

The Etiology of Sudden wilt disease Syndrome on Melon in Egypt

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Abstract: In the present research, five fungi were isolated from melon plants suffered from sudden wilt disease syndrome. These fungi were identified as *Fusarium solani*, *Macrophomina phaseolina*, *Monosporascus cannonballus*, *Pythium aphanidermatum* and *Rhizoctonia solani*, *Fusarium solani*. Some factors affecting the disease occurrence *i.e.*, water saturation, distance between irrigation nozzles, and plant beds, types of soils, varieties reaction and host range were studied. All cantaloupe cultivars were affected with sudden wilt. All cucurbit hosts were infected with the causal organisms of sudden wilt.

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1. Introduction:

Melon (*Cucumis melo*) is considered one of the major summer and winter vegetable crops in commercial fields and under protected cultivation during winter in Egypt. It is considered a major source of essential nutrients such as vitamins, minerals, carbohydrates, antioxidants and anti-carcinogenic substances, which are important to human nutrition and health (Joseph, 1994). The cultivated area of melons during 2010 reached 146211 feddans yielded about 8-10 tons/feddan of fruits.

Melon is liable to attack by several soil borne fungal pathogens during different growth stages resulted in considerable losses in fruits yield. The most important diseases, however, are damping-off, Fusarium wilt (Zitter *et al.*, 1996), sudden wilt (Cohen *et al.*, 1996, Pivonia *et al.*, 1997, Cohen *et al.*, 2000) and *Monosporascus* root rot / vine decline (Uematsu *et al.*, 1985, Martyn and Miller, 1996).

In Egypt, sudden wilt disease syndrome on melons has been frequently occurred causing severe losses during the growing seasons. Therefore, the present investigation aims to study the disease occurrence, causal pathogen, and pathogenic capabilities of the isolated fungi, varieties resistance and host range, efficiency of the environmental conditions.

2. Materials and Methods

1- Isolation of the associated fungi :

Isolation was made from twenty plants per field. Five fields represented each location showing disease symptoms. The diseased plants were uprooted then the roots were washed under running tap water to remove the soil particles. The tap and lateral roots were excised into small pieces (0.5-0.8 cm). The root

pieces were disinfested in 0.5% sodium hypochlorite then 70% ethanol for two minutes each. Then, they were rinsed in sterilized distilled water and dried between two sterilized filter papers. The surface sterilized samples were plated onto Potato Dextrose Agar (PDA) medium and incubated at 25°C until the recovery of the fungal colonies. The recovered fungi were microscopically examined.

2- Purification and Identification of the isolated fungi:

Purification of the isolated fungi was carried out using hyphal tip and /or single spore techniques (Dhingra and Sinclair, 1985).

The developed fungal colonies were kindly identified by the staff members of the "Mycology and Plant Diseases Survey Department" in Plant Pathology Research Institute. They used the morphological and microscopically characteristics of the recovered fungi according to (Barnett 1960, Pollack and Uecker, 1974 and Nelson *et al.*, 1983). The identified fungi were sub-cultured on PDA slants and kept at 5°C for further studies.

3- Production of inoculums :

The fungi used in this study were grown on cornmeal-sand medium. A mixture of 2-5 g corn meal and 95-98 g fine sand previously washed was transferred in a 250 ml glass bottle. Then each bottle received 50 ml of distilled water and plugged with a cotton stopper. The bottled medium was autoclaved at 121°C for 1 hr. The tested fungi were grown on PDA and incubated for 7 days at 25°C. A 4-mm disc of agar with mycelium from 7 days old culture of each fungus used in this study was transferred to the surface of the bottled medium. Five bottles were served for each fungus. All bottles were incubated at

25°C for 15 days and were daily shaken to spread the fungal inoculums through the medium.

4-Disease assessment :

Plants suffered from pre - and post - emergence damping - off disease were assessed two and four weeks after sowing respectively. Sudden wilt disease incidence was recorded at the fruit setting stage of cantaloupe plants. Plants were uprooted washed carefully, and the disease incidence was determined. Disease severity was determined using an improved grading system for measuring plant diseases described by (Horsfall and Barratt, 1945).

5-Varietal reaction :

Seeds of four cantaloupe cultivars namely, Galia, Rafigal, Ideal and Primal were sown in seedling trays for one month. The tested fungi were grown on autoclaved medium containing corn meal (80 g), sand (350 g) and water (80 ml) They were transferred alone or in combinations to sterilized pots (25 diam.) filled with in formalin-sterilized loamy soil (using 5 % formalin). The amount of each inoculum was (3 %) of soil weight per each pot. Three seedlings of one month old were transplanted in each pot. Percentage of infection with sudden wilt disease was estimated at fruit setting (70 days of sowing).

6- Host Range :

Reaction of the cucurbitaceous hosts namely, cucumber (cv. Beit Alpha), squash (cv. Eskandarani), watermelon (cv. Giza 1), snake cucumber (cv. Nabolsy), and loofah (cv.land race) to the different sudden wilt pathogens was studied.

Seeds of each host were sown in a seedling tray for one month. The studied pathogens' inocula were prepared and transferred alone or in combinations to sterilized pots (25 cm) filled with in formalin-sterilized loamy soil (using 5 % formalin) and seedlings transplanting were done as previously mentioned. Mean percentage of infection by sudden wilt disease was recorded at fruit setting, 70 days after sowing.

The Role of Irrigation Regime In Sudden Wilt Syndrome Development.

A- Effect of different distances between irrigation nozzle and plant position on the soil bed :

The effect of different distances between irrigation nozzle and plant position on the development of sudden wilt disease of cantaloupe was studied in field during summer season of 2009 at El-Kassaseen, Ismailia governorate. This experiment was carried out in sandy loamy soil naturally infested with sudden wilt pathogen(s) using cantaloupe cv. Galia. Intra row spacing was 50 cm, (the distance between 2 plants), and beds were 150 cm apart. Drip irrigation system was used. The distance between plant and

irrigation nozzle was 10, 15 or 25 cm. Data were recorded at fruit setting, 70 days after cultivation.

B- Effect of different intervals of irrigation on the sudden wilt infection of cantaloupe, under field condition. [Planted in pots (25 diam.)] :

The effect of different intervals of irrigation on the sudden wilt infection of cantaloupe was studied in field experiment cultivated in pots during winter and summer seasons 2009 at El-Kassaseen, Ismailia. Experiment was carried out in sterilized sandy loamy soil pots infested with each of sudden wilt pathogens using cantaloupe cv. Ideal. The pots were drip irrigated at different intervals (6, 9 and 12 days). The seedlings were mulched by using a plastic mulch to protect the plant from frost damage at night during winter time. Data were recorded at fruit setting where the plants 70 days after cultivation.

C- Effect of water saturation levels and soil types on the sudden wilt infection of cantaloupe, under greenhouse conditions :

The effect of water saturation levels of the soil on the sudden wilt infection of cantaloupe was studied in an experiment in pots, under greenhouse conditions. Water saturation levels were determined according to the method given by (Piper 1950). Three levels of saturation *i.e.* 100%, 50% and 25% were investigated. Also three soil types namely: sandy, clay and sandy loamy soil were used through this experiment.

A weighted amount of soil (350 g) was placed in a glass funnel (500 ml). Then a measured volume of water was poured on the soil until saturation. The run-off (excess of water) was received in a receiving beaker. After that, the measured amount of water was estimated for complete saturation of three kgs of each type of soil. The actual volume of water needed for saturate (100% saturation) sandy, clay and loamy soil was 70, 126 and 98 ml respectively (Piper 1950). Then, it can be estimated the volumes of water needed for 50 and 25 % water holding capacity accordingly. Plastic pots, 25 cm each, were filled with 3 kgs of each of the tested type of soil. Soil was infested with sudden wilt pathogens *i.e.* *F. solani*, *P. aphanidermatum*, *M. phaseolina*, *R. solani* and *M. cannonballus*. The amount of inoculum was 3% of soil weight in each pot (Dhingra and Sinclair, 1985). Seven seeds of cantaloupe cv. Ideal were sown in each pot. The experiment was drip irrigated. Each treatment was replicated five times.

The following aspects were studied:

- Effect of soil type on sudden wilt disease incidence.
- Effect of saturation level on the development of the disease.

3. Results

Isolation, identification:

Five genera of pathogenic fungi, *i.e.* *Fusarium*, *Monosporascus*, *Rhizoctonia*, *Pythium* and *Macrophomina* were isolated from diseased roots of cantaloupe. They were identified to their species level as *F. solani*, *Macrophomina phaseolina*, *Monosporascus cannonballus*, *Rhizoctonia solani* and *Pythium aphanidermatum*.

Reaction of common cantaloupe cultivars to sudden wilt pathogens:

In this experiment, four cantaloupe cultivars representing the most important commercially cultivars grown in Egypt were evaluated. These

cultivars *i.e.* Galia, Rafigal, Ideal and Primal were tested against the most common pathogens *i.e.* *F. solani*, *M. phaseolina*, *P. aphanidermatum*; *R. solani* and *M. cannonballus* (**Table 1**) alone or in all possible combinations under greenhouse condition.

Results showed that the tested cultivars have a similar reaction towards the tested pathogens either alone or in combination. The four cultivars were susceptible to sudden wilt diseases. However, the more the pathogens combined the more the number of infected plants of each cultivar.

Table (1): Varietal reaction of four cantaloupe cultivars to sudden wilt pathogens, under greenhouse condition.

Pathogen	Cultivars / Mean of sudden wilt infection (%)				
	Galia	Rafigal	Ideal	Primal	Mean
1- <i>F. solani</i>	3.69	3.69	5.31	3.69	4.09
2- <i>M. phaseolina</i>	3.69	3.69	5.31	3.69	4.09
3- <i>P. aphanidermatum</i>	0.71	0.71	5.31	0.71	1.86
4- <i>R. solani</i>	0.71	0.71	5.31	0.71	1.86
5- <i>M. cannonballus</i>	3.69	3.69	3.69	3.69	3.69
Mean	2.49	2.49	4.98	2.49	3.11
1+2	5.31	5.31	3.69	3.69	4.50
1+3	3.69	3.69	3.69	3.69	3.69
1+4	3.69	0.71	5.31	3.69	3.35
1+5	5.31	5.31	5.31	0.71	4.16
2+3	0.71	0.71	3.69	3.69	2.20
2+4	3.69	3.69	3.69	3.69	3.69
2+5	5.31	5.31	3.69	3.69	4.50
3+4	0.71	0.71	12.69	0.71	3.70
3+5	0.71	0.71	12.69	0.71	3.70
4+5	0.71	0.71	12.69	0.71	3.70
Mean	2.98	2.68	6.71	2.49	3.72
1 + 2 + 3	5.31	5.31	9.00	5.31	6.23
1 + 2 + 4	5.31	5.31	5.31	5.31	5.31
1 + 2 + 5	9.00	9.00	5.31	3.69	6.75
1 + 3 + 4	12.69	12.69	12.69	12.69	12.69
1 + 3 + 5	26.56	26.56	26.56	26.56	26.56
1 + 4 + 5	24.64	24.64	26.56	26.56	25.60
2 + 3 + 4	16.38	16.38	11.25	11.25	13.81
2 + 3 + 5	25.69	29.22	29.22	29.22	28.33
2 + 4 + 5	24.64	26.56	23.31	25.69	25.05
3 + 4 + 5	29.09	29.09	29.09	30.08	29.33
Mean	17.93	18.47	17.83	17.63	17.96
1 + 2 + 3 + 4	29.09	29.09	29.09	29.70	29.24
1 + 2 + 3 + 5	33.21	36.77	36.77	37.98	36.18
1 + 2 + 4 + 5	36.77	39.13	39.13	43.810	39.71
2 + 3 + 4 + 5	29.09	29.09	29.09	29.70	29.24
Mean	32.04	33.52	33.52	35.29	33.59
1 + 2 + 3 + 4 + 5	40.27	42.69	47.31	47.31	44.39
Control	0.71	0.71	0.71	0.71	0.71
Mean	16.07	16.76	18.51	17.65	17.24
L.S.D. at 5 %	1.22	0.56	1.14	1.58	

*Mean of five replicates. Percentages data were arcsine-transformed before carrying out the analysis of variance.

Analysis of variance of this experiment, (Table 2) shows that each of the individual pathogen or different combinations was highly significant and differed in their virulence on cantaloupe cultivars. Similarly, differences among cantaloupe cultivars were significant when tested against the individual pathogen or different combinations. Moreover, pathogens/cultivars interaction was always a significant source of variation in sudden wilt incidence suggesting that, the individual pathogen or different combinations responded differently with the different cultivars tested.

Host range:

Data obtained in Table (3) indicate that all the tested cucurbit hosts were susceptible to each one of the sudden wilt fungal pathogens either alone or in all possible combinations but they differed in their reaction in this respect. In most cases, increasing the number of the causal agents added in different combinations showed high level of aggressiveness on the tested hosts.

Cucumber plants cv. Beit alpha were severely infected by the causal agent combinations of (*F. solani* + *M. phaseolina* + *P. aphanidermatum* + *M. cannonballus*) followed by (*F. solani* + *P. aphanidermatum* + *R. solani*) and (*F. solani* + *M. cannonballus*). In addition, *M. phaseolina* alone was highly pathogenic, while *P. aphanidermatum* was the least one in this respect.

Squash plants cv. Eskandarani showed higher infection by all fungal combinations including three fungi except *F. solani* + *M. phaseolina* combined with each of *P. aphanidermatum* and *R. solani*. In addition, the combinations of either any four fungi or five were highly pathogenic on squash, while, combinations of *F. solani* + *M. phaseolina* with *P. aphanidermatum* or *R. solani* were the least pathogenic.

Watermelon plants cv. Giza 1 showed highly infection by *F. solani* + *P. aphanidermatum* combined with either *R. solani* or *M. cannonballus* as well as *M. phaseolina* + *P. aphanidermatum* + *R. solani*.

Snake cucumber plants cv. Napolsi was highly infected by (*P. aphanidermatum* + *R. solani*) combined with *F. solani* or *M. phaseolina*. While either *M. phaseolina* or *M. cannonballus* alone and *P. aphanidermatum* combined with either *F. solani* or *M. cannonballus* were the least effective since they gave the least percentage of infection (10%).

Loofah plants cv. Balady (land race) were severely infected by (*M. phaseolina* + *R. solani*), combined with *F. solani* or *M. cannonballus* as well as combination of *M. phaseolina* + *P. aphanidermatum* + *R. solani* + *M. cannonballus* resulted in 50% infection. However, the combination of *P. aphanidermatum* + *R. solani* + *M. cannonballus* gave the least percentage of infection (10%).

Irrigation Regime:

Effect of different distances between irrigation nozzle and plant position on the soil bed:

The effect of different distances between irrigation nozzle and plant position on the bed on sudden wilt disease infection on cantaloupe was studied in the field during summer of 2009. Data presented in Table (4) show that increasing the distance of irrigation nozzle by 10, 15 or 25 cm away from the cantaloupe plant position on the bed significantly decreased the mean percentage of infection with sudden wilt disease. The more the distance of the irrigation nozzle, up to 25 cm the less disease development, and vice versa.

Effect of different intervals of irrigation on the sudden wilt infection of cantaloupe, under field conditions:

The effect of intervals of irrigation regime on the development of sudden wilt infection on cantaloupe was studied in field plots infected by *F. solani*, *M. phaseolina*, *P. aphanidermatum*, *R. solani*, and *M. cannonballus* during the winter and summer seasons of 2009.

Results presented in Table (5) showed that percentage of sudden wilt infection caused by *P. aphanidermatum* and *M. cannonballus* increased by increasing the intervals between irrigation times in winter season. In summer season, however, sudden wilt infection caused by *M. cannonballus* increased by increasing the intervals between irrigation times.

The effect of water saturation levels and three soil types on sudden wilt infection of cantaloupe under greenhouse condition:

Data in Table (6) showed that the highest sudden wilt infection on cantaloupe plants was in loamy followed by clay then sandy soils. The three types of soil exhibited the highest percentage of sudden wilt infection when reached 50 and 100 % of water saturation level.

Table (2): Analysis of variance of reaction of four cantaloupe cultivars to the five pathogens and their different combinations.

Source of variance	Degree of freedom	Sum of square	Mean of square	F - value
Pathogens treatments	30	9520.15	308.34	166.49**
Cultivars	3	38614.87	12871.62	6957.63**
Pathogens X Cultivars	90	31965.66	355.17	225.33**
Error	218	402.53	1.85	

** Significant at $P < 0.01$.**Table (3):** Average percentage of infection by the causal agents of sudden wilt on various cucurbitaceous hosts, under greenhouse condition.

Pathogen	Cucurbitaceous hosts / Mean of sudden wilt infection (%)					
	Cucumber	Squash	Water-melon	Snake cucumber	Loofah	Mean
1- <i>F. solani</i>	20	30	30	30	20	26
2- <i>M. phaseolina</i>	30	30	10	10	20	20
3- <i>P. aphanidermatum</i>	10	20	20	20	20	18
4- <i>R. solani</i>	15	30	30	20	20	23
5- <i>M. cannonballus</i>	15	30	10	10	30	19
Mean	18	28	20	18	22	21.2
1+2	30	30	15	20	30	25
1+3	20	30	10	10	20	18
1+4	20	20	20	20	30	22
1+5	35	35	20	20	20	26
2+3	20	30	10	20	20	20
2+4	20	35	35	15	35	28
2+5	20	40	10	15	20	21
3+4	15	45	10	15	20	21
3+5	20	40	20	10	20	22
4+5	20	20	20	20	20	20
Mean	22	32.5	17	16.5	23.5	22.3
1+ 2+ 3	20	15	10	25	18	17.6
1+ 2+ 4	20	10	20	20	50	24
1+ 2+ 5	25	50	20	35	20	30
1+ 3+ 4	40	50	50	50	25	43
1+ 3+ 5	20	45	50	20	20	31
1+ 4+ 5	30	50	20	20	20	28
2+ 3+ 4	20	50	50	50	20	38
2+ 3+ 5	20	50	20	20	20	26
2+ 4+ 5	20	50	25	25	50	34
3+ 4+ 5	20	50	20	20	10	24
Mean	23.5	42	28.5	28.5	25.3	29.56
1+ 2+ 3+ 4	20	50	20	20	20	26
1+ 2+ 3+ 5	50	50	50	20	20	38
1+ 2+ 4+ 5	20	50	50	20	20	32
2+ 3+ 4+ 5	20	50	20	20	50	32
Mean	27.5	50	35	20	27.5	32
1+ 2+ 3+ 4+ 5	20	50	20	30	20	28
Control	0	0	0	0	0	
Mean	22.2	40.5	24.1	22.6	23.66	26.6

Table (4): Effect of different distances between irrigation nozzle and plant position on the bed on sudden wilt disease infection in the field during summer of 2009.

Distance between irrigation nozzle and plant position (cm)	% infection (70 days after sowing)
10	12
15	10
25	8
L. S. D. at 5%	1.1

Table (5): Effect of intervals of irrigation on sudden wilt infection on cantaloupe plants on cv. Galia (70 days of sowing) in pots, under field conditions, during winter and summer seasons of 2009.

Fungi	Percentage of sudden wilt infection						Mean
	Winter			Summer			
	6 days	9 days	12 days	6 days	9 days	12days	
<i>F. solani</i>	25	50	20	35	65	20	35.8
<i>M. phaseolina</i>	10	65	30	20	70	20	35.8
<i>P. aphanidermatum</i>	59	75	85	30	35	40	54.0
<i>R. solani</i>	15	50	20	25	60	30	33.3
<i>M. cannonballus</i>	35	70	80	40	75	85	64.2
Control without inoculation	0	0	0	0	0	0	
Mean	24.0	52.5	39.2	25.0	50.8	32.5	
L.S.D. at 5% for:							
Fungi (F)	4.2			6.0			
Intervals (I)	7.1			9.2			
F X I	10.4			12.5			

Table (6): Effect of soil types and different levels of water saturation on sudden wilt infection on cantaloupe (cv. Galia), under greenhouse conditions

Fungi	Soil Types												Mean
	Clay				Loamy				Sandy				
	% of saturation				% of saturation				% of saturation				
	25	50	100	Mean	25	50	100	Mean	25	50	100	Mean	
<i>F. solani</i>	35	45	20	33.33	35	50	20	35.00	30	35	20	28.33	32.22
<i>M. phaseolina</i>	20	35	25	26.76	35	45	20	33.33	10	25	20	18.33	26.14
<i>P. aphanidermatum</i>	30	60	65	51.67	35	70	80	61.67	25	40	40	35.00	41.44
<i>R. solani</i>	30	50	25	35.00	35	60	30	41.67	25	45	20	30.00	35.55
<i>M. cannonballus</i>	25	40	60	41.67	30	70	75	58.33	20	30	40	30.00	29.44
Mean of saturation	28	46	39		34	59	45		22	35	28		
Mean of soil types	37.67				46				28.33				

4. Discussion

In the past two decades, a destructive disorder of cantaloupe (*Cucumis melo* L.), characterized by sudden (commonly within 2 weeks to harvest) and generally uniform collapse of entire fields has plagued the cantaloupe industry in warmer climatic production regions (Reuveni *et al.*, 1983, Eyal and Cohen, 1986, Martyn and Miller, 1996, Pivonia *et al.*, 1996b, and Pivonia *et al.*, 1997). Common names of the disorder include crown blight, collapse, vine decline, quick decline and sudden wilt (Reuveni *et*

al., 1983, Eyal and Cohen, 1986, Stanghellini *et al.*, 1995, Cohen *et al.*, 1996).

In the present study, a considerable number of fungi have been reported as causal agents of melon collapse worldwide, but descriptions of vine and root symptoms have often been overlapping and the cause of vine collapse in many cases is unclear. In (1970, Troutman and Matejka) concluded that *R. solani*, *Verticillium albo-atrum*, and an unidentified fungus which was later described as *M. cannonballus* (Pollack and Uecker, 1974), were the primary fungi

associated with cantaloupe collapse and decline in Arizona. In Israel, growing melons as a monoculture crop, without crop rotation and without MB fumigation between the growing seasons, resulted in severe cases of sudden wilt. The causal agent of this phenomenon has not been identified in all cases. Several soil borne pathogens, such as *F. solani* (Mart.) Sacc. f. sp. *cucurbita* W.C. Snyder & H.W. Hans, *F. equiseti* (Corda) Sacc., *M. phaseolina* (Tassi) Goid, and *Monosporascus eutypoides* (Petra) von Arx have been isolated from such wilted plants in various regions in Israel (Reuveni *et al.*, 1983, Eyal and Cohen, 1986 and Pivonia *et al.*, 1996a). In Israel, field trials and inoculation experiments conducted by (Reuveni *et al.*, 1983) showed that *M. eutypoides* was a primary agent of melon collapse in the Jordan Valley, which is a hot and arid region. In Texas, a root rot-vine decline of muskmelon was first reported in 1988 (Champaco *et al.*, 1988) and was subsequently attributed to *M. cannonballus* (Mertely *et al.*, 1991). *M. cannonballus* (Pollack & Uecker 1974) was reported as the main pathogen in the southern part of the United States (Mertely *et al.*, 1993, Martyn and Miller, 1996); while in the Northeastern States, vine decline was associated with Fusarium wilt and cucumber mosaic virus (CMV) (Zitter, 1995). A sudden wilt of melons in California has been attributed to *Pythium ultimum*, *P. aphanidermatum*, and *P. myriotylum* (Gottlieb and Butler, 1939, and Amann, 1989). Four fungi (*F. solani*, *M. cannonballus*, *M. phaseolina*, and *Stangospora* sp.) were frequently isolated from muskmelon roots suffered from root rot/vine decline disease. *Pythium spp.*, *Cephalosporium* sp., and *F. oxysporum* were also encountered but at relatively low frequencies (Mertely *et al.*, 1991). (Bruton *et al.*, 1998) have classified diseases causing vine decline in mature melon plants into three groups. The first group contains the vascular wilts which are represented by *Fusarium oxysporum* and *Verticillium dahliae*. The second group contains the crown-rot fungi represented by *Myrothecium roridum* and *Macrophomina phaseolina*. The third group contains the root-rot fungi that incite melon declines represented by *Monosporascus cannonballus* and *Acremonium cucurbitacearum*.

Four cantaloupe varieties, Galia, Rafigal, Ideal and Primal the most commonly grown in Egypt were tested against the most common pathogens *i.e.* *F. solani*, *M. phaseolina*, *P. aphanidermatum*; *R. solani* and *M. cannonballus* alone and in all possible combinations under greenhouse condition. Results showed that the tested varieties have a similar susceptibility reaction towards the tested pathogens either alone or in combination. The more the pathogens combined the more the number of infected

plants of each variety. The use of varieties resistant to plant diseases is one of the best control measures, but according to the available literature there are currently no commercially available sudden wilt resistant varieties. However, (Mertely *et al.*, 1993) reported that honeydew varieties are more resistant than either cantaloupe or watermelon varieties. In a preliminary evaluation, (Wolff 1995) found 108 of 130 muskmelon cultigens were moderately to highly susceptible to root rot and vine decline in the field. 'Deltex', an Ananas type melon was found to be more tolerant to root rot, vine decline than commonly used commercial varieties of cantaloupe such as 'Caravelle'. The reduction in the incidence of wilt may be partially due to root system size and structure; 'Deltex' has a more vigorous root system, giving it better adaptation to dry-land production.

Five cucurbit hosts, cucumber, loofah, snake cucumber, squash, and watermelon, were subjected to the infection by the tested pathogens alone or in combination. The tested cucurbit hosts were susceptible to each one of the sudden wilt fungal pathogens either alone or in all possible combinations but they differed in their reaction in this respect. In most cases, the more the pathogens combined the more the number of infected plants of each cultivar. Although sudden wilt phenomenon was originally reported on cantaloupe, watermelon is highly susceptible, cucumber and summer squash are somewhat susceptible, and pumpkin, several winter squashes, bottle gourd (*Lagenaria siceraria*) and sponge gourd (*Luffa aegyptiaca*) have been shown through greenhouse tests to be susceptible as well (Mertely *et al.*, 1993).

In field experiment using drip irrigation system where the irrigation nozzles were positioned 10, 15, and 25 cm away from cantaloupe plant position on the cultivation bed, the percentage of sudden wilted plants were determined. Results showed that increasing the distance of irrigation nozzle by 10 cm, 15 or 25 cm away from the cantaloupe plant position on the bed significantly decreased the mean percentage of infection with sudden wilt disease. The more distance of the irrigation nozzle, up to 25 cm, the less the disease development, and vice versa. The effect of the intervals between irrigation times on the development of sudden wilt symptoms on cantaloupe grown in infested field plots showed that percentage of sudden wilt infection caused by *P. aphanidermatum* and *M. cannonballus* increased by increasing the intervals between irrigation times in winter season. However, sudden wilt infection caused *M. cannonballus* increased by increasing the intervals between irrigation times. (Cohen *et al.*, 2000) reported that in the daily irrigated plots, first wilt

symptoms were observed 47 days after planting, and melon plants totally collapsed 13 days later. However, in the less frequently irrigated melon plants, first wilt symptoms were observed 60 days after planting. In the daily irrigated plots, the root system penetrated to a depth of 20 cm, whereas plant roots under the less frequent irrigation scheme penetrated the soil to depth of 40 cm. Manipulating root system size through modifications in an irrigation scheme effectively reducing disease incidence. However, irrigation cannot be used effectively as the only management practice (Cohen *et al.*, 2000).

In the present study the highest sudden wilt infection on cantaloupe plants was in loamy followed by clay then sandy soils. The three types of soil exhibited the highest percentage of sudden wilt infection when reached 50 % of water saturation level. *P. aphanidermatum*, and *M. cannonballus* caused the highest sudden wilt incidence in clay and loamy soils at 50 and 100 % water saturation levels. Martyn (2007) reported that heavy soils are more conducive to vine declines of melon than light, sandy soils, but this is not always the case.

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