated with a loop of 24 hr. old of each of *B. subtilis* isolates while actinomycetes were grown on Jensen liquid medium (Allen 1953). All flasks were incubated at 28 ^{o}C for 3 days for bacteria and 7 days for fungi and actinomycetes. All flasks were shaken thoroughly on a mechanical shaker for 15 minutes. Each flask was completed to 1 liter with sterilized distilled water. Spore and cell suspensions of the bioagents were sprayed on ten date palm trees(zaglool cultivar) infected with each of the tested diseases. Ten date palm trees were left without treatments to serve as control. All tested bioagents were sprayed after trees had been pruned for three times ,intervals between each spray were one month. Diseases assessments and amount of yield per tree were recorded.

Effect of plant extracts and oils on the incidence of date palm diseases and yield:

This study was carried out to investigate the efficiency of the selected plant extracts and essential oils at different concentrations (*i.e* 50,100,150 and 200 ppm for plant extracts and 50,100 ppm for essential oils) on diseases incidence and yield of date palm. Plant extracts and oils were separately sprayed on the foliage of date palm trees three times after pruning. Sprays were carried out at the end of January ,February and March. Ten infected date palm trees with each tested fungus were used for each treatment and another ten were sprayed with water to serve as control. Disease assessment was recorded for each treatment. Dates yield per tree was also determined.

Effect of different fungicides on date palm diseases incidence as well as yield:

This study was carried out to investigate the efficiency of the six fungicides to control date palm diseases. Each tested fungicide was sprayed at different doses (*i.e* 1.5, 2.5 and 5 g/ 1 liter water) on the foliage of ten naturally infected date palm trees with each studied disease after pruning for three times as mentioned before. All fungicides were applied at the recommended doses. Ten date palm trees were assinged as control. Disease assessment was recorded for each treatment. Amount of yield per tree was also determined.

RESULTS AND DISCUSSION

Efficiency of plant extracts:

Data represented in Table(4) indicate that in general the aqueous plant extracts tested in the present study have an antifungal properties at most concentrations under laboratory conditions against the tested pathogens. Extract of Egyptian acacia was the most effective in significantly suppressing the mycelial growth of the tested pathogenic fungi compared to control since it gave 0.0 % reduction followed by extracts of neem and garlic at the lowest concentration (50 ppm). In the mean time extracts of swamp mahogany and ploughman's gave moderate inhibition. On the other hand the

lowest capacity in inhibiting the linear growth of the studied pathogenic fungi belonged to the extracts of jasmine , menthe and wormwood. Data also clear that raising extracts concentrations caused significant increase in its abilities to inhibit the linear growth of pathogenic fungi. *D. phoenicum* was the most affected pathogen by all plant extracts (72.6 % mean reduction) followed by *T. paradoxa. A. alternata.* and *B. theobromae* were moderately affected. The efficiency of different plant extracts on fungal species was demonstrated by many workers. Results of this study are in agreement with those reported by Al-Yahya (1985), Abd El-Salam (1995) and Sallal *et al*. (1996).

Table (4): Effect of plant extracts on linear growth of some date palm pathogenic fungi.

Plant extracts	Conc. ppm	*T. paradoxa*		*B. theobromae*		*D. phoenicum*		*A. alternata*	
		L.g	R.%	L.g	R.%	L.g	R.%	L.g	R.%
Swamp mahogony	50	5.2	42.2	5.7	36.6	4.8	46.6	6.7	25.5
	100	2.4	73.3	2.9	67.7	2.2	75.5	3.2	64.4
	150	1.6	82.2	1.3	85.5	1.4	84.4	1.8	80
	200	0.0	100	0.0	100	0.0	100	0.0	100
Neem	50	3.2	64.4	3.5	61.1	4.0	55.5	4.5	50
	100	1.6	82.2	1.7	81.1	1.8	80	2.4	73.3
	150	0.0	100	0.0	100	0.0	100	0.0	100
	200	0.0	100	0.0	100	0.0	100	0.0	100
Garlic	50	3.1	65.5	4.1	54.4	4.2	53.3	2.9	67.7
	100	1.5	83.3	1.8	80	2.0	77.7	1.3	85.5
	150	0.0	100	0.0	100	0.0	100	0.0	100
	200	0.0	100	0.0	100	0.0	100	0.0	100
Jasmine	50	6.3	30	6.4	28.8	5.1	43.3	4.8	46.6
	100	3.1	65.5	3.0	66.6	2.5	72.2	2.2	75.5
	150	0.0	100	0.0	100	0.0	100	0.0	100
	200	0.0	100	0.0	100	0.0	100	0.0	100
Wormwood	50	7.1	21.1	6.2	31.1	6.5	27.7	7.3	18.8
	100	5.6	37.7	4.3	52.2	3.6	60	5.5	38.8
	150	1.9	78.8	2.0	77.7	1.6	82.2	2.3	74.4
	200	0.0	100	0.0	100	0.0	100	0.0	100
Ploughman's	50	6.5	27.7	7.8	13.3	6.2	31.1	7.8	13.3
	100	4.2	53.3	4.2	53.3	3.2	64.4	3.9	56.6
	150	2.1	76.6	2.6	71.1	1.9	78.8	2.8	68.8
	200	0.0	100	0.0	100	0.0	100	0.0	100
Mint	50	7.0	22.2	7.5	16.6	8.0	11.1	7.9	12.2
	100	5.2	42.2	5.0	44.4	5.6	37.7	5.3	41.1
	150	2.6	71.1	2.4	73.3	2.9	67.7	2.4	73.3
	200	0.0	100	0.0	100	0.0	100	0.0	100
Egyptian Acacia	50	2.8	68.8	4.3	52.2	3.0	66.6	2.2	75.5
	100	1.2	86.6	2.5	72.2	1.8	80	1.0	88.8
	150	0.0	100	0.0	100	0.0	100	0.0	100
	200	0.0	100	0.0	100	0.0	100	0.0	100
Control		9.0	0.0	9.0	0.0	9.0	0.0	9.0	0.0

Lg = linear growth R% = % of growth reducation
LSD. at 5% f = fungi = 3.45 p = plant extract = 2.12 c = concentration = 3.75 f × p = 5.31 f × c = 4.81 p × c = 5.7 f × p × c = 8.11

***In vitro* evaluation of the inhibitory effect of some oils on the linear growth of the tested date palm pathogens:**

The inhibitory effect of essential oils at different concentrations against linear growth of date palm pathogenic fungi was *in vitro* evaluated. Data in Table (5) indicate that all concentrations inhibited the mycelial growth of all the tested pathogens. Oils of citronella appeared to be the most effective one in significantly inhibiting all the tested fungi at 25 ppm. *Alternaria alternata* showed more sensitivity to citronella oil followed by *Thielaviopsis paradoxa*. On the other hand, the other oils varied in their ability to inhibit linear growth of the pathogenic fungi . Peppermint was the least capable one. *D. phoenicum* seemed to be tolerant to certain oils and concentrations. These results agree with those obtained by Pattnaik *et al*. (1996), Zambonelli *et al*. (1996), Chao *et al.*(2000) and El-Shazly 2000 who reported that plant extracts and oils and their constituents present in various species are known to have antifungal properties which cause degeneration in fungal moulds.

Table (5) : Effect of some essential oils on linear growth of date palm pathogenic fungi.

Essential oils	Conc. ppm	*T. paradoxa*		*B. theobromae*		*D. phoenicum*		*A. Alternate*	
		L.g	R.%	L.g	R.%	L.g	R.%	L.g	R.%
Black cumin	25	5.5	38.8	5.3	41.1	5.0	44.4	6.0	35.2
	50	3.1	65.5	2.2	75.5	3.0	66.6	2.4	73.3
	75	0.0	100	0.0	100	0.0	100	0.0	100
	100	0.0	100	0.0	100	0.0	100	0.0	100
Peppermint	25	7.0	22.2	6.8	24.4	8.1	10	8.5	5.0
	50	3.5	61.1	4.6	48.4	5.9	34.4	5.0	44.4
	75	2.9	67.7	2.9	67.7	3.6	60	2.6	71.1
	100	1.3	85.5	1.8	80	2.0	77.7	0.0	100
Lemon grass	25	3.8	57.7	4.9	45.5	4.2	53.3	2.9	67.7
	50	1.6	82.2	2.3	74.4	2.0	77.7	1.3	85.5
	75	0.0	100	0.0	100	0.0	100	0.0	100
	100	0.0	100	0.0	100	0.0	100	0.0	100
Rocket	25	4.9	45.5	6.5	27.7	2.8	68.8	3.1	65.5
	50	2.4	73.3	3.6	60	1.5	83.3	2.6	71.1
	75	0.0	100	2.0	77.7	0.0	100	0.0	100
	100	0.0	100	0.0	100	0.0	100	0.0	100
Clove tree	25	5.8	35.5	7.3	18.8	5.3	41.1	6.3	30.0
	50	3.4	62.2	3.8	57.7	2.1	76.6	3.2	64.4
	75	0..0	100	2.0	77.7	0.0	100	2.3	74.4
	100	0.0	100	0.0	100	0.0	100	0.0	100
Common fennel	25	7.5	16.6	6.6	26.6	6.4	28.8	5.6	37.8
	50	4.1	54.4	3.5	61.1	3.4	62.2	3.0	66.6
	75	3.3	63.3	4.0	55.5	3.0	66.6	2.5	72.2
	100	2.0	77.7	2.2	75.5	1.3	85.5	1.5	83.3
Control		9.0	0.0	9.0	0.0	9.0	100	9.0	0.0

Lg = linear growth R% = % of growth reducation
LSD at 5% f = fungi = 2.35 o = oil = 2.75 c = concentration = 1.93
f × o = 4.25 f × c = 4.16 o × c = 3.11 f × o × c = 6.12

Antagonistic effect of some bioagents on the growth of date palm pathogens:

Data presented in Table (6) reveal that all tested bioagents sharply reduced the linear growth of all the pathogens. Maximum reduction in mycelial growth of the pathogens was observed in the presence of *B. subtilis* isolate (3) followed by *B. subtilis* isolate (2), *T. viride* and *T. hamatum*. They caused 69.6- 81.6 % mean reduction in the linear growth of the six studied pathogens. Heebar *et al.* (1992) suggested that antibiotic production rather than siderphores is responsible for the antifungal activity of *B. subtilis*. Chet (1984) found that *Trichoderma* apparently act as mycoparasite which detects its host sugar -lectin linkage and begins to excrete extracelluar lytic enzyme such as β-1,3 glucanase , chitinase, protease and /or lipase. He also stated that the genus *Trichoderma* has a substational ability to suppress a wide range of plant pathogenic fungi by various mechanisms including the production of cell-wall degradating enzyme.

Table (6): Effect of some antagonistic microorganisms on radial growth of date palm pathogenic fungi.

Antagonistic microorganisms	***T. paradoxa***		***B. theobromae***		***D. phoenicum***		***A. alternata***	
	L.g	R.%	L.g	R.%	L.g	R.%	L.g	R.%
Trichoderma. harzianum	4.2	53.3	2.4	73.3	1.5	83.3	3.3	63.3
T. viride	2.6	71.1	1.6	82.2	1.9	78.8	2.1	76.6
T. hamatum	3.2	64.4	2.9	67.7	2.6	71.1	2.8	68.8
Bacillus subtilis (1)	2.3	54.4	3.6	60.0	3.2	64.4	2.3	54.4
B. subtilis (2)	2.0	77.7	1.5	83.3	2.3	74.4	2.0	77.7
B. subtilis (3)	1.5	83.3	1.6	82.2	1.2	86.6	1.6	82.2
Streptomyces sp. (1)	3.1	65.5	3.4	62.2	2.6	71.1	2.6	71.1
Streptoyces sp. (2)	4.0	55.5	3.6	60.0	4.2	53.3	3.6	60.0
Streptomyces sp. (3)	3.3	63.3	2.8	68.8	4.5	50.0	3.8	57.7
Control	9.0	0.0	9.0	0.0	9.0	0.0	9.0	0.0
LSD at 5%	**2.41**		**2.87**		**3.15**		**3.25**	

Lg = linear growth R% = % of growth reducation

Suppressive effect of fungicides on pathogens linear growth:

Data in Table (7) indicate that all used fungicides completely inhibited mycelial growth of all the tested pathogenic fungi at 800 and 1000 ppm except Redomil mancozeb which inhibited the linear growth of all pathogens at 400 ppm. Daconil came at the second level in effectivity followed by Diathene M. Apron, Kocide and Previcur N were moderately effective in reducing linear growth of the tested pathogens. On the other hand, Elosal was the least effective one. Similar results were reported by Mentha *et al.* (1989).

Efficiency of treatment with plant extracts on date palm diseases incidence and yield :

Ten date palm trees individually infected with each studied disease were treated with four concentrations of each tested plant extracts in order to evaluate their efficiency to control some of the important date palm diseases. Data represented in Table (8) reveal that all treatments have significantly

reduced the diseases incidence even at low concentrations (50 and 100 ppm) compared with check treatment. Applying extracts of neem, swamp mahogany, garlic and jasmine resulted in the lowest percentage of infections with date palm diseases under study. Unlike the laboratory tests Egyptian acacia was moderately effective in suppressing date palm diseases under field

Table (7): Effect of some fungicides on linear growth of date palm pathogenic fungi

Fungicides	Conc. (ppm)	*T. paradoxa*		*B. theobromae*		*D. phoenicum*		*A. alternate*	
		L.g	R.%	L.g	R.%	L.g	R.%	L.g	R.%
Apron	100	5.8	35.5	4.8	46.6	7.4	17.7	5.7	36.7
	200	2.6	71.1	2.5	72.2	5.2	42.2	3.8	57.8
	400	1.7	81.1	1.3	85.5	2.6	71.1	1.9	78.9
	800	0.0	100	0.0	100	0.0	100	0.0	100
	1000	0.0	100	0.0	100	0.0	100	0.0	100
Daconil	100	4.5	50.0	4.5	50.0	4.2	53.3	5.2	42.2
	200	2.3	74.4	2.6	71.1	2.1	76.7	2.7	85.5
	400	1.3	85.5	1.1	87.7	1.0	88.9	1.3	85.5
	800	0.0	100	0.0	100	0.0	100	0.0	100
	1000	0.0	100	0.0	100	0.0	100	0.0	100
Diathin M	100	4.5	50.0	3.9	60.0	4.2	53.3	4.7	47.8
	200	3.5	61.1	2.8	68.9	2.9	67.8	3.4	62.2
	400	1.5	83.3	2.0	77.7	1.8	80.0	1.8	80.0
	800	0.0	100	0.0	100	0.0	100	0.0	100
	1000	0.0	100	0.0	100	0.0	100	0.0	100
Elosal	100	5.8	35.5	6.3	30.0	6.8	24.4	5.3	41.1
	200	4.2	53.3	3.2	64.4	3.6	60.0	4.1	54.4
	400	2.2	75.5	2.0	77.8	2.7	70.0	3.2	64.4
	800	0.0	100	0.0	100	0.0	100	0.0	100
	1000	0.0	100	0.0	100	0.0	100	0.0	100
Kocide	100	6.0	33.3	6.1	32.2	6.0	33.3	6.3	30.0
	200	4.0	55.5	4.2	53.3	3.0	66.6	3.9	65.7
	400	1.8	80.0	2.2	75.5	1.5	83.3	1.6	82.2
	800	0.0	100	0.0	100	0.0	100	0.0	100
	1000	0.0	100	0.0	100	0.0	100	0.0	100
Privecur N	100	4.0	55.5	5.2	42.2	4.2	53.3	3.1	65.5
	200	3.0	66.7	4.0	55.5	2.9	67.7	2.2	75.5
	400	1.8	80.0	2.4	73.3	1.9	78.8	1.5	83.3
	800	0.0	100	0.0	100	0.0	100	0.0	100
	1000	0.0	100	0.0	100	0.0	100	0.0	100
Ridomel plus	100	3.1	65.5	3.6	60.0	3.8	57.7	3.7	58.9
	200	1.5	83.3	2.0	77.8	2.4	73.3	2.5	72.2
	400	0.0	100	0.0	100	0.0	100	0.0	100
	800	0.0	100	0.0	100	0.0	100	0.0	100
	1000	0.0	100	0.0	100	0.0	100	0.0	100
Control		9.0	0.0	9.0	0.0	9.0	0.0	9.0	0.0

Lg = linear growth R% = % of growth reducation
LSD at 5% f = fungicides = 2.35 c = concentration 3.12 f × c = 5.31

conditions also was menthe extracts. The least effective extract was wormwood. In addition to suppress diseases incidence all the extracts significantly increased yield of date palm per tree compared to control treatment, although at varying degrees. Increasing concentrations of plant extracts lead to decreasing diseases incidence. These effects might be due to the presence of some phenolic compounds, alkaloids which had an antifungal effects. Differences in the toxicity of different extracts may also be due to the solubility of active ingredients in water and / or the presence of inhibitors to fungal toxic principle as reported by Qasem and Abu-Blan (1996). These results are in harmony with results obtained by Assef *et al*. (1986), Al-Yahya 1986 and Sallal (1996).

Table (8): Efficiency of plant extracts on diseases incidence and yield of date palm

Plant extract	CONC.	Black scorch		Bending head		Inflorescence rot		Leaf spot	
		D I	Y/T	D I	Y/T	D I	Y/T	D I	Y/T
Camphor Tree	50	20.0	53	30.0	50	20.0	60	10.0	59
	100	10.0	60	20.0	59	10.0	65	0.0	69
	150	0.0	72	10.0	65	0.0	71	0.0	70
	200	0.0	70	0.0	72	0.0	71	0.0	70
Neem	50	20.0	55	20.0	59	20.0	63	10.0	66
	100	10.0	75	10.0	75	10.0	70	0.0	75
	150	0.0	70	o.o	65	0.0	75	0.0	75
	200	0.0	69	o.o	70	0.0	69	0.0	70
Garlic	50	10.0	65	30.0	45	20.0	56	20.0	55
	100	0.0	70	20.0	55	10.0	66	10.0	58
	150	0.0	71	0.0	70	0.0	70	0.0	70
	200	0.0	69	0.0	70	0.0	69	0.0	70
Jasmine	50	20.0	55	20.0	55	20.0	60	10.0	63
	100	10.0	60	10.0	65	10.0	62	0.0	70
	150	0.0	68	0.0	68	0.0	70	0.0	72
	200	0.0	70	0.0	68	0.0	70	0.0	73
Wormwood	50	30.0	51	40.0	45	30.0	52	30.0	50
	100	20.0	56	20.0	57	10.0	60	20.0	56
	150	10.0	65	20.0	60	10.0	62	0.0	69
	200	0.0	69	0.0	72	0.0	70	0.0	75
Ploughman's	50	30.0	50	30.0	50	40.0	41	20.0	55
	100	10.0	60	20.0	56	30.0	49	10.0	59
	150	10.0	62	10.0	67	20.0	53	10.0	60
	200	0.0	69	10.0	66	10.0	64	0.0	72
Menthe	50	40.0	45	30.0	50	40.0	45	30.0	50
	100	30.0	51	20.0	55	20.0	55	10.0	66
	150	20.0	57	0.0	70	20.0	58	0.0	70
	200	10.0	72	0.0	73	10.0	62	0.0	72
Acacia arabica	50	40.0	41	10.0	66	20.0	55	20.0	56
	100	30.0	50	10.0	64	10.0	65	10.0	65
	150	10.0	62	0.0	69	10.0	69	0.0	72
	200	0.0	75	0.0	72	0.0	73	0.0	73
Control		70.0	25	40.0	42	70.0	28	50.0	38
LSD at 5 %		15.9	8.9	17.0	8.5	16.3	6.8	12.5	8.3

DI = disease index Y / T = yield per tree (Kg)

Evaluation of oils on date palm diseases incidence and yield:

Six different oils were evaluated for their ability to control some date palm diseases under natural infection conditions in addition to their effect on yield. Data in Table (9) indicate that there were significant difference in diseases incidence and quantity of yield/ tree between treated trees with oils and untreated ones, although oils varied in their ability to control date palm diseases under study. Data show that oils of nigella, rocket , peppermint and clove tree were the most effective ones in decreasing all studied diseases in addition to increasing the quantity of yield per tree. Also it was obvious that increasing oils concentrations to 100 ppm suppressed diseases incidence like inflorescence rot, basal leaf rot and leaf spots. Unlike laboratory test oils of citronella and fennel were moderately effective .These results are in agreement with those reported by Sabaou and Bounga (1987) , Singh *et al.* (1994) and El-Shazly (2000). They reported that, the inhibitory effect of oils might be due to oil components of phenolic compounds, alkaloids which had antifungal effect .They also suggested that, reduction in diseases incidence as a result to treatments with natural plant products might be due to altering the physiology and biochemistry of plants through augmented phenolic levels or to altering the physiology of the pathogen.

Table (10) : Effect of some essential oils on disease incidence and yield of date palm.

Essential oil	Conc. ppm	Disease incidence							
		Black scorch		Bending head		Inflorescence rot		Leaf spot	
		D I	Y/T	D I	Y/T	D I	Y/T	D I	Y/T
Nigella	50	30.0	43	20.0	53	20.0	55	10.0	62
	100	10.0	62	10.0	62	0.0	73	0.0	75
Peppermint	50	30.0	45	30.0	49	20.0	54	20.0	55
	100	10.0	59	10.0	60	10.0	63	0.0	73
Citronella	50	30.0	48	20.0	53	10.0	60	20.0	56
	100	20.0	55	0.0	73	0.0	69	10.0	61
Rocket	50	20.0	57	20.0	50	30.0	45	10.0	59
	100	10.0	64	0.0	75	10.0	65	0.0	70
Clove tree	50	20.0	55	20.0	50	10.0	66	10.0	67
	100	10.0	60	0.0	67	0.0	72	0.0	74
Fennel	50	40.0	40	30.0	45	20.0	55	30.0	47
	100	20.0	55	20.0	55	0.0	73	20.0	53
Control		50.0	36	40.0	42	50.0	42	30.0	44
LSD at 5%		10.6	15.2	10.9	5.5	15.2	8.6	16.7	8.9

DI = disease index Y / T = yield per tree (Kg)

Efficiency of bioagents on diseases incidence and yield of date palm:

Data presented in Table (10) reveal that all the tested bioagents were significantly effective in suppressing infection with the six studied diseases under field conditions compared with check treatment. In this respect *T. harzianum* , *T. viride* and *B. subtilis* isolate (1) were the most effective since they completely suppressed (0.0 %) inflorescence rot and leaf spot. Meanwhile isolates 2 and 3 of *B. subtilis* and *T. hamatum* were moderately effective in reducing the studied diseases . On the other hand Streptomyces isolates came in the last degree since it was the least effective and gave the

highest percentage of infection and the lowest quantity of date yield. Quantities of yield were significantly affected in various degrees by the presence of all the antagonists. The most effective one was *B. subtilis* since it gave the highest quantity as it was increased one fold. Our results in harmony with those reported by Sivan and Chet (1989), Moustiri (1997). These results might be attributed to the antagonistic action of the tested antagonistic microorganisms against the studied fungal pathogens . The biocontrol agents suppress the activity of date palm pathogens through the enzymatic digestion of the pathogen cell walls (Elad *et al*. 1983) and /or production of inhibitory volatile substances as found by Sarker and Sharma (2001).

Table(11): Effect of some biocontrol agents on diseases incidence and yield of date palm.

Biocontrol agent	Disease incidence							
	Black scorch		Bending head		Inflorescence rot		Leaf spot	
	D I	Y/T	D I	Y/T	D I	Y/T	D I	Y/T
Trichoderma. harzianum	10.0	59	10.0	63	20.0	55	0.0	72
T. viride	10.0	60	20.0	53	10.0	60	0.0	70
T. hamatum	20.0	55	10.0	64	30.0	45	10	65
Bacillus subtilis (1)	20.0	53	20.0	50	20.0	54	0.0	74
B. subtilis (2)	10.0	66	10.0	58	20.0	50	10.0	60
B. subtilis (3)	20.0	48	10.0	62	20.0	59	20.0	50
Streptomyces sp. (1)	20.0	56	20.0	48	30.0	45	10.0	62
Streptoyces sp. (2)	30.0	45	30.0	43	20.0	55	20.0	58
Streptomyces sp. (3)	30.0	49	20.0	50	20.0	53	20.0	60
Control	60.0	28	30.0	49	60.0	32	40.0	40
LSD at 5 %	13.5	15.3	8.5	7.6	15.3	8.67	11.8	6.8

DI = disease index Y / T = yield per tree (Kg)

Effect of treatments with fungicides on date palm diseases and yield:

Six fungicides were evaluated for their efficiency to control date palm diseases. Data represented in Table (11) show that spraying the infected date palm trees with the tested fungicides lead to significantly decreasing the percentage of infection with diseases under study. Data show that Diathen M was the most effective fungicide in controlling all the studied diseases at dose 1.5 g/liter except black scoch where Daconil was the effective one against it at the same dose. In the second level of effectivity came Apron, Privecur N, Daconil and Ridomil plus while Kocide and Elosal were the least effective . It was also clear that increasing doses of fungicides to 2.5 and 5 g/liter prevent infections with almost all the studied diseases except for Kocide and Elosal where the infection percentages were only decreased. In the mean time treating date palm trees with these fungicides increased quantities of yield per tree at various degrees also increasing fungicides doses consequently increase quantity of yield. These results are in agreement to with those obtained by Mentha *et al.* (1989) and Rahman *et al*. (1989) The differences in fungicides reactions might be due to the genetic differences of the tested pathogenic fungi which affect their metabolism, living activities and cell permeability. Also such differences could be attributed to the active ingredients of the fungicides which could be more or less toxic and consequently save or kill the pathogens.

Table (12): Effect of fungicides on diseases incidence and yield of date palm.

Fungicide	Conc.	Disease incidence %							
		Black scorch		Bending head		Inflorescence rot		Leaf spot	
		D I	Y/T	D I	Y/T	D I	Y/T	D I	Y/T
Apron	1.5	10.0	60	10.0	60	10.0	63	20.0	56
	2.5	0.0	65	0.0	62	0.0	74	0.0	74
	5.0	0.0	70	0.0	69	0.0	72	0.0	66
Daconil	1.5	10.0	59	10.0	61	20.0	53	20.0	52
	2.5	0.0	66	0.0	69	0.0	65	0.0	69
	5.0	0.0	71	0.0	72	0.0	70	0.0	74
Diathin M	1.5	10.0	67	20.0	56	10.0	65	10.0	64
	2.5	0.0	75	10.0	65	0.0	70	0.0	71
	5.0	0.0	76	0.0	71	0.0	72	0.0	75
Elosal	1.5	20.0	55	20.0	56	30.0	48	20.0	55
	2.5	10.0	69	0.0	68	10.0	66	10.0	64
	5.0	0.0	72	0.0	73	0.0	72	0.0	69
Kocide	1.5	30.0	50	30.0	46	20.0	55	10.0	60
	2.5	10.0	65	20.0	54	10.0	59	0.0	66
	5.0	0.0	76	0.0	70	0.0	73	0.0	70
Privecur N	1.5	10.0	65	20.0	55	10.0	56	10.0	63
	2.5	0.0	70	0.0	69	0.0	60	0.0	70
	5.0	0.0	74	0.0	70	0.0	65	0.0	75
Ridomil	1.5	20.0	56	10.0	60	10.0	61	10.0	63
	2.5	10.0	70	0.0	65	0.0	69	0.0	68
	5.0	0.0	75	0.0	70	0.0	70	0.0	72
Control		60.0	25	40.0	40	60.0	23	40.0	32
LSD at 5%		**12.5**	**16.4**	**10.3**	**8.33**	**10.5**	**12.7**	**9.4**	**13.6**

DI = disease index Y / T = yield per tree (Kg)

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كفاءة استخدام بعض بدائل المبيدات في مقاومة أمراض نخيل البلح

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قيمت كفاءة استخدام بعض بدائل المبيدات في مكافحة أمراض نخيل البلح وهي التفحم الكاذب للأوراق وعفن النورات والفحة السوداء وعفن قواعد الأوراق وتبقع الأوراق وتشير النتائج إلي أن استخدام بعض المستخلصات النباتية وبعض الزيوت النباتية وبعض العوامل الحيوية أعطت نفس كفاءة استخدام المبيدات في مقاومة الأمراض السابق ذكرها حيث وجد أن استخدام مستخلص أوراق أشجار النيم وكذلك مستخلص أوراق الكافور ومستخلص فصوص الثوم ومستخلص أوراق الياسمين الزفر منعت حدوث الإصابة بالأمراض السابق ذكرها عند تركيز ١٠٠ جزء في المليون ووجد أن زيت حبة البركة والجرجير كانت أكثر فاعلية في مقاومة نفس الأمراض عند نفس التركيز ووجد أن استخدام فطر التريكو درما هرزيانم وفطر التريكو درما فيردي وبكتريا الباسلس سابتلس عزله رقم (١) حيث استخدمت كعوامل حيوية كانت أكثر فعالية في مقاومة الأمراض المذكورة .

وتشير النتائج أيضا إلي أن استخدام مبيد الدياثين م ٤٥ كان أكثر فعالية في مقاومة الأمراض المدروسة عند تركيز ١,٥جرام مبيد / لتر ماء فيما عدا مرض اللفحة السوداء فكان مبيد الداكونيل أكثر فاعلية في مقاومته عند نفس التركيز .