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ROOT-ROT AND WILT OF THREE CUT-FLOWER PLANTS IN EGYPT: 2- SAPROPHYTIC BEHAVIOUR OF THE CAUSAL PATHOGENS AND THE POSSIBILITY OF CHEMICAL AND BIOLOGICAL CONTROL.

BY

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ABSTRACT

Competitive saprophytic ability (CSA) for pathogenic fungi of carnation, gerbera and marigold was studied using Cambridge methods. *R. solani* (carnation), *F. oxysporum* (gerbera) and *F. moniliforme* and *F. oxysporum* (marigold) have high efficiency of CSA. Therefore, they were considered as vigorous competitive saprophytes. Furthermore, the same fungi of carnation and gerbera have also high degrees of tolerance to antibiotics produced by soil microorganisms and spore-forming bacteria. In contrast, *F. oxysporum* f.sp. *dianthi* (carnation), *Phytophthora* sp. (gerbera) and *Phytophthora* sp. (marigold) have low degrees of CSA and tolerance to antibiotics of soil microorganisms.

Vitavax/Thiram was found to be an effective fungicide against *F. oxysporum* f.sp. *dianthi* and *R. solani*; the pathogenic fungi of carnation, followed by Topsin-M and Rizolex-T, respectively. However, cuttings were dipped in each fungicide suspension (500 ppm) for 15 minutes, directly before planting in infested soil. On the other hand, Topsin-M followed by Vitavax/Thiram as seed treatment (3g/kg seed) gave enough control to damping-off infection on marigold, under greenhouse conditions, where soil was infested with *F. oxysporum* or *F. moniliforme*. While, Vitavax/Thiram was superior in controlling the disease in field, followed by Monceren-Combi.

To determine efficacy of biological control against diseases of carnation and marigold, Plant Guard (*Trichoderma harzianum*, $30x10^6$ cfu/ml) and Rhizo-N (*Bacillus subtilis*, $30x10^6$ cfu/g) were used. Marigold seeds were dipped in Plant Guard (4 ml/L water) for 12 hours before planting, while Rhizo-N was used as seed dresser (4 g/kg seeds). The same rates of each biocide were used as soil drench in case of carnation. Results of these experiments indicated that they were effective treatments in decreasing the diseases incidence. Plant Guard was superior than Rhizo-N with the diseases of marigold.

INTRODUCTION

The annual summer herbaceous marigolds (*Tagetes* spp.) and both perennial carnation (*Dianthus caryophyllus* L.) and gerbera (*Gerbera jamesonii* Bolus) are among the important cut-flower ornamental plants in Egypt. Increase in local consumption has occurred during the last decade.

Cut-flower plants allover the worlds are severely infected with many diseases causing considerable losses in plant growth as well as yield quantity and quality. However, root-rot, wilt and/or damping-off were recently reported in Egypt on gerbera and marigolds (Eisa *et al.*, 2000), causing economic losses. Also, root-rot and wilt were considered one of the most important diseases on carnation (Hilal *et al.*, 1994b and Eisa *et al.*, 2000).

Soil-borne pathogenic fungi are always surrounded in the soil with several microorganisms. That often affects its pathogenic potentialities on each one of the three studied cut-flower plants. However, such competitive pathogenic ability was dependent upon interacting combinations and host variety (Sabet and Khan, 1969). Furthermore, the competitive saprophytic colonization was reduced by increasing the organic matter and hence the microbial population of the soil (Dhingra *et al.*, 1976).

Fungicidal seed, soil and cutting treatments were recommended as good control means against soil-borne diseases attacking carnation (Baker, 1980; Meeta & Nisha, 1991 and Wojdyla, 1994). Also, biological control was found to be an attractive alternative strategy for the control of soil-borne diseases as well as, it was useful in reducing harmful side effect of pesticides on environment (Cook & Baker, 1983). It is carried out by applying bioagents, or its metabolic products (Subba-Rao, 1988). Treating soil, cuttings and/or carnation plants with fungal and/or bacterial bioagents has controlled successfully its pathogenic soil-borne fungi (Rapett & Garibaldi, 1986; Bankina, 1992; Rattink, 1992 and Orlikowski, 1995). In Egypt, there are no studies concerning saprophytic behaviour for pathogenic fungi of gerbera and marigolds. Also, a few investigations were carried out to investigate and control wilt, root rot and stem rot diseases of carnations (Abo-El-Ela, 1992 and Hilal *et al.*, 1994b). While, no studies concerning gerbera and marigold diseases control. Therefore, the present work was planned to investigate the saprophytic behaviours, fungicidal seed and soil treatments as well as biological control applications against root-rot and wilt fungal diseases of carnation, gerbera and marigold.

MATERIALS AND METHODS

1. Saprophytic behaviour:

A. Competitive saprophytic ability (CSA):

The competitive saprophytic abilities of *F. oxysporum* f.sp. *dianthi* and *R. solani* (carnation), *F. oxysporum* and *Phytophthora* sp. (gerberas) as well as *F moniliforme*, *F. oxysporum* and *Phytophthora* sp. were determined applying the agar plate modification of Cambridge method according to Rao (1959) and

Wastie (1961). These fungal pathogens were, however, previously isolated, purified and identified by the authors of this investigation (Eisa *et al.*, 2000).

Each PDA plate was immediately inoculated into the center of the plate with 5 mm. discs cut out from solidified water agar medium previously impregnated with mixture of inoculum of unsterilized Giza and Qalubyia soil, as well as either of the tested fungi at the rates of 100, 90, 75, 50, 25, 10 and 0 (w/w) (group "A"), and after 24 hours from incubation at 30°C (group "B"). Four replicates were used for each particular treatment and incubated at 30°C. Percentages of the total area occupied with fungi were determined when any plates, which inoculated with discs of 100% fungal inoculum (free from unsterilized soil) was completely covered with the growing colonies.

B-Tolerance to antibiotics

a- The cellophane sheet method:

According to Wastie (1961), the fungal inocula were placed on soil inoculated PDA plates over sterile cellophane sheets. Discs of the tested fungi were transferred either immediately over the cellophane sheets above the site of soil-inoculum (group A), or after the soil-inoculated plates were incubated for 24 hrs. (group B). Reduction in their diameters comparing with those developed in control plates was recorded when the growing colonies in any of the control plates (without soil-inoculum), for each tested fungus, has covered the whole plate.

b. Sensitivity to spore-forming bacteria or actinomycetes:

PDA plates were streaked with soil suspension previously heated at 80°C for 10 min., then cooled at once. Streaked plates were inoculated either immediately (group "A") or after 24 hrs. of inocubation at 30°C (group "B") with two discs of fungal growth for each plate, placed on the opposite sides of streaks at standard distance (25 mm). The experiment was terminated when the growth of two colonies in the control plates for each fungus (streaked with a loop of sterile water) covered the whole plate. Measurements of inhibition zone were determined at three positions and then averaged.

2. Chemical control:

A. Carnation:

Basal stem parts of freshly prepared healthy-looking cuttings were separately dipped for 15 min. in suspensions of Rizolex-T[(1)], Topsin-M[(2)] and Vitavax/Thiram[(3)] at the rate of 500 ppm, then transplanted in autoclaved soil infested with the tested fungi at the rate of 1% w/w. Cuttings dipped in water only were served as control treatment.

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(1) 20% tolclofos methyl (0,2,6-dichloro-4-methyl-phenyl 0,0-dimethyl phosphorothioate + 30% thiram, Tolclofos methyl + thiram, Sumotomo-Japan.

(2) Dimethyl (1,2-phenylene) bis-(iminocarbonothyioyl) bis (carbamate) also know as 4, 4-0-phenylene bis (3-thioallophanate), Thiophanate-methyl, Sumotomo-Japan.

(3) 37.5% carboxin (5,6-dihydro-2-methyl-1,4-oxathion-3-carboxanilide, DNOC), and 37.5% captan.

Three treated or not treated cuttings (control one) were planted in infested soil, for each pot (25 cm. diam.) and four replicates were, however, used for each particular treatment. Percentages of infection were determined 60 days after planting.

B. Marigold:

(a) Under greenhouse conditions:

Monceren-Combi[1], Ridomil-MZ[2], Topsin-M and Vitavax/Thiram were used as seed dressing fungicides to control root and/or stem rots as well as wilt disease of marigold seedlings under greenhouse conditions. Each fungicide was thoroughly mixed with seeds at the rate of 3 g/kg seeds, in a plastic bag using arabic gum solution (5%) and shaked to ensure the complete coverage of seeds. Treated seeds were allowed to dry for three hours before planting. Pots (25 cm diam.) were separately filled with autoclaved soil infested with the tested fungi at the rate of 1% w/w. Each pot was planted with 10 treated seeds and four replicates were used for each particular treatment. For control treatment, seeds free from fungicides were planted in four pots infested with either of the tested fungi. Growing plants were periodically examined and disease incidence was determined as pre- and post- emergence damping-off as well as the survived plants, 25, and 60 days from planting, respectively.

(b) Under Field conditions:

The same fungicides applied as seed dressing in greenhouse experiment were also used through out field trials at Tahanoub, Qalubyia governorate, during two successive seasons, 1995 and 1996. The field soil was continuously planting with marigold (*Tagetes erecta*) during the last three years. Treatments of the field trials were arranged in a complete randomized block design with four replicates. The experimental unit area was 16 m^2 (4 x 4 m) with 5 rows. One hundred holes (20 cm apart) for each replicate (20 holes/row) were planted with fungicide treated seeds (10 seeds/hole) or not treated ones (control). Sowing seeds was carried out on 15th April and data were recorded as percentages of infection, 60 days after planting.

3. Biological control:

Two commercial biocide products, *i.e.* Plant Guard (*Trichoderma harzianum*; $30x10^6$ cfu/ml) and Rhizo-N (*Bacillus subtilis*; $30x10^6$ cfu/g), produced by El-Nasr Co. for fertilizers and biocides, Egypt, were used to evaluate their efficiency in controlling root rot and/or stem rot as well as wilt diseases of marigold and carnation under greenhouse conditions. Marigold seeds were dipped in Plant Guard (4 ml/L water) for 12 hours before planting, while Rhizo-N was

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(1) 20% pencycuron [n-(4-chlorophenyl)-methyl-N-cyclophenyl)-N-phenylurea), 50% Captan (N-trichloromethylthio)-4-cyclo-hexan-1,2-dicarboximide, Pencycuron, Bayer-Germany.

(2) Combination of metalaxyl, (10% a.i.) plus mancozeb (48% a.i.), N-(3,5-dichlorophenyl)-1, 2-dimethylcyclopropane-1,2-dicarboximide,

used as seed dresser (4 g/kg seeds) with Arabic gum as sticker directly before planting. On the other hand, these biocides were used as soil drench treatments at the same rates as their suspensions were added into pots infested with the tested fungi just before planting carnation cuttings.

Diseases incidence on marigold as pre- and post-emergence damping-off (25 and 60 days, respectively) as well as percentage of infection on carnation cuttings (60 days) after planting were recorded.

RESULTS AND DISCUSSION

1- Saprophytic behavior:

A- Competitive saprophytic ability (CSA):

Data presented in Table (1) show the results of using the agar plate technique modification of Cambridge method (Roa, 1959). The colonization ratings for the tested carnation, gerbera and marigold fungi gradually increased by increasing the amount of inoculated fungus in inoculum-soil disc. Whereas, it decreased when the inoculum soil mixtures were allowed to interact for 24 hrs. before discs were taken. *R. solani* isolated from carnation plants showed high degrees of competitive saprophytic ability (CSA), since it was able to colonize the inoculum-soil discs at all concentrations (10-90%, w/w). Therefore, it was considered as a vigorous competitive saprophyte. In contrast, *F. oxysporum* f.sp. *dianthi* had lower degrees of CSA, therefore, it was described as a weak competitive saprophyte. On the other hand, gerbera pathogenic fungi, *i.e. F. oxysporum* and *Phytophthora* sp. showed different degrees of CSA. However, *F. oxysporum* showed higher degree of CSA, since it was able to colonize the inoculum-soil discs at all concentrations (10-90% w/w), therefore, it was considered as a vigorous competitive saprophyte. On the contrary, *Phytopthora* sp. had lower degree of CSA, therefore, it was described as a weak competitive saprophyte. On the other hand, marigold fungi show that *Phytophthora* sp. had a low degree of CSA, since it was able to colonize the inoculum-soil discs only at high concentrations (50-90% w/w), while *F. moniliforme* had a higher degree and *F. oxysporum* was moderate in this respect. Therefore, *Phytophthora* sp. and *F. oxysporum* were weak and vigorous competitive saprophytes, respectively.

The obtained results on CSA were supported by findings of Garrett (1963), who suggested that fast spore germination, fast growth, ability to produce many enzymes, antibiotics and tolerance to antibiotics produced by other microorganisms are factors likely to make an organism active competitive saprophyte. Positive correlation between level of the fungal inoculum in soil discs and colonization ratings was similar to those reported by Sabet and Khan (1969a), El-Khadem *et al.* (1987), Sallam *et al.* (1993) and Helmy (1998). Moreover, Roa (1959) and Wastie (1961) classified *F. oxysporum* as a vigorous saprophyte and results of Sabet and Khan (1969a), Abdel-Azim *et al.* (1979) and Khalil *et al.* (1981) confirmed that it had high CSA. On the other hand, results concerning *F. moniliforme* and *Phytophthora* sp. were somewhat similar to those reported by Hilal (1985) and Abo-El-Ela (1992).

Table (1): Competitive saprophytic ability of pathogenic fungi of carnation, gerbera and marigold plants, under two treatments (A & B).

%inoculation in inoculum-soil-discs	% Colonization of inoculum-soil discs													
	Carnation				Gerbera				Marigold					
	F. oxysporum f.sp. dianthi		*R. solani*		*F. oxysporum*		*Phytophthora sp.*		*F. moniliforme*		*F. oxysporum*		*Phytophthora sp.*	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	21.18	0.0	20.00	4.71	17.51	3.52	1.87	0.0	16.5	5.1	12.9	0.0	0.0	0.0
25	29.41	10.58	32.29	18.82	35.63	7.88	5.44	2.67	30.6	10.2	21.2	7.1	0.0	0.0
50	48.23	17.65	50.59	30.59	51.32	18.38	14.39	8.53	39.6	18.0	27.0	14.1	5.1	0.0
75	75.29	29.41	80.00	47.06	78.83	23.51	21.18	16.11	79.6	31.0	36.4	18.8	8.2	3.5
90	89.41	55.29	92.94	64.71	88.13	41.85	26.58	18.34	96.5	72.9	87.1	50.6	40.0	15.3
100	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

(A) Inoculum-soil mixtures weren't allowed to interact.
(B) Inoculum-soil mixtures were allowed to interact for 24 hrs. before inoculation.

B-Tolerance to antibiotics:

Data in Table (2) show that *R. solani* was more tolerant to antibiotics than *F. oxysporum* f.sp. *dianthi*. While, the reverse reaction was found against soil bacteria, *i.e. F. oxysporum* f.sp. *dianthi* was more sensitive than *R. solani* to antibiotics produced by soil spore-forming bacteria. Besides, results of gerbera fungi against antibiotics revealed that *F. oxysporum* resulted in a lower percentage of reduction in colony diameter than *Phytophthora* sp. in both methods; Wastie's cellophane and streaked PDA plates, and in both treatments (A & B), subsequently, proved that *F. oxysporum* was more tolerant to antibiotics produced by soil microorganisms and spore forming bacteria than *Phytophthora* sp. On the other hand, *Phytophthora* sp. (marigold) recorded the lowest degree of tolerance to antibiotics of soil microorganisms and completely not affected with that of spore forming bacteria. *F. moniliforme* proved to be the most tolerant organism against antibiotics of soil microorganisms, followed by *F. oxysporum* which was found to be the least tolerant fungus against antibiotics produced by soil spore-forming bacteria. The present results are relatively near to those obtained by Sabet and Khan (1969a), Khalil *et al.* (1981), Hilal (1985) and Abo-El-Ela (1992).

Table (2): Tolerance of pathogenic fungi of carnation, gerbera and marigold plants to antibiotics produced by soil microorganisms and spore-forming bacteria.

Source of antibiotics	% reduction in colony diameter		
	Fungi	Group A*	Group B**
	Carnation fungi:		
Soil microorganisms	*F. oxysporum f.sp. dianthi*	67.48	83.00
	R. solani	55.15	78.41
Spore-forming bacteria	*F. oxysporum f.sp. dianthi*	11.57	17.00
	R. solani	3.50	5.62
	Gerbera fungi:		
Soil microorganisms	*F. oxysporum*	66.00	84.00
	Phytophthora sp.	82.00	**No growth**
Spore-forming bacteria	*F. oxysporum*	8.60	13.00
	Phytophthora sp.	18.00	22.80
	Marigold fungi:		
Soil microorganisms	*F. moniliforme*	64.50	82.40
	F. oxysporum	73.30	86.20
	Phytophthora sp.	82.70	93.80
Spore-forming bacteria	*F. moniliforme*	4.30	8.20
	F. oxysporum	6.60	10.36
	Phytophthora sp.	0.00	0.00

*** In group A:** Fungal discs were immediately placed on medium surface after streaking.

**** In group B:** Fungal discs were immediately placed on medium surface after 24 hrs of incubation at 30°C from streaking.

2- Chemical Control:

A- Carnation:

Data presented in Table (3) show that percentages of infection were significantly decreased lower than the control with all tested fungicidal treatments. Decreases ranged between 33.3% to 58.3% were recorded in case of *F. oxysporum* f.sp. *dianthi*, while they were 54.5% to 81.8% with *R. solani*. Vitavax/Thiram was the best fungicidal treatment in decreasing disease incidence with *F. oxysporum* f.sp. *dianthi* (58.3%) and *R. solani* (81.8%) followed by Topsin-M in case of *F. oxysporum* f.sp. *dianthi* (41.6%) and Rizolex-T with *R. solani* (72.7%).

Dip-treatments for cuttings in fungicides to minimize disease incidence was recommended by Abo-El-Ela (1992). Also, the obtained results were relatively realized by Jamalainen and Routsalainen (1969) and Vigodsky-Haas *et al.* (1982).

Table (3): Effect of three fungicides applied to carnation as cutting-dip treatment on disease incidence, 60 days after planting.

Fungicides	% infection with *F. oxysporum* f.sp. *dianthi*	%* decrease	% infection with *R. solani*	%* decrease
Rizolex-T	50.0	33.3	18.8	72.7
Topsin-M	43.8	41.6	31.3	54.4
Vitavax/Thiram	31.3	58.3	12.5	81.8
Control (without fungicide)	75.0	0.0	68.8	0.0
L.S.D. at 5%	13.0		21.0	

* Decrease in infection relative to control.

B. Marigold:

(a) Under greenhouse conditions:

Percentages of pre- emergence damping-off (Table, 4) were decreased than the control (without fungicide) in most cases by using each one of the tested fungicides. While, percentages of post- emergence phase were decreased by all the tested ones. Topsin-M followed by Vitavax/Thiram were the most effective fungicidal seed treatments in decreasing percentages of both pre- and post- emergence damping-off than the control in case of *F. moniliforme* and *F. oxysporum*. Whereas, Ridomil MZ followed by Vitavax/Thiram were superior in decreasing disease incidence percentages (pre- & post-emergence) and in increasing percentages of healthy survival plants than the other fungicidal seed treatments as regard to *Phytophthora* sp. In contrast, treating seeds with Topsin M was not effective as fungicidal seed treatment against Phytophthora disease.

(b) Under Field Conditions:

Applying all the experimental fungicidal seed treatments (except Ridomil MZ) on marigold seeds significantly decreased percentages of infected

plants (root rot and wilt) than the control treatment (Table, 5). Vitavax/Thiram was the best fungicide resulted in the least percentages of infection (20.0% & 12.5%) in seasons, 1995 and 1996, followed by Monceren-Combi (32.9% & 21.3%). Differences between Vitavax/Thiram and other fungicides were, however, significant. The least effective fungicide in decreasing fungal infection was Topsin-M. On the other hand, decreases in infection percentages reached (66.6% & 75.7%) and (45.1% & 58.6%) were recorded with Vitavax/Thiram and Monceren-Combi in both seasons, respectively. While, they were 9.4% & 20.6% in case of Topsin-M.

Table (4): Effect of five seed dressing fungicides on pre-, post- emergence damping-off and healthy survival of marigold plants, under greenhouse conditions.

Fungi	Fungicides	%Pre-emergence	%Post-emergence	%Healthy survival
F. moniliforme	Monceren-Combi	27.50	40.00	32.50
	Ridomil-MZ	25.00	37.50	37.50
	Topsin-M	7.50	15.00	77.50
	Vitavax/Thiram	22.50	37.50	40.00
	Control	35.00	47.50	17.50
	Mean	24.58	36.67	38.75
F. oxysporum	Monceren-Combi	7.50	45.00	47.50
	Ridomil-MZ	12.50	52.50	35.00
	Topsin-M	5.00	25.00	70.00
	Vitavax/Thiram	7.50	32.50	60.00
	Control	10.00	62.50	27.50
	Mean	8.75	45.83	45.42
Phytophthora sp.	Monceren-Combi	35.00	45.00	20.00
	Ridomil-MZ	12.50	30.00	57.50
	Topsin-M	27.50	65.00	7.50
	Vitavax/Thiram	17.50	37.50	45.00
	Control	27.50	65.00	7.50
	Mean	26.25	48.75	25.00

L.S.D. at 5% for:	Pre-emergence	Post-emergence	Survival
Fungi (A)	= 7.0	5.6	8.5
Fungicides (B)	= 7.1	7.5	8.8
(A) x (B)	= 12.3	13.1	15.3

As regard as to the results in Tables (4 and 5) success of applying fungicidal seed treatments in controlling root rot and wilt diseases was somewhat similar to those obtained on carnation (Abo-El-Ela, 1992), black-cumin (Hilal *et al.*, 1994a), and roselle (Hilal *et al.*, 1996).

Table (5): Effect of five fungicidal seed treatments on infection percentages of root rot and/or wilt diseases on marigold in naturally infested field soil at Tahanoub, Qalubyia, 1995 & 1996 seasons.

Fungicides	% infection		% decrease*	
	1995	1996	1995	1996
Monceren-Combi	32.9	21.3	45.1	58.6
Ridomil-MZ	57.4	47.9	4.2	6.8
Topsin-M	54.3	40.8	9.4	20.6
Vitavax/Thiram	20.0	12.5	66.6	75.7
Control (without fungicides)	59.9	51.4		
L.S.D. at 5%	3.4	8.3		

* Decrease in infection relative to control.

3-Biological control:

A. Carnation:

Data in Table (6) indicate that the tested biocides were effective in controlling *F. oxysporum* f.sp. *dianthi* resulting in a significant decrease regarding infected plants compared with the control treatment. These results are supported with those previously mentioned on carnation by Filippi *et al.* (1987), who reported that *F. oxysporum* f.sp. *dianthi* was found to be highly sensitive to be inhibited by *Basillus subtilis*. Also, infesting soil with *Trichoderma* spp. controlled *F. oxysporum* f.sp. *dianthi* during the first three months of seedling growth (Rumine, 1989). However, Plant Guard was significantly more effective than Rhizo-N. Besides, the tested biocides could significantly control *R. solani* on carnation plants. However, Rhizo-N was superior against that fungus than Plant Guard. In this respect, Bankina (1992), Krebs *et al.* (1993) and Mighel *et al.* (1993) reported that *Trichoderma* spp. and *B. subtilis* were effective as antagonistic microorganisms against carnation soil-borne diseases.

Table (6): Effect of two biocides, applied as cutting- dip treatment on disease incidence, 60 days after planting.

Biocides	% infection by *F. oxysporum* f.sp. *dianthi*	%* decrease	%infection by *R. solani*	%* decrease
Plant Guard	25.0	66.7	50.0	27.3
Rhizo-N	43.8	41.6	25.0	63.7
Control (without bioside)	75.0	0.0	68.8	--
L.S.D. at 5%	13.0		24.0	--

* Decrease in infection relative to control.

B. Marigold:

Plant Guard and Rhizo-N effectively decreased percentages of damping-off and increased plant survivals (Table, 7). Percentages of pre- emergence-

Table (7): Effect of two biocides as seed dressers on damping-off diseases of marigold.

Fungi	%pre-emergence				%post-emergence				% survival				**% increases	
	Plant Guard	Rhizo-N	*Control	Mean	Plant Guard	Rhizo-N	*Control	Mean	Plant Guard	Rhizo-N	*Control	Mean	Plant Guard	Rhizo-N
F. moniliforme	22.5	20.0	35.0	25.8	30.0	35.0	47.5	37.5	47.5	45.0	17.5	36.7	171.4	157.1
F. oxysporum	5.0	7.5	10.0	7.5	32.5	42.5	65.5	46.8	62.2	50.0	27.5	46.6	126.2	81.8
Phytophthora sp.	22.5	27.5	27.5	25.8	17.5	25.0	65.0	35.8	60.0	47.5	7.5	38.4	700.0	533.3
Mean	16.7	18.3	24.2	19.7	26.7	34.2	59.3	40.0	56.6	47.5	17.5	40.7	332.5	257.4

* Without biocide.

** Increase in healthy survival relative to control.

L.S.D. at 5% for:		Pre-emergence	Post-emergence	Survivals
Fungi (F)	=	6.0	4.0	5.1
Treatments (T)	=	N.S.	2.2	8.2
(F) x (T)	=	N.S.	7.3	N.S.

damping-off decreased by using Plant Guard than the control. Decrease in disease incidence in case of *F. moniliforme* was higher than those obtained with the other fungi. Also, Rhizo-N decreased pre- emergence damping-off incidence than the control, except in case of *Phytophthora* sp. On the other hand, Plant Guard and Rhizo-N has significantly affected post-emergence-damping-off more than pre-emergence-damping-off. Decreases from 47.5% - 65.5% to 17.5% - 42.5% were recorded. However, Plant Guard was better than Rhizo-N with all the tested fungi. Differences between Plant Guard and Rhizo-N were significant in most cases.

In this respect, Hilal and Helmy (1998) reported that treating turfgrasses seeds with Plant Guard and Rhizo-N was found to be an effective mean in controlling the crown and root-rot diseases caused mainly with soil-borne fungi including *Fusarium* spp. and R. *solani*.

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أعفان الجذور والذبول لثلاثة من نباتات أزهار القطف في مصر:
٢- السلوك الترممي للفطريات الممرضة وإمكانية المقاومة الكيمائية والبيولوجية لأمراضها.

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تـم دراسـة القـدرة التنافسية على ترمـم الفطريات الممرضة لنباتات القرنفل ، الجربيرا ، والقطيفة باتباع طرق جامعة كامبردج.

وقـد أظهرت النتائج القدرة العالية على التنافس الترممي لفطريات نباتات القرنفل *Rhizoctonia solani* ، الجربيرا : *Fusarium oxysporum* و القطيفـة *F. moniliforme* & *F. oxysporum*. ولذلـك تعتـبر هذه الفطريات ذات قدرة عالية على التنافس الترممي. كما وجـد أن نفـس هذه الفطريات ذات قدرة عالية على تحمل المضادات الحيوية التي تنتجها الكائـنات الحية الدقيقة والبكتيريا المكونة للجراثيم في التربة. وعلى العكس مما سبق وجد

أن فطريات *F. oxysporum* الذي يصيب القرنفل ، *Phytophthora* sp. الذي يصيب الجربيرا والقطيفة ذات قدرة منخفضة على التنافس الترممي وتحمل المضادات الحيوية للكائنات الحية الدقيقة في التربة.

وجد أن الفيتافاكس/ثيرام يعتبر وسيلة فعالة لمقاومة الفطريات الممرضة لنباتات القرنفل وهي *F. oxysporum* ، *R. solani* يليه التوبسين-م وريزولكس تي في مقاومة هذين الفطرين على الترتيب. وذلك عند غمر العقل في معلق المبيد بتركيز ٥٠٠جزء في المليون لمدة ١٥ دقيقة قبل الزراعة مباشرة في التربة الملوثة. ومن ناحية أخرى أعطى التوبسين-م يليه الفيتافاكس/ثيرام عند استخدامها لمعاملة البذور بمعدل ٣جم/كجم بذرة مقاومة كافية لمرض موت البادرات على القطيفة عند الزراعة في تربة ملوثة بالفطريات *F. oxysporum* أو *F. moniliforme* ، بينما تفوق فيتافاكس/ثيرام في مقاومة الأمراض تحت الدراسة في تجارب الحقل يليه المونسرين كومبي.

ولتقدير فعالية المقاومة البيولوجية في مقاومة أمراض القرنفل والقطيفة تم استخدام البلانت-جارد ، والريزو (ن) حيث تم غمر بذور القطيفة قبل الزراعة في البلانت جارد بمعدل ٤مل/لتر ماء ولمدة ١٢ ساعة ، في حين تم معاملة البذور بالريزو (ن) بمعدل ٤جم/كجم بذرة (قبل الزراعة مباشرة) ، كما تم ري الأصص المنزرعة بعقل القرنفل بالبلانت جارد (٤مل/لتر ماء) والريزو (ن) (٤جم/لتر ماء). ولقد أظهرت نتائج المقاومة بالمعاملات السابقة خفضا في نسب الإصابة بالأمراض وكان البلانت جارد أفضل من الريزو (ن) في حالة القطيفة فقط.