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ROOT-ROT AND WILT OF THREE CUT-FLOWER PLANTS IN EGYPT:
1- Distribution, causal fungi, pathogenicity and disease symptoms.

BY

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ABSTRACT

Inspection of ornamental cut-flower plantation in Cairo, Giza and Qalubyia governorates revealed a considerable occurrence of root-rot, wilt and/or damping-off infection in carnation (*Dianthus caryophyllus*), gerbera (*G. jamesonii*) and marigold (*Tagetes* spp.). Infection was found to be gradually increased year by year. Based on symptomatology, morphological and cultural characteristics, the fungal agents of these diseases were identified. *Fusarium* spp., *Rhizoctonia solani* & *Pythium* sp. (carnation), as well as *Fusarium* spp. & *Phytophthora* sp. (gerbera and marigolds) were the highest frequent fungi in isolation trials. *Fusarium* isolates of carnation and gerbera were identified as: *F. equiseti, F. oxysporum* (or f.sp. *dianthi*), *F. semitectum* & *F. solani*, while those of marigolds were: *F. moniliforme, F. oxysporum* & *F. solani*. According to the available literature, the recorded diseases of gerbera and marigolds and their fungal pathogens are reported for the first time in Egypt.

In infested soil, pathogenicity tests indicated that *F. oxysporum* f.sp. *dianthi* & *R. solani* (carnation), *Phytophthora* sp. & *F. oxysporum* (gerbera) and *Phytophthora* sp., *F. moniliforme* & *F. oxysporum* (marigold) were the most aggressive fungi. Whereas, *F. solani* & *Pythium* sp. (carnation), *F. semitectum* & *F. solani* (gerbera) and *Sclerotinia sclerotiorum* (marigold) were less aggressive. On the other hand, distinct disease symptoms for several pathogenic fungi were fully described. *F. oxysporum* (or f.sp. *dianthi*) showed, however, a characteristic features of wilt symptoms on the infected plants characterized with dark brown discoloration on vascular system and often accompanied with reduction in root system formation. Also, the infection by fungi causing root and/or collar rots were usually associated with yellowing, browning or dryness on leaves.

INTRODUCTION

Carnation (*Dianthus caryophyllus* L.), gerbera (*Gerbera jamesonii* Bolus) and marigold (*Tagetes* spp.) are considered one of the important cut-

flower ornamental plants in Egypt. Root-rot and wilt diseases of gerbera and marigolds were not previously studied in Egypt, while few attempts were only done on those of carnation.

Cut-flower plants allover the world are heavily attacked by certain fungal diseases causing considerable losses in plant growth as well as yield quantity and quality. *Fusarium* wilt (*F. oxysporum* f. sp. *dianthi*), basal stem and root rot (*Fusarium* spp., *Pythium* spp., *Phytophthora* spp. and *Rhizoctonia solani*) are among the major disease problems of carnations (Pirone, 1978 and Chase *et al.*, 1995). Whereas, several soil-borne fungi were also found to be the causal pathogens to gerbera, such as *Fusarium* spp., *Phytophthora* spp., *Pythium* spp., *Rhizoctonia solani* and *Sclerotinia sclerotiorum* (Orlikowski, 1977; Kaewruang *et al.*, 1987 and Chase *et al.*, 1995). On the other hand, marigold plants suffered from infection by Fusarium wilt caused by *F. oxysporum* f. sp. *callistephi* (Olsen, 1965 and Lim, 1969), damping-off incited by several soil-borne fungi (Jones, 1991), stem and root rots caused by *Fusarium* spp., *Phytophthora cryptogea*, *Pythium* spp., *S. sclerotiorum* and *Sclerotium rolfsii* (Pirone, 1978; Khattab and Wasfi, 1989) and charcoal rot caused by *Macrophomina phaseolina* (Pirone, 1978 and Saxena and Singh, 1991).

In Egypt, a few attempts were carried out to investigate soil-borne diseases of carnations (El-Allaf, 1979; Abo-El-Ela, 1992 and Hilal *et al.*, 1994). Therefore, the present investigation was planned to study root-rot and wilt of carnation and gerbera and damping-off disease of marigold causal pathogens and their pathogenic capabilities as well as description of disease symptoms.

MATERIALS AND METHODS

1- Survey and disease assessment:

Percentage of naturally infected carnation, gerbera and marigold plants showing typical symptoms of root-rot and/or wilt diseases were recorded successively during four years (1994-1997). Plant were, however, considered as diseased ones, when they showed one or more of stunting, yellowing, dryness, wilt and rot symptoms.

Inspection of outdoor plantations, nurseries and greenhouses was carried out twice monthly during the growing season. Data were recorded as mean percentage of infected plants in the inspected plantations.

2- Isolation, purification and identification of the causal organisms:

Samples of the diseased seedlings of carnation, gerbera and marigold showing root-rot, stem-rot and wilt symptoms were obtained in two successive seasons.

Surface sterilized diseased tissues using 5.0% sodium hypochlorite were placed onto PDA plates, then incubated at 27°C for 7 days. Frequency of the developed fungal colonies were recorded after microscopic examination as follows:

$$*\%\ \text{frequency} = \frac{\text{No. of the colonies per each fungus}}{\text{Total No. of colonies for all fungi}} \times 100$$

Also, they were purified using hyphal-tip or single spore techniques.

Identification of the isolated fungi was achieved according to Barnett (1960), Booth (1971), Domsch *et al.*, (1980) and Plaats-Niterink (1981). Identification was also confirmed by the Department of Mycology and Plant Disease Survey, Plant Pathology Research Institute, ARC, Giza, Egypt.

3- Pathogenicity of the isolated fungi:

Pathogenicity tests were carried out using the most frequently isolated fungi from carnation (*Fusarium equiseti*, *F. oxysporum* f.sp. *dianthi*, *F. solani*, *Macrophomina phaseolina*, *Pythium* sp. and *Rhizoctonia solani*) and those isolated from gerbera (*F. equiseti*, *F. oxysporum*, *F. semitectum*, *F. solani and Rhizoctonia solani*) as well as fungi isolated from marigolds (*F. moniliforme*, *F. oxysporum*, *F. solani*, *M. phaseolina*, *Phytophthora* sp. and *Sclerotinia sclerotiorum*).

Inocula of the tested fungi were prepared by growing it separately in 500 ml glass bottles containing autoclaved corn meal-sand medium according to Whithead (1957). Formalin-sterilized pots (20 cm. diam.) filled with formalin-sterilized loamy-sand soil after getting of formalin residues at the rate of 3 kg were used soil/pot.

Soil infestation was achieved by mixing inoculum of each fungus with the upper layer of the soil at the rate of 1% (w/w), 7 days before planting. The infested soil was then watered to stimulate fungal growth and regularly mixed to ensure its homogeneous distribution of the tested fungi. Control treatments were prepared using the same amount of uninoculated sterile cornmeal-sand medium.

Apparently healthy seeds of marigold (*Tagetes erecta*), cuttings of carnation (*Dianthus caryophyllus*) and seedlings of gerbera (*G. jamesonii*) were planted at the rate of 10 seeds, 3 cuttings and 3 seedlings per each pot, respectively. Four replicates were used for each particular treatment.

The percentages of pre- and post- emergence damping-off for marigold and the percentages of infected cuttings and seedlings for carnation and gerbera as well as healthy survived plants for the three plant species were counted after 25 and 60 days from planting, respectively. Disease symptoms were also described.

RESULTS AND DISCUSSION

1- Survey and disease assessment:

A- Carnation:

The percentages of naturally infected plants were recorded in the growing plantations in Qalubyia and Giza governorates in nurseries and

greenhouses. In the examined cultivations, wilt symptoms often developed on plants associated with symptoms of root-rot and/or basal stem rots. This was expressed in terms of percentage of infected carnation plants, either in nurseries (up to 50 days old) or on cuttings grown in greenhouses (up to 2 months old). In this respect rot and wilt diseases of carnation are among the most widely distributed diseases under Egyptian conditions (El-Allaf, 1979 & Hilal *et al.*, 1994) and allover the world (Horst, 1990 and Chase *et al.*, 1995).

As shown from data in Table (1) the percentage of natural infection differed in nurseries and greenhouses in the two surveyed governorates according to the age of examined plants. Cuttings grown in nurseries (50 days old) showed 22.7% and 18.7% infection in Giza and Qalubyia governorates, respectively. In this respect, El-Allaf (1979) reported serious infection with stem rot and wilt diseases on carnation at Alexandria governorate. Also, Hilal *et al.*, (1994) recorded high percentage of infection with soil-borne diseases on carnation in five Egyptian governorates during 1992 and 1993. As regards plants developed from cuttings grown in greenhouses, data confirm the same trend for the two examined governorates. Also, there was a clear positive correlation between the percentages of natural infection and the age of plants as it increased with plant age.

Table (1): Mean percentage of naturally infected carnation by root rot and wilt in Giza and Qalubyia governorates during two successive seasons, 1995/1996 and 1996/1997.

Governorates	% Naturally infected carnation in:		
	Nurseries	Greenhouses	
	Seedlings up to 50 days old	Months after transplanting	
		2 months	4 months
Giza	22.7*	34.8*	40.5*
Qalubyia	18.7*	30.3*	36.5*
Mean	20.7	32.6	38.5

* Mean of the two surveyed seasons; 1995/96 & 1996/97.

B. Gerbera and Marigold:

Disease survey was carried out in different plantations (protected and non protected plants) to collect gerbera plants showing root rot, wilt and/or crown rot symptoms. Percentages of infected plants were recorded in three governorates, *i.e.* Cairo, Giza and Qalubyia through four successive seasons (1994 - 1997).

Regarding gerbera, data presented in Table (2) showed that percentages of infection during the four successive seasons ranged between 6.9% - 26.5%. However, the highest ones were recorded in Giza governorate (11.4%- 26.5%) followed by Qalubyia governorate (8.8% - 17.8%). Mean of infection percentages has gradually increased year after year through 1994, 1995, 1996 and 1997 seasons, respectively. This may be due to planting in the same areas for several successive years without effective control means.

Naturally infected marigold plants were usually showing symptoms of withering, discoloration or yellowing of leaves and/or stems as well as stunting and rotting of stems and/or roots. Wilt symptoms were frequently developed on growing plants associated with root and/or stem rot symptoms. Percentages of natural infection (Table, 2) ranged between 10.2 % and 41.8 % were recorded on the growing plants of the three surveyed governorates. The highest mean incidence was recorded in Qalubyia (37.4%), followed by Giza (26.6%), while the least was found in Cairo (17.1%).

In this respect, gerbera and marigold cut-flower plants are subjected to infection with several serious diseases affecting vegetative growth, plant stand and flowers yield and quality (Forsberg, 1975, Pirone, 1978, Keim and Humphrey, 1987, Horst, 1990, Daughtrey and Chase, 1992 and Chase *et al.*, 1995).

According to the available literature no attempts were made under Egyptian conditions to carry out surveying studies on the diseases of gerbera or marigold. Also, disease incidence was found to be increasing gradually year after year. This might be due to the continuous planting these cut-flower plants in the same areas for a long period, in addition to the weakness of the used sanitary methods and insufficient control disease programmes.

Table (2): Mean percentages of naturally infected gerbera and marigold plants in three governorates, through 1994 to 1997 seasons.

Governorates	Host plant	% infection at season of:				Mean
		1994	1995	1996	1997	
Cairo	Gerbera*	6.9	7.7	12.7	14.3	10.4
	Marigold**	10.2	17.6	23.5	--	17.1
Giza	Gerbera*	11.4	18.9	19.3	26.5	19.0
	Marigold**	21.1	28.0	30.7	--	26.6
Qalubyia	Gerbera*	8.8	10.0	13.6	17.8	12.6
	Marigold**	33.4	36.9	41.8	--	37.4

(--) Not investigated

* Gerbera plants grown under plastic greenhouse conditions.

** Marigold of bedding and field plants

2- Isolation and identification of the causal organisms:

A. Carnation:

Isolated fungi from roots and basal stem parts of diseased plants are shown in (Table, 3). Fungi associated with roots of wilted and rotted carnation plants (2 months old) were: *Fusarium* spp., *Rhizoctonia* sp. and *Pythium* sp. followed by *Botryodiplodia* sp. and *Helminthosporium* sp. As for fungi associated with rotted stem bases, *Rhizoctonia* sp., *Fusaium* spp., *Pythium* sp. and *Botryodiplodia* sp. were the most common fungi, while *Alternaria* spp. and *Helminthosporium* sp. were the least ones in this respect. *Macrophomina* sp. was not detected in roots or stem base fragments. On the other hand, *Fusarium* spp., *Rhizoctonia* sp. and *Pythium* sp. resulted more frequent in infected roots and

basal-stem rots of 4 months-old plants than the other isolated fungi. However, none of these recorded fungi was isolated singly from infected tissues of roots and stem bases in all isolation trials.

The isolated fungi were identified as *Fusarium equiseti, F. oxysporum* f.sp. *dianthi, F. semitectum, F. solani, Macrophomina phaseolina, Rhizoctonia solani, Alternaria* spp., *Botryodiplodia* sp., *Helminthosporium* sp. and *Pythium* sp.

In Egypt, Hilal *et al.* (1994), recorded high occurrence of *Fusarium* spp., *R. solani*, and *Pythium* sp. in the isolation trials from infected plants similar to our findings. Also, El-Allaf (1979) in Alexandria governorate isolated some soil-borne fungi including *Fusarium* spp. and *R. solani* from rotted and wilted plants. On the other hand, all the isolated fungi in Egypt were recorded in other countries as fungal pathogens of rot and wilt diseases of carnation (Pirone, 1978; Daughtrey and Chase, 1992 and Chase *et al.*, 1995).

Table (3): Frequency of the isolated fungi associated with diseased carnation plants.

Fungi	% Frequency of fungi isolated from plants of :			
	2-months-old		4-months-old	
	Roots	Stem bases	Roots	Stem bases
Alternaria spp.	5.2	5.2	2.5	3.3
Botryodiplodia sp.	13.3	16.7	11.4	13.3
Fusarium spp.	30.0	24.7	32.7	34.7
Hemlinthosporium sp.	8.5	6.0	3.4	3.4
Macrophomina sp.	--	--	10.0	1.3
Pythium sp.	16.5	19.3	18.7	20.0
Rhizoctonia sp.	26.5	22.1	21.3	24.0
Total No. of trials	50	50	50	50

B. Gerbera:

Three fungal genera were isolated from infected roots and crowns of diseased plants (Table, 4). They were *Fusarium* spp. (70.8%), *Phytophthora* sp. (21.3%) and *Rhizoctonia* sp. in roots. *Phytophthora* sp. (60.0%) was more common in sterns, whereas, *Rhizoctonia* sp. was more higher (26.4%) in roots. None of these recorded fungi was isolated singly from infected tissues of the roots and the crowns. They were, however, identified as *Fusarium equiseti, F. oxysporum, F. semitectum, F. solani, Phytophthora* sp. and *Rhizoctonia solani*.

According to the available literature, these fungal pathogens were recorded for the first time under Egyptian conditions. Whereas, they were isolated from gerbera plants in several other countries. *Fusarium oxysporum* was isolated from rotted roots and wilted plants (Orlikowski, 1977 and Kaewruang *et al.*, 1987 & 1988). Also, *Phytophthora* sp. was also reported by Orlikowski (1977), Pirone (1978), Gerlach and Kummer (1985), Kaewruang *et al.*, (1988) and Kimishima and Goto (1993) from root and crown rots as well as wilted plants. Whereas, *F.*

equiseti and *R. solani* were isolated from root rotted gerbera plants by Orlikowski (1977) and Kaewruang *et al.* (1987).

Table (4): Frequency of the isolated fungi associated with diseased gerbera plants.

Fungi	%Frequency of fungi isolated from:	
	Roots	Stems
Fusarium spp.	70.8	13.0
Phytophthora sp.	21.3	60.6
Rhizoctonia sp.	7.9	26.4
Total No. of trials	100.0	100.0

C. Marigold:

The isolated fungi from rotted roots and wilted marigold plants are shown in Table (5). *Phytophthora* sp. and *Fusariurn* spp. resulted in more frequently occurrence from infected parts of root and basal sterns than the other isolated fungi. However, percentages of occurrence were (37.2% and 46.2%) and (36.0% and 23.0%) on roots and basal stems, respectively. On the other hand, *Alternaria* spp., *Macrophomina* sp. and *Sclerotinia* sp. was less frequent.

The isolated fungi were, however, identified to five species and five genera of fungi as *Fusarium moniliforme*, *F. oxysporum*, *F. solani*, *Macrophomina phaseolina*, *Sclerotinia sclerotiorum*, *Alternaria* spp. and *Phytophthora* sp.

According to the available literature these diseases and their causal pathogens were recorded for the first time in Egypt. On the other hand, Olsen (1965), Lim (1969) and Naraynappa and Sohi (1985) recorded *F. oxysporum* as a causal of wilt disease on marigold. while. *M. phaseolina* and *Phytophthora* sp. were recorded by Jones (1991) and Saxena and Singh (1991) as the causal of rot and damping-off of marigold.

Table (5): Frequency of the isolated fungi associated with diseased marigold plants.

Tested fungi	%Frequency of fungi isolated from:	
	Roots	Stems
Alternaria spp.	12.7	11.0
Macrophomina sp.	12.1	14.6
Fusarium spp.	36.0	23.0
Phytophthora sp.	37.2	46.2
Sclerotinia sp.	2.0	5.2
Total No. of trials	100.0	100.0

3- Pathogenicity of the isolated fungi:

A. Carnation:

Data presented in Table (6) show that the highest percentages of infected plants were achieved in soil infested with *F. oxysporum* f.sp. *dianthi* (75.0%), followed by *R. solani* (68.75%). While, *M phaseolina* ranked the second position (37.5%) followed by *F. equiseti* (31.25%) and *F. semitectum* (31.25%). In contrast, the lower infection was obtained in soil infested with *F. solani* (25.0%) and *Pythium* sp. (18.75%).

Table (6): Percentages of infected carnation plants developed from cuttings, grown for 60 days in artificially infested soil.

Fungi	% infection	% healthy survivals	Symptoms
Fusarium equiseti	31.25	68.75	Root & crown rots
F. oxysporum f.sp. *dianthi*	75.00	25.00	Wilt
F. semitectum	31.25	68.75	Root rot
F. solani	25.00	75.00	Root rot
Macrophomina phaseolina	37.50	62.50	Root rot
Pythium sp.	18.75	81.25	Root rot
Rhizoctonia solani	68.75	31.25	Root & crown rot
Control (without fungus)	0.00	100.00	
L.S.D. at 5%	5.8	---	

The obtained results in pathogenicity trials are in agreement with those reported by El-Allaf (1979), Hadar *et al.* (1982), and Hilal *et al.* (1994) who recorded these fungi as causal pathogens of rot and wilt diseases on carnation. Also, they reported that *F. oxysporum* f.sp. *dianthi* and *R. solani* were the most virulent pathogens to carnation similar to our results.

B. Gerbera:

Data presented in Table (7) indicate that all the tested fungi were found to be pathogenic to gerbera plants. *Phytophthora* sp. was the most virulent fungus, causing 75.0% infection, followed by *F. oxysporum* (66.7%), while *F. equiseti* (41.7%) and *R. solani* (41.7%) gave intermediate effect. *F. semitectum* (33.3%) and *F. solani* (25.0%) were, however, the least virulence in this respect.

These pathogenic fungi on gerbera in Egypt were previously recorded in other nations (Gerlach and Kummer, 1985, Kaewniang *et al.*, 1987 & 1988, Kimishima and Goto, 1993 and Chase *et al.*, 1995). Also, results of Kaewniang *et al.* (1987 & 1988) and Jacob and Folk (1986) on the virulence of *F. oxysporum* and *Phytophthora* sp. were similar to the present findings. According to the available literatures, these fungi were reported for the first time in Egypt as causal pathogens of rot and wilt diseases on gerbera.

C. Marigold:

Data (Table, 8) indicated that, all the tested fungi were pathogenic to marigold seedlings as they increased percentages of pre- and post-emergence

damping-off compared with the control (without fungus). Increases were, however, significant between pre-emergence phase caused by *F. moniliforme* (35.0%), *Phytophthora* sp. (27.5%) and *F. solani* (17.5%) and the control (0.0%). Whereas, increases occurred in post-emergence damping-off by each fungus was significant. The highest percentage of post-emergence damping-off was due to *Phytophthora* sp. (65.0%) followed by *F. oxysporum* (62.5%).

Table (7): Percentages of infected gerbera plants grown in infested soil, 60 days after transplanting.

Fungi	% infection	% healthy survival	Symptoms
Fusarium equiseti	41.7	58.3	Root & crown rots
F. oxysporum	66.7	33.3	Wilt
F. semitectum	33.3	66.7	Root rot
F. solani	25.0	75.0	Root rot
Phytophthora sp.	75.0	25.0	Root & crown rots
Rhizoctonia solani	41.7	58.3	Root & crown rots
Control (without fungus)	0.0	100.0	
L.S.D. at 5%	6.1	---	

Table (8): Percentages of damping-off diseases of marigold, 25, 60 and 60 days after sowing in infested soil.

Fungi	*% pre-emer-gence	**% post-emer-gence	**% healthy survi-vals	***% decrease	Symptoms
Fusarium moniliforme	35.0	47.5	17.5	82.5	Root & stem rots
F. oxysporum	10.0	62.5	27.5	72.5	Wilt
F. solani	17.5	17.5	65.0	35.0	Root rot
Macrophomina phaseolina	2.5	32.5	65.0	35.0	Root & stem rots
Phytophthora sp.	27.5	65.0	7.5	92.3	Root & crown rots
Sclerotinia sclerotiorum	5.0	12.5	82.5	17.5	Root rot
Control (without fungus)	0.0	0.0	100.0	0.0	---
L.S.D. at 5%	10.3	11.0	11.1	---	

* Data recorded after 25 days from planting.
** Data recorded after 60 days from planting.
*** Decreases in healthy survivals relative to control.

Phytophthora sp., followed by *F. moniliforme* and *F. oxysporum* were the most virulent fungi as they significantly decreased percentages of healthy survivals than the other fungi. Differences between percentages of healthy survivals recorded in case of *Phytophthora* sp. and *F. oxysporum* was significant. *F. solani* and *M. phaseolina* gave intermediate reaction in this respect, while *S. sclerotiorum* was the least effective in decreasing healthy survivals.

These findings on the pathogenic capabilities of marigold fungi were somewhat similar to those reported by Pirone (1978), Narayanappa and Sohi (1985), Jones (1991) and Daughtrey and Chase (1992) in foreign countries, whereas, there is no previous studies concerning marigold soil-borne diseases under Egyptian conditions.

Disease symptoms:

A. Carnation:

Disease symptoms caused by *F. oxysporum* f.sp. *dianthi* and *R. solani* were observed on carnation plants developed from plant cuttings in artificially infested soil. Plants infected by *F. oxysporurn* f.sp. *dianthi*, showed a characteristic feature of Fusarium wilt of carnation exhibited as dark brown discoloration of the stem internodes, yellowing, followed by withering of the leaf bases. The infected leaves gradually became yellowish and finally wither. Leaves born on infected ends of a shoot became chlorotic. Eventually, the entire plant became infected as a result of the lateral growth of the pathogen, and then died. However, under heavy infestation, wilt symptoms are usually accompanied with complete reduction in root formation. On the other hand, symptoms of root and collar rots caused by *R. solani* clearly begin at basal stem parts of infected plants. Discoloration from green to dark- brown appears on the lower most 5cm. of the stem (collar or crown part) associated with yellowing, browning, and then dryness of the lower leaves.

B. Gerbera:

Root and crown rots on gerbera plants were noticed with *F. equiseti*, *Phytophthora* sp. and *R. solani* in artificially infested soil. Brown rot symptom was found only in case of *F. semitectum* or *F. solani*. Infected plants showing root and crown rots, were often stunted, yellowed and had withered leaves. Moreover, roots and crowns infected by *Phytophthora* appeared water-soaked, black and soft rot. On the other hand, *F. oxysporurn* wilt symptoms started to appear 30 days after transplanting as yellowing on young leaves and suddenly wilting on the hole plant. Dark brown, discoloration was always appeared on vascular systems of the wilted plants when the roots and stems were sectioned.

C. Marigold:

Pre- and post-emergence damping-off disease always occurred in soil artificially infested with *F. moniliforme*, *F. oxysporum* or *Phytophthora* sp. Germinating seeds were rotted at various degrees, according to the tested fungus, causing pre-emergence damping-off disease.

The leaf bases of seedlings start to dry and become dark- brown in case of *F. moniliforme* infection. The infection appears on the basal stem parts as rotted tissues near to the surface of soil. Eventually the infected leaves died and gradually the infected part of the stem turn to dark brown, then the hole plant start to dry and dies.

Typical wilt symptoms caused by *F. oxysporum* started to appear 45 days after planting as yellowing and unilateral development on the tip of diseased

plants, followed by withering of the leaves. The infected plants turn to brown discoloration and dry. On the other hand, symptoms of *Phytophthora* sp. started to appear on seedlings, 35 days after planting. Stunting and complete reduction in root system formation were usually characteristics symptoms of this fungal infection. As disease symptoms progressed, withered, dried with dark-brown discoloration clearly appeared before died.

Disease symptoms caused by *R. solani* on carnation and *F moniliforme* on marigold were noticed to produce brown colour on the infected tissues, especially in early growth stages. This could be attributed to the capacity of such fungal genera to produce pectic enzymes (macerating enzymes) that affect the plant tissue colour. On the other hand, *F. oxysporum* infected carnation, gerbera and marigold causing symptoms appeared as stunting, yellowing, browning vascular system and wilting. This may explain on the bases that this fungus associated with plant vessels causing partial or complete blocking and macerating the vascular system due to its growth and toxin. These different phases of symptoms are supported by those described by El-Mosallamy *et al.* (1988).

The described symptoms for rot and wilt diseases in this study are somewhat similar to those previously reported on carnation (Andreucci, 1966, Garibaldi, 1966, Ben-Yephet *et al.*, 1992 and Hilal *et al.*, 1994), gerbera (Pirone, 1978, Daughtrey and Chase, 1992 and Kimishima and Goto, 1993) and marigold (Olsen, 1965, Lim, 1969, Jones, 1991 and Chase *et al.*, 1995).

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أعفان الجذور والذبول لثلاثة من نباتات أزهار القطف في مصر:
١- انتشارها ، مسبباتها الفطرية ، قدرتها المرضية وأعراضها.

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أثبت الحصر الذي أجري على زراعات نباتات أزهار القطف المنزرعة بمحافظات القاهرة ، الجيزة ، القليوبية حدوث إصابات كبيرة بأمراض أعفان الجذور ، الذبول ، أو موت البادرات على نباتات القرنفل (٣٢,٦ – ٣٨,٥%) ، الجربيرا (١٠,٤ – ١٩,٠%) والقطيفة (١٧,١ – ٣٧,٤%). كما وجد أن نسب الإصابة بهذه الأمراض تزداد تدريجياً من عام لآخر. وبناءً على الأعراض والخصائص المورفولوجية والمزرعية ، تم تعريف المسببات الفطرية لهذه الأمراض حيث كان أكثرها تكرارا في العزل من نباتات القرنفل: أنواع مختلفة من جنس *Fusarium* ، *Rhizoctonia solani* ، نوع من جنس *Pythium* ومن نباتات الجربيرا والقطيفة أنواع من جنس *Fusarium* ونوع من جنس *Phytophthora* ، ولقد تم تعريف أنواع جنس *Fusarium* التي تصيب القرنفل والجربيرا وكانت: *F. equiseti*, *F. oxysporum* (or f.sp. *dianthi*), *F. semitectum* & *F. solani*, بينما تلك التي تصيب القطيفة على أنها: *F. moniliforme*, *F. oxysporum* & *F. solani* ويعتبر ذلك أول تسجيل لهذه الأمراض ومسبباتها الفطرية في مصر وذلك تبعا للمراجع المتاحة بهذا الخصوص.

ثـبت مـن تجـارب العدوى الصناعية في التربة الملوثة أن الفطريات التي تصيب القـرنفل هـي: *F. oxysporum* f.sp. *dianthi* & *R. solani* وفطـريات الجربيـرا: *Phytophthora* sp. & *F. oxysporum* والفطـريات الـتي تصـيب القطيفـة هـي: *Phytophthora* sp., *F. moniliforme* & *F. oxysporum* ، كـانت أكثر الفطريات المختبرة قدرة على إحداث الإصابة بهذه النباتات ، بينما كانت فطريات *F. solani* & *Pythium* sp. (القـرنفل) ، *F. semitectum* & *F. solani* (الجربيـرا) ، *Sclerotinia sclerotiorum* (القطيفـة) هي أقل الفطريات قدرة على إحداث الأمراض ، وقد تم أيضا توصيف كامل للأعـراض المرضـية المحـددة لـبعض المسببات المرضية المختبرة. وقد أظهر فطر *Fusarium oxysporum* f.sp. *dianthi* أعراض محددة ومميزة لمرض الذبول على النباتات المصابة مصحوباً بتلون بني داكن على الحزم الوعائية ، وغالباً ما يصاحب ذلك حدوث نقـص فـي تكويـن المجموع الجذري. كما أنه عادة ما تكون الإصابة بأمراض أعفان الجذور والتاج مصحوبة بظهور اصفرار الأوراق ثم تحولها إلى اللون البني وجفافها.