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STUDY OF PREVALENCE AND PATHOGENICITY OF ROOT ROT AND WILT PATHOGENS OF PEA IN EGYPT

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ABSTRACT: The occurrence of root rot pathogens of vining pea was determined in field surveys in four governorates from north Egypt during 2002, 2003, 2004 seasons. Disease incidence was varied among ten tested locations. Percentage of infection ranged from 4.0% to 36%. The most frequently isolated pathogens were *Fusarium solani* and *F. oxysporum*. Other pathogens isolated from roots were *R. solani, Pythium debaryanum, F. moniliforme, Macrophomina phaseolina Verticillium albo-atrum* and *Cephlosporium maydis*; the latter was isolated from El-Menoufia governorate only.

In greenhouse pathogenicity tests, *F. oxysporum* and *F. solani* caused the most severe root damage and plant death of pea, followed by *R. solani, Pythium debaryanum* and *M. phaseolina*. Pea plants were highly wilted with infected soil by F. oxysporum isolate No. (4). in host range test, while the tested plants from *Cucurbitaceae* and *Leguminosae* families became infected and developed damping-off symptoms.

Benlate 50, monceren Co and sumisclex were the most effective fungicides controlling the disease caused by *F. oxysporum, F, oxysporum* f. sp. *pisi, F. solani, M. phaseolina, Pythium debaryanum, R. solani*, and *Verticillium albo-atrum*, while rhizolex. T was highly effect with *R. solani*.

INTRODUCTION

Fusarium root rot, caused by *Fusarium solani* (Mart) sacc. f. sp. *pisi* (F.R. Jones), W.C. Snyder & H.N Hans, is an economically important fungal disease of pea *(Pisum sativum* L.) in most pea growing areas around the worled (kraft *et al. 1988, 2001).* Currently, no commercial cultivars are completely resistant to this pathogen (Grünwald *et al. 2003).* Other reported pathogens causing foot and root rot are *Aphanomyces euteiches* Drechs, *Phoma medicaginis* Malbr. var. *pinodella* (L.K. Jones) Boerema, *Pythium* spp., *Chalara elegans* Nag Raj, and *Rhizoctonia solani*

Kühn (Persson *et al 1997*). The importance of these pathogens varies according to location, climate and crop management strategy.

In Delta, vining pea has been cultivated since the 1960s. In order to avoid disease problems, pea is usually not grown in crop rotations more frequently than one in every two years in Delta, but its grown every year in the same fields in some areas of Menoufia governorat.

This surveys were conducted to determine which pathogens are the most prevalent and serious in pea fields in north of Egypt. The results will be used to develop more effective control strategies.

MATERIALS AND METHODS

Field surveys, plant samples were taken from commercial fields owned by farmers growing several different pea cultivars. The fields were selected from ten areas in four Governorats. The number of previous pea crops in each field varied between zero and six. In 2002 to 2004, fields were surveyed in El-Menoufia, El-kalubia, El-Beheira and El-Gharbia Governorates.

Samples were taken at the beginning of the flowering stage, which started at the end of October to 25th of November. (early-sown crops) and lasted until the end of November to the end of Dec. (Late sown crops).

Disease was assessed by visual examination of the roots and epicotyls according to a method modified from Sherwood and Hagedorn *(1985)*. A disease severity index (DSI) was given to each plant as follows: o: healthy plant without any visible symptoms; 5 discoloration of less than 5mm on a single root; 10 = discoloration of about 20mm of the root system; 25 = about 50% of the root system was dark and affected; 50 = the whole root system was dark and affected but no symptoms on epicotyl or leaves; 75 = the whole root system, as well as the epicotyl was dark and affected and the lowest leaves were wilted, and 100 = dead plant. An average field disease severity index (FDSI) was calculated for each field. Fifty fields were surveyed in any area.

Isolation of fungi:

Isolation of fungi were made from 5 to 10 symptomatic plants per field. Roots from the arbitrarily selected plants were washed and placed under running tap water for at least 1/4 h., the roots were surface disinfected in 1.5% sodium hypochlorite for 3 min. and dried between pieces of sterile filter paper. From the interface between apparently

healthy and diseased tissue of epicotyls and roots, small transverse sections were cut and transferred to plates with PDA media. Isolation were made from only a few wilted plants with red vascular tissue (surface sterilized) because typical Fusarium wilt symptoms are rare on many plants in Egypt.

The plates were incubated at 20 to 25C^0 for approximately 5 days, fungi that developed on the media were transferred to fresh plates with PDA media. Isolates were identified by staff of Plant Pathology, Botany Department Faculty of Agric. Al-Azhar Univ. which *Ascochyta* spp were identified through microscopical observations of the characteristics of the pycnidiospores Hagedorn *(1984)*. Fusarium spp were identified through color and cultural characteristics on PDA. and through macro and micro conidia, conidiophores and chlamydospores. with keys and methods described by Booth (1971). and Domsch *et al (1980)*. *Pythium* spp. showing pathogenicity to pea were identified to species level through observations of daily growth rate and zoospores.

Pathogenicity tests:

Sterilized sandy loam soil and clay (1:1 w.w) and 40cm in diameter pots were used. The pots were infested at rate of 2% by the spores and mycelium of each fungus which propagated on corn meal medium for two weeks at 25± 3C^0 . Inoculum was mixed thoroughly with the soil in each pot, watered and left for one week to ensure even distribution of the inoculum. Control pots were filled with the same soil mixed with the same amount of sterilized corn meal medium (non infested soil). A set of four pots with ten seed per pot, were used for each tested fungus.

Healthy seeds of three pea cultivars letel marfil, lencolin and master (B) were used for testing to all fungi isolates. All seeds were surface sterilized in 1.5% sodium hypochlorite for four min and washed several times in sterilized water. After that the seeds were sown at a depth of 2cm *(*Gonzalez and Gonzalez *1981)* and watered regularly every 7 days under green house (open ear conditions). The atmospheric temperature renged between 20 to 26 C^0 in the day and 12 to 17 C^0 in the night. All pots were fertilizars at the normal rate. Percentages of pre, post emergence damping off and root rot wer recorded after 15, 40 and 60 days after planting respectively.

Host rang. thirty – five species of plants were screend for their susceptibility to F. oxysporum isolate No (4) in Table (3) which recorded highly die and wilted plant. Fourty seeds of plants were sown in pots

diameter 30cm (5 or 10 seeds per pot) containing infested soil by F. oxysporum isolate No. (4) or uninfested soil as mentioned before.

Effect of some fungicides on disease incidence

Table (1) trade mark, common name, % of active ingredient, chemical name and rate of application of some fungicides used for controlling pea root rot and wilt diseases.

Trade mark	Common name &% of active ingredient	Chemical name	Rate of application g/L
Benlate	50% Benomyl	Methyl-l-(butylcorbonyl)-2-benzimidazole carbonate	2.0
Bravo	50% chlorothalonil.	50% Tetrachloroisophthalonitrile	2.5
Daconil	75% chlorothalonil	75% Tetrachloroisophthalonitrile (W.P).	2.0
Monceren	50% Telclofos methyl	N- (4-chlorophenyl) methyl -N-cyclopentyl-N-phenyl urea	2.0
Rhizolex-T	50% Tolclofos methyl+ Thiram	0,0-dimethyl-0-2,6-dichloro-4-methyl phenyl)-phosphorot-hioate.	2.0
Sumisclex	50% procymidone	N(3,5-dichlorophenyl)1,2 dimethyl cyclopropane-1,2 dicarboximide.	10.0

Sterilized sandy loam soil and clay (1:1 w.w) and 40 cm in diameter pots were used. The pots were infested at rate 2% by the spores and mycelium of each of *Cephalosporium maydis, F. moniliforme. F. oxysporum, F. semitectum, F. solani, Macrophomina phaseolina, pythium* spp, *Rhizoctonia solani* and *Verticillium albo-atrum* which propagated on corn meal medium for two weeks at 25 C^0. Pea seeds lencolin c.v. wer treated with benlate, bravo, daconil, monceren, rhizolex–T and sumisclex at the recommended dose. Treated seeds were planted in infested or uninfested pots. Seeds which immersed at the same time in sterilized water (control). Ten seeds were planted in each pot and four pots were used for each treatment. All pots were kept under open air conditions at 18± 8 C^0 through November 2006. All treatments were fertilizers at the normal rate.

Percentages of pre, post-emergence damping-off and root rot were recorded after 30 and 60 days from planting respectively.

RESULTS AND DISCUSSION

Field surveys:

Disease incidence at root rot or wilt greatly varied among locations

and within the governorates (Table 2). The infection ratios ranged from 4% to 36% . The maximum infection was at Ashmoun location (El-Menoufia governorate) followed by Shebin EL-Kanater location (El-Kalubia governorate), Menouf and Quisna locations (El-Meuoufia governorate). The minimum infection was detected at Basion (Gharbia governorate). The overall infection among the governorates can be ranked in descending order as follows: El- Menoufia, El-Kalubia El-Gharbia and El- Beheira. The survey also indicated that the disease existed in all tested locations over 4 different governorates. This finding suggested that root rot/ wilt disease is endemic in the north of Egypt. Root rot and wilt diseases were increased every year in Shebin El- Kanater (Kalubia governorate) and Ashmoun (Menoufia governorate) because the farmers planting pea plants every year in the same fields. That's result may be to back the propagation and distribution the pathogen inoculum in the soil year after year. The variations in disease incidence found among locations is not surprising since the environmental conditions varied among locations and may contributed greatly in development at the disease. Supporting evidence came from Khattab and Omar *(1992)* and Kraft *et al. (1986)* reported that root rot and wilt of food legumes increased by soil compaction, poor drainage, excess or deficit water and extremes of temperature.

Data in Table (2) showed that thirteen different fungi were associated with pea roots. The isolated fungi varied in their isolation frequencies at the different locations. *Fusarium solani* was the highest frequently isolated fungus from Ashmoun Menouf, Quisna, El-kanater, Qaha and Noubaria locations than another fungi isolates, followed by. *F. oxysporum* in the same locations except Menouf and Ashmoun locations which *F. semitectum* and *Rhizoctonia solani* respectively gave the second highly frequency of isolates. *R. solani, Pythium debaryanum* were modretly frequency. while *Cephalosporium* sp. was the lowest frequently isolated fungus and restricted to specific site and isolated only from. El- Menoufia governorate.

Fusarium oxysporum, F. semitectum, F. solani, Verticillium sp. and *Cephalosporium* sp. were isolated from vascular tissue.

Generally the most frequently isolated root pathogens from all fields was *Fusarinm solani* 72% followed by *F. oxysporum, R. solani, pythium debaryanum, F. semitectum, F. moniliforme, Macrophomina phaseolina, Verticillium* sp. And *Ascochyta* spp. which recorded 68.85, 51.64, 48.89, 39.64, 34.64, 25.28, 14.71 and 7.71 frequency respectively. Babadoost

Table (2) Fungi isolated from symptomatic pea plants in four Governorates of Egypt in a disease survey in 2002 to 2004.

Fungi Species	Percentage of Fields																														Mean
	El-Bheira			El-Gharbia						El-Kalubia													El-Menoufia								
	Noubaria			Basion			Kafr El-ziat			El-Kanater			Kalub			Qaha			Shebin El-konater			Ashmoun			Menouf			Quisna			
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	
Alternaria spp	0.0	2	2	A	2	0.0	A	0.0	2	2	0.0	2	0.0	0.0	0.0	0.0	0.0	2	2	2	0.0	2	0.0	4	0.0	0.0	0.0	0.0	6	0.0	1.07
Ascochyta spp	0.0	4	4	A	4	6	A	6	8	14	10	12	10	12	10	0.0	14	10	12	12	8	0.0	8	10	6	8	6	12	4	6	7.71
Aspergillus spp	2	0.0	0.0	A	2	2	A	0.0	0.0	2	2	2	0.0	2	0.0	2	0.0	2	2	2	2	2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.92
Cephalosporium sp.	0.0	0.0	0.0	A	0.0	0.0	A	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	20	24	20	12	14	16	18	16	18	5.64
F. moniliforme	40	30	28	A	60	52	A	38	48	40	38	38	30	34	28	20	24	32	26	28	24	30	38	48	34	38	44	24	26	30	34.64
F. oxysporum	60	66	64	A	64	72	A	72	78	60	66	62	70	66	74	60	68	74	70	74	84	64	70	74	60	64	68	70	76	78	68.85
F-Semitectum	30	28	30	A	0.0	0.0	A	22	22	16	24	20	40	46	38	36	40	40	42	36	40	60	70	78	64	66	68	50	56	48	39.64
F-solani	60	64	72	A	60	66	A	70	78	70	68	82	66	68	60	70	64	70	60	44	58	86	90	96	82	88	94	70	78	82	72.0
Mocrophomina spp	20	16	22	A	0.0	0.0	A	20	24	4	8	8	22	20	22	34	22	30	30	32	38	40	30	32	48	54	36	28	34	36	25.28
Penicilliam spp	0.0	2	0.0	A	0.0	2	A	2	2	0.0	0.0	2	0.0	0.0	2	0.0	2	0.0	2	0.0	2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.57
Pythium debaryanum .	35	30	40	A	40	50	A	30	36	40	44	50	60	44	50	48	40	50	44	60	68	50	58	62	54	48	50	60	58	70	48.89
Rhigoctonia solani	30	36	36	A	50	40	A	50	60	54	60	60	50	60	64	44	50	40	40	50	48	60	72	80	50	58	62	48	50	44	51.64
Verticillium sp.	0.0	4	12	A	20	16	A	20	20	18	12	14	22	18	18	12	16	14	20	14	16	20	18	12	14	16	12	10	12	12	14.71
Of root rot/ wilt	6	4	6	A	4	6	A	6	8	16	18	22	12	12	10	6	12	8	20	26	28	24	28	36	18	16	20	18	26	20	

(A) Not surveyed in 2002
(*) 1= 2002, 2= 2003 and 3=2004 seasons
total number of fields surveyed =50 field

(2002) and Peters and Grau *(2002)* reported that root rot of pea may be caused by any one or a combination of several common soil fungi. The most common pathogens are *Aphanomyces euteiches, Pythium ultimum, Fusarium solani* f. sp. pisi and *Rhizoctonia solani*. Other fungi that can be associated with pea roots include *Thielaviopsis basicola,* F. *oxysporum, Ascochyta pinodella* and *Sclerotinia sclerotiorum*.

The variable weather conditions may explain the differences in isolation frequency between years. The growing season of 2003 was exceptionally dry, which explains the lowest of plants infected with *P. debaryanum*. However the differences between governorates, such as El-Menoufia and El-Beheira were mainly due to the cropping history. In Noubaria pea growing started in 1990, whereas in Ashmoun and shebin El-Kanater several fields have regularly been cropped with pea over a 40 year period. Investigation of some of my isolates showed that they were highly pathogenic to pea. These findings are in accordance with Hagedron *(1984)* and Persson *at al (1997)*: which recorded that *F. solani* was the most frequently isolated fungus in all pea- growing areas. Disease severity was increased in some governorates than others- this results may be due to the distribution of pathogenic (endoparasitic and semi-endoparasitic) nematodes in the soil, such as *Aphelenchoides fragaria, A. subtenus, Rotylenchulus spp.* and *meloidogyne spp*. Meny investigators isolated this genera from roots and soil around the root of economic crops i.e. Cotton, Onion, Weat, Horse bean, kidney bean and Pea in El-Gharbia, El-Kalubia, El-Menoufia and El-Sharkia governorates. Mostafa *(1997)* recorded twenty nine nematode species including ecto, semi- endo and endoparasitis nematodes.

Species of *Pythium*, as well as lesion, stunt and other nematodes are all commonly a part of the disease complex and can increase the severity of root rot. If plants in the field or garden are stunted, or the leaves are pale yellow, dig up some of the plants. Carefully wash off the soil and examine the roots for decay. Babadoost *(2002)*

Pathogenicity tests:

F. oxysporum isolates number 2 and 3, F. solani, R. *solani and Pythium debaryanim* isolates were highly pathogenic, causing root rot. M. phaseolina was modratly pathogenic., while *V. albo-atrum, F. moniliforme F. semitectum, C. maydis* and *Ascochyta pisi* were low pathogenic on tested pea c.v.s (Table 3). *Fusarinm* spp. caused disease severity that ranged from 22.5% with *F. semitectum* to 90% with *F.*

Table (3): Percentage of pea plants infected with root rot/ wilt fungi.

Isolates	Number. Of isolates	Letel Marfil				Lencolin				Master (B)			
		% of infection after			% of survival	% of infection affer			% of survival	% of infection after			% of survival
		15	40	60		15	40	60		15	40	60	
Ascochyta pisi.		12.5	5.0	0.0	82.5	12.5	7.5	0.0	80.0	12.5	2.5	0.0	85.0
Cephalosporium maydis	1	0.0	5.0	10.0	85.0	0.0	7.5	10.0	82.5	0.0	0.0	10.0	90.0
	2-	0.0	7.5	15.0	77.5	0.0	10.0	12.5	77.5	0.0	2.5	12.5	85.0
Fusarium moniliformo		15.0	7.5	5.0	72.5	15.0	10.0	0.0	75.0	10.0	0.0	0.0	90.0
Fusarium oxysporum	1-	7.5	20.0	40.0	32.5	7.5	20.0	60	12.5	0.0	5.0	30	65.0
	2-	20.0	30.0	17.5	32.5	40.0	30.0	10	20.0	10.0	20.0	0.0	70.0
	3-	20.0	35.0	15.0	30.0	45.0	35.0	0.0	20.0	10.0	5.0	2.5	82.0
	4-	10.0	25.0	40.0	25.0	12.5	17.5	60	10.0	0.0	7.5	27.5	65.0
Fusarium semitectum		17.5	0.0	0.0	82.5	12.5	10.0	0.0	77.5	5.0	7.5	0.0	87.5
Fusarium solani	1	40.0	10.0	0.0	50.0	25.0	30.0	10.0	35.0	20.0	7.5	0.0	72.5
	2	35.0	15.0	5.0	45.0	40.0	20.0	7.5	32.5	20.0	2.5	0.0	77.5
	3	20.0	12.0	0.0	67.5	30.0	15.0	5.0	50.0	20.0	0.0	0.0	80.0
	4	37.5	15.0	0.0	47.5	25.0	30.0	10.0	35.0	15.0	10.0	2.5	72.5
Mocrophomina phaseolina	1	10.0	7.5	0.0	82.5	30.0	5.0	0.0	65.0	7.5	0.0	0.0	92.5
	2	10.0	10.0	0.0	80.0	20.0	20.0	0.0	60.0	10.0	0.0	0.0	90.0
	3	10.0	10.0	0.0	80.0	20.0	15.0	0.0	65.0	7.5	2.5	0.0	90.0
	4	10.0	10.0	0.0	80.0	20.0	10.0	0.0	70.0	10.0	2.5	0.0	87.5
Pythium debaryanum	1	30.0	15.0	0.0	55.0	35.0	20.0	0.0	45.0	20.0	5.0	0.0	75.0
	2	30.0	20.0	0.0	50.0	35.0	17.5	0.0	52.5	20.0	0.0	0.0	80.0
	3	30.0	10.0	0.0	60.0	40.0	10.0	0.0	50.0	15.0	7.5	0.0	77.5
	4	25.0	15.0	0.0	60.0	35.0	20.0	0.0	55.0	20.0	5.0	0.0	75.0
Rhizoctonia	1	40.0	10.0	0.0	50.0	45.0	10.0	0.0	45.0	30.0	5.0	0.0	65.0
	2	40.0	15.0	0.0	45.0	42.5	15.0	0.0	42.5	30.0	5.0	0.0	65.0
	3	42.5	10.0	0.0	47.5	40.0	7.5	0.0	52.5	30.0	10.0	0.0	60.0
	4	40.0	5.0	0.0	55.0	45.0	10.0	0.0	45.0	35.0	5.0	0.0	60.0
Verticillium	1	0.0	7.5	12.5	80.0	0.0	15.0	12.5	72.5	0.0	0.0	10.0	90.0
	2	0.0	5.0	10.0	85.0	0.0	10.0	15.0	75.0	0.0	7.5	10.5	82.5
Control		0.0	0.0	0.0	100.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	100
LSD at 0.5		12.7	12.7	12.7	9.8	12.7	12.7	12.7	10.2	12.7	12.7	12.7	9.4
		13.2				12.4				13.2			
		Between all treatments 8.45											

oxysporum isolate No. (4) the highly pathogenic isolates caused sever root discolorations and plant death on pea lencolin c.v. Isolates of *F. oxysporum* No (2,3) induced high mean of infected plants. while

Fusarium semitectum gave lowere infected plants on Pea lencolin c.v. The symptoms of plants severely attacked by these three pathogens were similar and included dark brown to black decayed plant tissues. *Verticillium albo-atrum, Cephalosporium maydis* and two isolates of F. oxysporum causing reproducible wilt symptoms. Most *F. oxysprum* induced no wilt symptoms or red vascular tissues, but only brown to black root rot. The isolates of *F. solani* from red vascular tissues caused a severe foot and root rot but no red-colored vascular tissues. Earlier pathogenicity tests of this isolates have shown that *F. solani* and *F. oxyaporum* isolated from pea epicotyls were all pathogenic, whereas isolates from roots could be divided in two groups: one pathogenic and one nonpathogenic.Many of the wilted plants that were regarded as infected by some *F. oxysporum* turned out to be infected by *F. solani.* For these plants, red- colored vascular tissues could be found high up above the soil line and *F. solani* could be isolated up to the seventh node level. This is in contrast to earlier findings indicating that red discoloration caused by *F. solani* usually does not progress above the soil line Kraft *et al (1988).*

However, in the pathogenicity test, *F. solani* could not be verified as a vascular pathogen, which indicates that growth conditions in the greenhouse might not be favorable for the expression of these symptoms. Most *F. oxysporum* isolated from roots caused a significant root rot. Among *F. solani* and *F. oxysporum,* isolates obtained from different pea fields (plant parts) show different levels of pathogenicity, which can lead to misinterpretation of the importance of a certain pathogen. Infantino *et al 2006* reported that soil-borne fungal diseases are among the most important factors, limiting the yield of grain legumes in many countries worldwide. Root rot caused by *Aphanomyces euteiches, Rhizoctonia solani, Fusarium solani* and wilt, caused by several forma specials of Fusarium *oxysporum* are the most destructive soil-borne disease of pea, chick pea and faba bean.

Pythium debaryanum is commonly isolated from soil and it is pathogenic to several crops, pea among them Blok *(1970).* The pathogenicity test showed that *P. debaryanum,* induced root rot and had a clear growth reducing effect. This is in accordance with findings by Ingram and Cook *(1990)* who showed that *P. debaryanum* caused pre-emergence death and stunting of pea. *P. debaryanum* is probably a major problem in some fields. *R. solani* was highly pathogenic at early stage (15 day after planting) in all pea cultivars under study. The same results were showed with Eisa, *(2003)* who recorded that *R. solani*

isolated from pea and cowpea were highly pathogenic to pea, causing pre-emergence damping- off.

On the other hand Master (B) cultivar was resistant to all pathogenic fungi except R. solani which gave modratly disease incidence, but the other cultivars exhibited some resistant. It is my be increased by breeding programes to resistant.

Host range, thirty five crop species exhibited damping-off and wilt symptoms by *F. oxysporum* isolate (4) (Table 4). Plants of 8 crop species did not develop any symptoms. All plants from cucurbitaceae and leguminosae families became infected and developed damping-off symptoms. Faba bean, cowpea, green bean, alfalfa, chick pea, lima bean, melon and squash were the most susceptible to damping-off caused by *F. oxysporum* isolate (4) which gave 50,50,50,50, 45,40,40 and 40% nfected plants at pre and post emergence damping off respectively while lentil, turnip, honeydew melon, basil and onion were highly resistant to this isolate, the diseased plants recorded 5%. Beet, spinach, Broccoli, cabbage, rice, eggplant, carrot and parsley did not develop any symptoms. Pea plants gave highly wilt which recorded 60% wilted plants and 85% total plant death. Some species of crops gave low percentage of wilt i.e chick pea, cowpea and melon which gave 15,10 and 10% wilted plants respectively. The first symptoms on pea are usually a yellowing of the lower leaves and a stunting or dwarfing of plant growth. The stipules and margins of the leaflets curl downward and inward. The stems at or near the soil line may be slightly thickened and brittle. Across section of the lower stem often reveals a lemon to orange-brown and finally black discoloration of the water-conducting tissue (xylem) within the stem. Affected plants may wilt and die either slowly or rapidly soon after the first symptoms are noted due to destruction of the feeder roots. The same results were recorded by Dany *(1988)*. These results indicated that isolate No- (4) of *F. oxysporum* was semilary *F. oxy.* f. sp. *pisi.*

Table (4): Host range of F. oxysporum isolate (4) causing wilt on pea.

Family	Common name	Scientific name	Diseased plants%			%of surs.
			Pre-	Post-	Wilt	
Chenopodiaceae	Beet	*Beta vulgaris*	0.0	0.0	0.0	100
	Spinach	*Spinacia oleracea*	0.0	0.0	0.0	100.,
Cruciferae	Radish	*Raphanus sativus*	5.0	2.5	0.0	92.0
	Turnip	*Brassica rapa*	0.0	5.0	0.0	95.0
	Broccoli	*Brassice oleracea*	0.0	0.0	0.0	100.0
	Cabbage	*Brassica Oleracea*	0.0	0.0	0.0	100.0
	Cauliflower	*Brassica oleracea*	2.5	5.0	0.0	92.5
Cucurbitaceae	Cantaloupe	*Cucumis melo*	10.0	10.0	0.0	80.0
	Cucumber	*Cucumis sativus*	15.0	10.0	0.0	75.0
	Honeydew melon	*Cucurbita melo*	5.0	0.0	0.0	95.0
	Melon	*Pisum melo*	30.0	10.0	10.0	50.0
	Squash	*Cucurbita pepo*	25.0	15.0	0.0	60.0
	Watermelon	*Citrullus lanatus*	15.0	10.0	0.0	75.0
Gramineae	Corn	*Zea mays*	10.0	0.0	0.0	90.0
	Rice	*Oryga sativa*	0.0	0.0	0.0	100.0
	Wheat	*Triticum aestivum*	10.0	10.0	0.0	80.0
Labiatae	Basil	*Ocimum basilicum*	0.0	5.0	0.0	95.0
Leguminosae	Alfalfa	*Medicago sativa*	40.0	10.0	0.0	50.0
	Faba bean	*Vicia faba*	30.0	20.0	0.0	50.0
	Chick pea	*Lupinus termis*	25.0	20.0	15.0	40.0
	Cowpea	*Vigna sinensis*	30.0	20.0	10.0	40.0
	Green bean	*Phaseolus vulgaris*	20	30.0	0.0	50.0
	Lentil	*Aervum lens*	2.5	2.5	0.0	95.0
	Lima bean	*Phaseolus lunatus*	30	10	0.0	60.0
	Snow pea	*Pisum sat:vum*	10.0	15.0	60.0	15.0
	Soybean	*Glycine max*	15.0	10.0	0.0	75.0
Liliaceae	Garlic	*Allium sativum*	20	0.0	0.0	80.0
	Onion	*Allium cepa*	5.0	0.0	0.0	95.0
Solanaceae	Eggplant	*Solanum melongena*	0.0	0.0	0.0	100
	Pepper	*Capsicum annum*	10.0	15.0	0.0	75.0
	Tomato	*Lycopersicon esculentum*	15.0	5.0	0.0	80.0
Umbellikerae	Carrot	*Doucus carota*	0.0	0.0	0.0	100
	celery	*Apium graveolens*	20.0	10.0	0.0	70.0
	Dill	*Anethum graveolens*	30.0	5.0	0.0	65.0
	Parsley	*Petroselinum crispum*	0.0	0.0	0.0	100.0

Effect of some fungicides on disease incidence:

Evaluation of six seed dressing fungicides on the root rot end wilt disease are presented in Table (5). Pea seeds treated with all tested fungicides were significantly effective against the disease incidence than untreated ones, except *V. albo-atrum* with Rhizolex-T, Daconil and Bravo, which gave the same or near percentage of survival plants compared with infested control. Statistical analysis revealed that benlate 50, monceren-co and sumisclex proved to be the best fungicides tested on most of root rot pathogens, while rhizolex-T was the best fungicides on *Rhizoctonia solani*. This finding is in agreement with those reported by Eisa (2003). They found that seed dressing fungicides reduced fungal levels in the rhizosphere of faba bean and pea, and subsequently reduced percentage of root infection.

These studies indicated that there is no completely satisfactory control for the root rot diseases of pea once the causal fungus or fungi: is/are introduced and becomes prevalent in the soil abroad rang of pathogens is involved in the root rot complex of pea. Breeding for race - specific resistance has been widly applied with great success in the control strategy of fusarium pea wilt, however, the occurrence of non specific soil borne pathogens demonstrates that integrated control strategies are needed including a high level at partial resistance in commercial pea cultivars.

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Table (5) Effect of six chemical fungicides on root rot/ wilt disease incidence of pea (lencolin cultiver)

	F.oxysporum (2)			F.oxys.f.sp.pisi			F.solani (2)			M.phascolina (1)			P.debaryanum (1)			R.solani (2)			V.albo-atrum (1)			Control		
	%of infection after		% of Surv	%of infection after		% of Surv	%of infection after		% of Surv	%of infection after		% of Surv	%of infection after		% of Surv	%of infection after		% of Surv	%of infection after		% of Surv	%of infection after		% of Surv
	30day	60day		30d.	60d.		30d.	60d.		30d.	60d.		30d.	60d.		30d.	60d.		30d.	60d.		30d.	60d.	
Benlate 50	5.0	2.5	92.5	0.0	10.0	90.0	10.0	2.5	87.5	10.0	0.0	90.0	7.5	0.0	92.5	0.0	5.0	95.0	5.0	0.0	95.0	0.0	0.0	100
Bravo	25.0	5.0	70.0	5.0	35.0	60.0	20.0	10.0	70.0	20.0	5.0	75.0	20.0	0.0	80.0	12.5	5.0	82.5	10.0	7.5	82.5	0.0	0.0	100
Daconil	20.0	2.5	77.5	5.0	30.0	65.0	20.0	5.0	75.0	20.0	7.5	72.5	22.5	2.5	75.0	15.0	5.0	80.0	12.5	5.0	82.5	0.0	0.0	100
Monceren Co	5.0	5.0	90.0	0.0	15.0	85.0	10.0	5.0	85.0	10.0	5.0	85.0	15.0	0.0	85.0	10.0	2.5	87.5	7.5	2.5	90.0	0.0	0.0	100
Rhigolex-T	20.0	5.0	75.0	0.0	30.0	70.0	25.0	5.0	70.0	25.0	5.0	70.0	30.0	5.0	65	5.0	2.5	92.5	7.5	17.5	75.0	0.0	0.0	100
Sumisclex	10.0	2.5	87.5	0.0	15.0	85.0	12.5	5.0	82.5	10.5	2.5	87.5	12.5	2.5	85.5	10.5	0.0	90.0	10.0	0.0	90.0	0.0	0.0	100
Control	60.0	20.0	20.0	15.0	70.0	15.0	50.0	15.0	35.0	40.0	0.0	60.0	52.5	0.0	47.5	45.0	10.0	45.0	10.0	15.0	75.0	0.0	0.0	100
L.S.D/ 0.05	8.2	4.7	10.3	2.5	7.5	11.7	6.3	3.2	9.8	5.9	2.1	9.4	6.5	1.6	9.7	3.4	2.1	8.7	3.4	2.7	9.4	-	-	-

* **L.S.D at 0.05 between fungi:**

at 30 days = 6.8 **at 60 day = 5.1** **at Survival = 4.5**

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دراسة على حصر وانتشار وعدوى مرض عفن الجذور والذبول على البسلة في مصر

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الملخص العربي

تم عمل حصر لمرض عفن الجذور والذبول في الحقول المنزرعة بالبسلة في عشرة مناطق مختلفة تابعة لأربع محافظات بالوجه البحري. كما تم عزل الفطريات المسببة من عينات مصابة من كل منطقة تم فحصها خلال ثلاثة مواسم متتالية ٢٠٠٢، ٢٠٠٣، ٢٠٠٤م ما عدا محافظة الغربية فقد تم حصر المرض والعزل منها عام ٢٠٠٣، ٢٠٠٤م

تراوحت النسبة المئوية للإصابة بمرض عفن الجذور والذبول خلال المواسم المختلفة للعزل بين ٤% إلى ٣٦% وكانت أقل نسبة إصابة في مركز النوبارية (البحيرة) ومركز بسيون (الغربية) خلال موسم ٢٠٠٣ بينما سجلت أعلى نسبة إصابة بمركز أشمون (المنوفية) يليه مركز شبين القناطر (القليوبية) خلال موسم ٢٠٠٤م.

عموماً كانت أقل المحافظات في نسبة الإصابة خلال الثلاث مواسم هي محافظتي البحيرة والغربية بينما كانت محافظتي المنوفية والقليوبية أعلى في نسبة الإصابة، كما تباينت المراكز فيما بينها في نسبة الإصابة داخل المحافظة الواحدة.

تم عزل ثلاثة عشر نوعاً من الفطريات المختلفة من جذور نباتات البسلة المصابة وسجلت الفطريات فيوزاريوم سولاني، فيوزاريوم أكسيسبورم وريزوكتونيا سولاني وبيثيوم، فيوزاريوم سميتيكتم وفيوزاريوم مونيلفورم تكراراً أعلى في العزل على التوالي، كما تم عزلهم من جميع مناطق الزراعة التي تم فحصها في جميع السنوات.

تم إجراء تجربة عدوي مبدئية لتحديد العزلات ذات القدرة العالية على إحداث الإصابة وتم تحديد تلك العزلات لأنواع الفطريات المختلفة المعزولة من البسلة في إجراء العدوى الصناعية على ثلاثة أصناف من البسلة والتي تم الحصول عليها من قسم البساتين كان الفطر الأكثر قدره على إحداث الإصابة بأعفان الجذور هو الفطر فيوزاريوم أكسيسبورم العزلة ٢، ٣ حيث سجلت ٨٠% نسبة إصابة يليه سلالات الفطر فيوزاريوم سولاني ثم الفطر رايزوكتونيا سولاني يليه الفطر بيثيوم ديبريانم ثم الفطر ماكروفومنيا فاسيولينا كما وجد أن الفطر فيوزاريوم سولاني المعزول من شبين القناطر هو الأكثر شراسه في إحداث المرض عن باقي العزلات. بينما الفطر رايزوكتونيا سولاني المعزول من محافظة المنوفية هو الأعلى في القدرة المرضية عن العزلات المأخوذة من المحافظات الأخرى أما الفطر بيثيوم فكانت العزلات متماثلة في جميع المحافظات المأخوذ منها العينات.

كما أحدث الفطر فيوزاريوم أكسيسبورم العزلة رقم ١، ٤، ٨ من عزلات (قويسنا) محافظة المنوفية والفطر فرتسيليوم ألبوأترم والفطر سيفالوسبوريم مايدز ذبولا للنباتات.

ثبت أن الصنف ماستر (ب) مقاوم لبعض الفطريات وقابل للإصابة بالبعض الأخر أما الصنف لنكولين فهو قابل للإصابة بجميع الفطريات المسببة لأعفان الجذور.

تم اختبار استجابة ٣٥ صنف نباتي تابعيين لتسع عائلات نباتية مختلفة للعزلة رقم ٤ للفطر فيوزاريوم أكسيسبورم وأثبت الاختبار أن هذه العزلة تسبب نسبة عالية من ذبول نباتات البسلة وأنها للفطر فيوزاريوم أوكسيسبورم بيسي.

تم اختبار ستة مبيدات فطرية على البذرة فكانت المبيدات بتليت ٥٠ ومونسرين وسوميسلكس وريزولكس الأكثر تأثيراً في مقاومة المرض بينما المبيدان برافو وداكونيل الأقل تأثيراً على معظم الفطريات. وعموماً فإن المعاملة بالمبيدات أعطت فروق معنوية بالنسبة لجميع المبيدات عن معاملة المقارنة الخالية من المبيدات ما عدا المبيدات ريزولكس وبرافو وداكونيل مع الفطر فرتسيليوم الذي لم يعط أي فروق معنوية عن المقارنة بالكنترول.