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PATHOLOGICAL STUDIES ON *FUSARIUM* SPECIES AFFECTING COTTON PLANTS

Abdel-Latif, M.R.; Z.A. Shehata, A.A. Galal, E.M. Hussein and A.M. El-Samawaty[(1)]

Plant Pathol. Dept., Fac. Agric., Minia Univ., Minia, Egypt

[(1)] Plant Pathol. Inst., Agric. Res. Center, Giza, Egypt

ABSTRACT

Nine *Fusarium* species, i.e. *fusarioides, moniliforme, subglutinans, oxysporum, poae, sambucinum, semitectum, solani* and *sporotrichioides* were isolated. Since *F. fusarioides* and *F. sporotrichioides* recorded as new additional pathogens to cotton plants. While *F. solani* expressed the highest disease severity (59%) and *F. fusarioides* gave the least disease severity (47.75%). Cotton Giza 87 cv. showed the least disease severity (40.4) and Giza 90 existed the most susceptible one (54.5% disease severity).

Frequency of *Fusarium* species associated with cotton seeds, seedlings or plants was varied with sampling date, location, cotton cultivars and previous crops. Since the least frequency was obtained in April 2000 (35.58%), while the highest frequency (69.2%) was given by June 2000. Previous crop broad bean exhibited higher frequency than clover plants. Seeds of cotton Cultivar Giza 89 gave the highest frequency (12%) while cv. Giza 85 revealed the least frequency (2%).

Fusarium species were infected cowpea, roselle and okra plants. Roselle plants were the most susceptible (gave 36.7% disease severity) while okra plants were the least susceptible (expressed 24.75% disease severity). Negative correlation was pronounced between plant age and infection with *Fusarium* species where 30 days old plants showed resistance against all tested fusaria (showed 4.4% disease severity) as compared to infection planting time. *F. moniliforme* and *F. semitectum* have ability to infect all cotton organs tested. *F. poae* infected cotyledons, flowers and bolls. Only cotyledons and followers were infected by *F. fusarioides*. Otherwise *Fusarium* species had no ability to infect these organs.

INTRODUCTION

Fusarium spp. occur frequently among the fungal microflora associated with cotton seedling diseases and are a major cause of seedling death in some countries involving Egypt (Mohamed, 1962; Watkins, 1981 and Minton and Garber, 1983). Jakob (1969) isolated 97 isolates of *Fusarium* spp. from seedlings of Egyptian cotton infected with damping-off pathogens. These isolates were classified as *F. oxysporum* (56.7%), *F. moniliforme* (23.7%), *F. solani* (9.3%), *F. orthoceras* (5.2%), *F. scirpi* (4.1%) and *Fusarium* sp. (1%). *Fusarium oxysporum* and *F. moniliforme* were the only infective to cotton seedlings while other species were categorized as wound parasites or saprophytes.

Soleymani *et al*. (1993) showed that *F. moniliforme, F. buharicum* and *F. equiseti* were the most common fungi isolated from seeds of different cotton cultivars, which collected from the major cotton producing areas in Iran. Zhang-Jiuxu *et al*. (1995) found that *F. oxysporum, F. solani, F. equiseti, F. nygamai* and *F. semitectum* were present on the rhizoplane of cotton plants. *F. oxysporum* and *F. solani* were the dominant species. *F. nygamai* was a new species record for the United States. Wrather *et al*. (2002) indicated that

Fusarium spp. was included in fungi associated with post emergence cotton seedling in Missouri, USA. When, Aly *et al*. (1996) conducted a survey encompassed 88 samples of infected cotton roots from different governorates in Egypt. *Fusarium* spp. were isolated from 97.7% of the samples examined. They also reported that *F. oxysporum* and *F. moniliforme* were the important pathogens in the etiology of cotton damping-off in Egypt. The importance of *F. oxysporum* was due to its high frequency of isolation, while the importance of *F. moniliforme* was due to its high virulence.

El-Samawaty (1999) isolated 55 isolates of *Fusarium* spp. from 79 samples of cotton seedlings suffered from post emergence damping-off or rotted roots of adult cotton plants grown in Upper Egypt Governorates. These isolates were *F. oxysporum* (52.7%) *F. solani* (15.5%), *F. moniliforme* (5.5%) and *F. semitectum* (5.5%). Each of *F. tobacinum, F. sambucinum, F. avenaceum* and *F. poae* were represented only by one isolate. Two isolates were belonging to unknown *Fusarium* sp. *Fusarium moniliforme, F. oxysporum, F. semitectum* and *F. solani* were associated with damping-off, root rot and wilt diseases influenced cotton plants in Minia governorate (Armanious-Hanaa, 2000).

Either incidence or severity of cotton damping-off, root rot or wilt is strongly affected by cotton cultivars particularly under artificial-inoculation of pathogens (Aly *et al*. 1996 and Galal *et al*., 2001). While cotton cv. Giza 75 has no resistance to *F. oxysporum* f. sp*. vasinfectum* infection since cv. Giza 74 was resistant in this respect (Aly *et al*., 1996). When ten cotton cultivars tested against infection with either *Fusarium oxysporum* f. sp. *vasinfectum* or *Macrophomina phaseolina*, one cultivar, Giza 86, was partially resistant while Giza 77 was the highest susceptible to infection with both fungi (Galal *et al*., 2001).

Beside cotton roots, *Fusarium* was recovered from the rotted bolls of cotton (Patil *et al*., 1991; Hillocks, 1992; Abd El-Rehim *et al*., 1993; Tahir and Mahmoud, 1995; Wang *et al*., 1998 and Galal *et al*., 2001). On the other hand, Patil *et al*. (1991) isolated *Fusarium pallidoroseum* from cotton leaves during Aug. 1988 at Rahuri, Maharashtra, India. Host age plays a major role in the development of several plant diseases (Hart and Endo, 1981; Sippell and Hall, 1982 and Galal *et al*., 2001).

MATERIALS and METHODS

1. Isolation, purification and identification of *Fusarium* spp.; and other fungi from cotton seedlings, roots and seeds:

Isolation from roots was made using 135 samples collected from different locations of 3 Governorates, i.e. El-Minia, Assiut and Sohag during growing season 2000. Planting date, previous crop and cotton cultivar were recorded for each sample. Each sample included 10 to 15 seedlings affected with a variety of damping-off symptoms or rotted roots of 5 adult plants. Diseased cotton seedlings or plants were removed from the field and washed thoroughly under running tap water to remove any adhering soil. Small pieces (approximately 0.5 cm long) of necrotic root and hypocotyl tissue were

surface sterilized with 10% chlorox solution for 2 minutes, and washed several times with sterilized water. The surface sterilized pieces were then blotted dry between sterilized filter papers and placed (5 pieces/plate) on potato dextrose agar (PDA) medium amended with penicillin G 30µg/ml and rose bengal to eliminate bacterial contamination. The plates were incubated at 26±3°C for 3-7 days.

The developing colonies were purified by single spore, and/or hyphal tip techniques (Abdel-Latif, 1976). Pure cultures of the isolated *Fusarium* spp. were identified to species level according to the descriptions of *Fusarium* by Booth (1971), Nelson *et al*. (1983) and Windls (1991). The obtained isolates were divided into 9 groups. From each group a representative isolates were subjected to identify the species. However, the identification representative isolates was confirmed in Department of Botany, Faculty of Science, South Valley University, by Dr. A.I. Ismail. Colonies of each fungus were expressed as percentage of the total developing colonies.

Isolation from seeds of 9 cotton cultivars was carried out according to the same method previously used in isolation from roots. There were 20 replicates (plates) for each treatment (cultivar), and each plate contained five seeds. Seeds were obtained from Res. Section of Cotton and Fiber Crop Diseases, Plant Pathology Research Inst., Agric. Res. Center, Giza, Egypt.

2. Pathogenicity test of *Fusarium* spp.

Substrate for growth of the tested isolates of *Fusarium* was prepared in 500-mL glass bottles; each bottle contained 100 g of sorghum grains and 80 mL of tap water (Aly *et al*., 1996). Contents of each bottle were autoclaved for 30 minutes. Isolate inoculum, taken from one-week old cultures grown on potato dextrose agar (PDA), was aseptically introduced into the bottle and allowed to colonize sorghum for 3 weeks. Pathogenicity tests were carried out by using autoclaved clay loam soil. Batches of soil were infested separately with inoculum of each isolate at the rate of 50 g/kg of soil (Abdel-Latif, 1976).

Infested soil was dispersed in 15-cm diameter clay pots and these were planted with 10 seeds per pot (cultivar Giza 80 or Giza 83 individually). In the control treatment, non-infested sterilized sorghum grains were mixed thoroughly with soil at the rate of 50 g/kg of soil. Pots were randomly distributed on greenhouse bench. The prevailing temperature during pathogenicity tests was 21.5$\pm$6.5 (minimum) and 36.5$\pm$5.5 (maximum). Disease severity was assessed till 45 days after planting.

3. Disease severity assessment:

Emergence, 15 and 30 days from planting was estimated .At 45-day old, survival cotton plants were removed from the soil and washed thoroughly to remove soil debris and scored for root discoloration according to Kraft *et al*., (1981) and Allam (1990) as follows: 0= roots without discoloration (no infection), 1= 1-20%, 2= 21-40%, 3= 41-75%, 4= 76-100% discoloration root mass and 5= completely dead plants. A mean disease rating (disease severity, DS) for each replicate was calculated by multiplying the number of

plant in each category by their numerical rating adding the rating, and dividing the total number of plants rated according to the following formula:

DS= {(nX1)+(nX2)+(nX3)……(nXy)/5Xn}X100

Where: n= the total number of plants

5= the maximum rating which included pre-, post-emergence damping off and the dead adult plants.

4. Reaction of cotton cultivars to infection by *Fusarium* spp.

Response of ten cotton cultivars, namely Giza 45, Giza 70, Giza 80, Giza 83, Giza 85, Giza 86, Giza 87, Giza 88, Giza 89 and Giza 90 to *Fusarium fusarioides, F. semitectum, F. poae, F. sambucinum, F. oxysporum*, *F. moniliforme* var. *subglutinans, F. moniliforme, F. solani* and *F. sporotrichioides* infections was tested similarly as previously mentioned in the pathogenicity test.

5. Host range:

Cowpea (*Vigna sinensis* cv. Cream 7), Roselle (*Hibiscus sabdariffa,* cv. Balady), and Okra (*Hibiscus esculentus,* cv. Balady) were evaluated to infection with *Fusarium* spp. (9 species) according to method in the pathogenicity test.

6. Factors affecting cotton infection by *Fusarium* spp.

6.1. Plant age:

Inoculums of pathogenic isolates of *Fusarium* spp. (9 species) were prepared as above described. This inoculum was used to infest autoclaved clay loam soil at the rate of 50 g/kg soil. Inoculum was added at (0.0) planting time, 15 and 30 days after planting. Infested soil was dispensed in 30-cm diameter clay pots, then planted with 10 seeds/pot (c.v. Giza 83). In the control (non-inoculated) treatments, autoclaved sorghum grains were mixed thoroughly with soil at the rate of 50 g/kg soil and five replications (pots) for each treatment. Pots were randomly distributed on a greenhouse bench under a temperature regime from 27.5±2°C to 37±3°C. Disease severity (%) was recorded for each date after 45 days from inoculation date.

6.2. Plant organs:

a- Cotyledons and leaves inoculation:

Cotyledons and true leaves of 30 days old seedlings cv. Giza 83 were wounded by using carborandum (400 mesh) and inoculated by spraying the suspension of pathogenic isolates of *Fusarium* spp. (9 species) to be tested (inoculum density was 10^4 propagule/ml suspension). After inoculation the plants were covered with polyethylene bags for 48 hr. Disease severity index (DSI) was recorded 20 days after inoculation. Each treatment consisted of 5 replicates (5 plants per replicate). In control, plants were sprayed with sterilized distilled water instead of inoculum.

b- Flower inoculation:

Healthy apparently flowers were inoculated by spraying 10^4 propagules/ml suspensions of pathogenic isolates to be tested, and then covered with polyethylene bags for 2 days. Plants were sprayed with sterilized water used for control. DSI was recorded 20 days after inoculation.

c- Boll inoculation:

Cotton cv. Giza 83 bolls (unopened green bolls) were scratched and inoculated as described above with leaf inoculation. DSI was recorded 20 days after inoculation.

Disease assessment:

Disease severity index (DSI) of inoculated cotyledons, leaves, flowers and bolls was assayed using scale from 0.0 to 4, where 0.0= no symptoms,1= 1-25%, 2=26-50%, 3=51-75% and 4= up to 75% blighted area as described by (Vakalounakis, 1990).

RESULTS AND DISCUSSION

1- Isolation, identification and pathogenicity test:

Forty one isolates of different species belonging to genus *Fusarium* (Table 1) were obtained from cotton seedlings or plants infected with damping-off or rotted roots symptoms. In addition some other fungi belonging to different genera, listed in Table (2), were also isolated. Among 41 *Fusarium* isolates, nine species were identified according to the descriptions of Booth (1971), Nelson *et al*. (1983) and Windels (1991), and confirmed in the Fac. Science, South Valley Univ. *Fusarium fusarioides* Booth. (one isolate), *F. moniliforme* Sheldon. (4 isolates), *F. subglutinans* Wollenw. & Reinking (one isolate), *F. oxysporum* (Schlecht) emedn. Snyd. & Hans. (9 isolates), *F. poae* (Peck) Wollenw (2 isolates), *F. sambucinum* Fuckel. (3 isolates), *F. semitectum* Berk. & Rav. (3 isolates), *F. sporotrichoides* Sherb. (2 isolates) and *F. solani* (Mart) Appel & Wollenw. emend. Snyd. & Hans. (16 isolates).

All 41 isolates were tested for their pathogenicity to 2 cotton cultivars (Table 1 and Fig. 1). *Fusarium* isolates gave various abilities to infect the 2 tested cotton cultivars. Isolates of *F. solani* and *F. oxysporum* were collectively the predominant group of the tested isolates of *Fusarium* spp. (60.79% frequency) as well as the predominant group of the pathogenic isolates of *Fusarium* spp. (58.1% disease severity). *F. fusarioides* represented as *F. subglutinans* (2.44%). *F. fusarioides* was more (caused 60% disease severity) pathogenic than *F. subglutinans* (caused 40% disease severity) on cv. Giza 80 while *F. subglutinans* was more pathogenic (caused 56.6% disease severity) than *F. fusarioides* (caused 28.3% disease severity) on cv. Giza 83. However, *F. sambucinum* represented as *F. semitectum* (7.32% frequency) but isolates of *F. sambucinum* were more pathogenic than of *F. semitectum* on both cultivars.

Table 1: Disease severity (%) to cotton cultivars Giza 80 and Giza 83 grown under inoculation with different *Fusarium* isolates.

***Fusarium* species isolates**	**No. of**	**[a]Disease severity (%) To cotton cultivar**		**Mean**
		Giza 80	**Giza 83**	
Control		0.0	0.0	0.0
F. fusarioides	1	60.00	28.3	44.16
F. moniliforme	4	67.9	55.4	30.82
F. subglutinans	1	40.0	56.6	48.30
F. oxysporum	9	66.70	38.3	52.50
F. poae	2	64.2	65.8	65.0
F. sambucinum	3	66.7	67.7	67.2
F. semitictum	3	37.3	45.5	41.4
F. sporotrichoides	2	75.9	57.5	66.7
F. solani	16	59.2	43.8	51.5
Mean		56.91	47.45	
LSD at 0.05 for: Isolates of *Fusarium* spp. (A) =			9.30	
Cultivars (B)		=	2.0	
A x B		=	13.15	

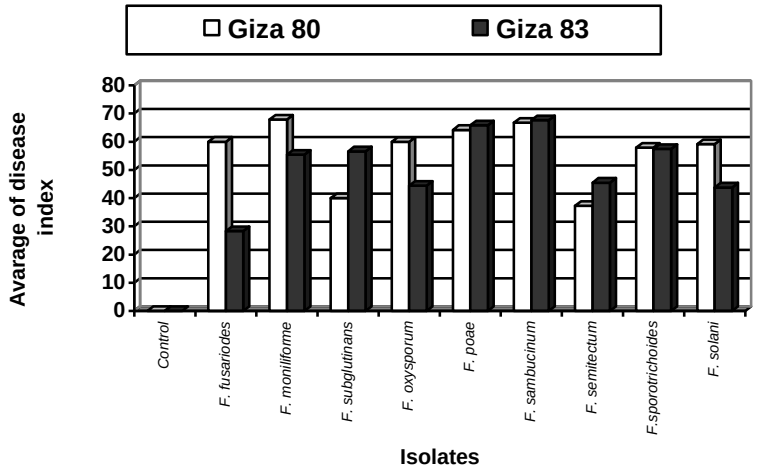

Figure 1: Average of Disease severity (%) to cotton cultivars Giza 80 and Giza 83 grown under inoculation with different *Fusarium* isolates, i.e. *Fusarium fusarioides* (one isolate), *F. moniliforme* (4 isolates), *F. subglutinans* (one isolate), *F. oxysporum* (9 isolates), *F. poae* (2 isolates), *F. sambucinum* (3 isolates), *F. semitectum* (3 isolates), *F. sporotrichoides* (2 isolates) and *F. solani* (16 isolates).

Data assumed that *F. solani* isolates were the predominant followed by isolates of *F. oxysporum*. However, 7 species of *Fusarium,* e.g. *F. oxysporum*, *F. moniliforme, F. moniliforme var subglutinans, F. poae, F. sambucinum, F. semitectum* and *F. solani* were recorded as cotton pathogens (Aly *et al*., 1996; Baird and Carling, 1998; El-Samawaty, 1999). Accordingly *F. fusarioides* and *F. sporotrichioides* recorded as new additional pathogens to cotton plants.

2. Survey of *Fusarium* spp. associated with cotton seedlings or plants:

Due to the great importance of *Fusarium* diseases affecting cotton plantations (Kumari and Mukewer, 2000; Wrather *et al*., 2002), this issue was insightly concerned in the present study. Survey studies (Table 2) revealed that the frequency of *Fusarium* species associated with cotton seedlings or plants was varied with sampling date, location, cotton cultivars and previous crops. Since the least frequency of *Fusarium* species was in April, 2000 (35.58%) while the highest frequency (69.2%) was proved in June, 2000. The build up of *Fusarium* population began with cotton rhizosphere at the first stages of growth development in April and reached to its maximum by June.

Table 2: Frequency of *Fusarium* spp. associated with cotton seedlings or plants grown in different location after various crops at different sampling dates.

Variable	No. of samples	% samples	Frequency (%) of	
			Fusarium spp.	Other fungi
Date of sampling				
April	[a]28	[b]20.74	[c]35.58 A	[d]64.42
May	39	28.89	45.04 B	54.96
June	31	22.97	69.20 EG	31.80
July	19	14.07	63.57 DFG	36.43
August	18	13.33	58.02 CF	41.98
Location				
Minia	45	33.33	49.63 A	50.37
Assiut	45	33.33	53.83 A	46.17
Sohag	45	33.33	54.95 A	45.05
Cultivar				
Giza 80	45	33.33	49.63 A	50.37
Giza 83	90	66.67	54.39 A	45.61
Previous crop				
Clover	53	39.26	48.98 A	51.02
Other crops	40	29.63	50.38 AC	49.62
Onion	18	13.33	55.59 ACE	44.41
Broad bean	24	17.78	58.06 BDE	41.94

[a] **Each sample consisted of 10-15 diseased seedlings with post emergence damping off or 5 diseased adult plants with root rot.**

[b] **Other crops were garlic, cumin, potato, lentil, cabbage, fenugreek, tomato.**

[c] **Means in a variable followed by the same letter(s) are not significantly different ($P \leq 0.05$) according to LSD test.**

[d] **Other fungi included *Rhizoctonia* spp., *Macrophomina phaseolina, Alternaria* spp., *Chaetomium* spp., *Humicola* spp., *Aspergillus* spp., *Penicillium* spp., *Rhizopus* spp., *Trichoderma* spp., *Helminthosporium* spp., and unidentified fungi.**

3. Survey of *Fusarium* species associated with seeds of cotton cultivars:

Insignificant differences in the frequency of Fusaria were recorded at 3 governorates tested in both cotton cvs. Giza 80 and Giza 83 (Table 3). Previous crop broad bean existed higher frequency than clover plants. Several investigators reported that previous crops play a major role in the frequency of soil borne fungi due to root exudates (Stevenson *et al*., 1995 and Mohamed, 2002). Otherwise, frequency of fusaria associated with cotton seeds were varied with cultivars. Cultivar Giza 89 gave the highest frequency (12%) while Giza 85 showed the least frequency (2%). Data suggest the occurrence of fusaria in either roots or seeds of cotton that mean *Fusarium* species are seed and/or soilborne fungi (Patil *et al*., 1991, Soleymani *et al*., 1993 and Idrees *et al*., 1999). Seeds of cotton cv. Giza 89 gave the highest frequency (12%) followed by cv. Giza 86 (8%). Meanwhile, both Giza 80 and Giza 85 showed the least frequency (2%).

Table 3: Frequency of *Fusarium* spp. associated with cotton seeds of different cotton cultivars.

Cultivars	Frequency (%) ± SD
Giza 45	6 ± 0.5*
Giza 70	6 ± 1.0
Giza 80	2 ± 0.2
Giza 83	4 ± 0.4
Giza 85	2 ± 0.4
Giza 86	8 ± 0.6
Giza 87	4 ± 0.5
Giza 88	6 ± 1.2
Giza 89	12 ± 2.0

*** Values are means of five replicates ± standard deviation (SD).**

4. Reaction of cotton cultivars to infection by *Fusarium* spp.:

Response of cotton cultivars to infection with *Fusarium* spp. was significantly varied (Table 4) all the tested cultivars were infected by all *Fusarium* spp. to be studied Giza 90 cultivar showed the highest percentage of infection (54.5%) followed by Giza 80 (48.63%) while Giza 87 cv. gave the lowest percentage (40.41%) of infection. *F. solani* caused the highest disease severity (59%) followed by *F. oxysporum* 57.55%, *F. sporotrichiodes* (54.05%) while *F. fusarioides* caused the lowest disease severity 47.75%. On the other hand, mixture of *Fusarium* spp. caused the least disease severity 39.2% from *Fusarium* spp. everyone. Several studies provided various responses for cotton cultivars to infection with several fungi (Aly *et al*., 1996 & 1998 and Galal *et al*., 2001).

5. Host range:

The present study showed that *Fusarium* species have various abilities to infect other plant species such as cowpea, roselle and okra (Table 5). Since roselle plants were the most infected (36.7%) followed by cowpea

(26.7%) and okra (24.75). *Fusarium moniliforme* was the most aggressive (caused 38.3% disease severity). On the other hand, *F. fusarioides* was the weakest pathogen (caused 29.15% disease severity). *Fusarium moniliforme* caused the highest disease severity to cowpea plants (57.5%). *F. sporotrichioides* exhibited the highest disease severity (45%) to roselle plants. Meanwhile, both *F. fusarioides* and *F. semitectum* caused the highest disease severity to okra plants. Some of *Fusarium* species have host specificity (Jadhav and Nimbalkar, 2000 and Yuan-Hong and Shang, 2002) while others have wide host range (Chongo *et al*., 2001 and Skovgaard *et al*, 2002). Increasing the number of host range for pathogen lead to make difficult control it (Agrios, 1997).

Table 5: Disease severity to cowpea, roselle and okra plants caused by infection with different *Fusarium* species.

***Fusarium* spp.**	**Cowpea %**	**Roselle %**	**Okra %**	**Mean**
1- Control	0.0	0.0	0.0	0.0
2- *F. fusarioides*	20.0	37.5	30.0	29.15
3- *F. semitectum*	27.5	40.0	30.0	32.50
4- *F. poae*	22.5	42.5	27.5	30.83
5- *F. sambacinum*	20.0	42.5	27.5	30.00
6- *F. oxysporum*	30.0	40.0	27.5	32.50
7- *F. subglutinans*	37.5	42.5	30.0	36.70
8- *F. moniliforme*	57.5	35.0	22.5	38.33
9- *F. solani*	32.5	42.5	25.0	33.33
10- *F. sporotrichioides*	19.5	45.0	27.5	30.65
Mean	26.7	36.75	24.75	
LSD at 0.05 for:				
Hosts (A)		=3.45		
Isolates of *Fusarium* spp. (B)		=6.01		
A x B		=10.92		

6- actors affecting cotton infection by *Fusarium* species:

The present results addressed other factors affecting *Fusarium* infectivity such as plant age and plant organs.

A negative correlation was recorded between plant age and infection with *Fusarium* species (Table 6). Increasing plant age decreased disease severity caused by *Fusarium* species and inoculation at 30 days after planting exhibited the least disease severity (4.4%). These findings are consistent with those reported by Galal *et al*. (2001).

Beside cotton roots, different organs were artificially infected by some species of *Fusarium*. Data revealed that both *F. moniliforme* and *F. semitectum* have ability to infect all cotton organs tested, i.e., cotyledons, true leaves, flowers and bolls. While, *F. poae* did not infect true leaves but infected cotyledons, flowers and bolls. *Fusarium fusarioides* infected cotyledons and flowers only. Otherwise *Fusarium* species have no ability to infect these organs. Tahir and Mahmoud (1995) reported that boll rot cuased by *Fusarium* was most prevalent in Kabirwala Tehsil; 74% of the localities

were affected. However, such kinds of knowledge are needed to make a correct decision for controlling *Fusarium* diseases.

Fusarium semitectum. *Fusarium moniliforme* gave the highest severity on leaves (42.57%) followed by *F. poae* (36.56%) and *F. semitectum* (30.52%). *Fusarium fusarioides* gave the least blight severity (13.04%) to cotyledonary leaves. Whereas the rest of the tested species were not able to infect the cotyledonary leaves.

Table 6: Root rot severity (%) to cotton plants cv. Giza 83 caused by *Fusarium* spp. infection as influenced by time of inoculation.

***Fusarium* spp.**	**Time of inoculation (days) after planting,**			
	0.0	**15**	**30**	**Mean**
1- Control (free of the fungus)	0.0*	0.0	0.0	0.0
2- *F. fusarioides*	32.5	6.25	6.25	15.0
3- *F. semitectum*	25.0	8.12	3.12	12.1
4- *F. poae*	27.5	16.87	7.15	17.17
5- *F. sambacinum*	45.0	11.11	5.0	20.37
6- *F. oxysporum*	47.5	8.57	6.25	20.77
7- *F. subglutinans*	22.5 a	9.37	0.0	10.62
8- *F. moniliforme*	37.5	8.12	5.55	17.05
9- *F. solani*	42.5	16.66	7.30	22.15
10- *F. sporotrichioides*	27.5	3.12	3.57	11.40
Mean	30.75	8.82	4.42	
LSD at 0.05 for:				
Time of inoculation (A)		=	4.2	
Isolates of *Fusarium* spp. (B)		=	7.6	
A x B		=	10.8	

*** Each treatment was evaluated for disease severity at 45 days after inoculation.**

Only 3 species of *Fusarium*, i.e. *moniliforme, sambucinum,* and *semitectum,* were infective to true leaves causing blight symptoms. *Fusarium moniliforme* gave the highest severity (23.42%), followed by *F. sambucinum* (11.24%) and *F. semitectum* (9.14%). In regard to flowers infections, 4 species, e.g. *F. fusorioides, F. moniliforme, F. poae* and *F. sambucinum,* have ability to infect flowers causing soft rot and blight symptoms. *F. moniliforme* was the most infective (45.19%) followed by *F. sambucinum* (31.5%), while *F. poae* showed the least severity (22.38%). Cotton bolls were infected by 3 species, i.e., *F. moniliforme, F. poae* and *F. sambucinum* where *F. moniliforme* caused the highest boll rot severity (38.87%) followed by *F. sambucinum* (21.41%) and *F. poae* (19.62%). Only two species *F. moniliforme* and *F. sambucinum* were able to infect all plant organs subjected to artificial inoculation (Fig. 2) *F. semitectum Fusarium moniliforme* gave the highest severity on leaves (42.57%) followed by *F. poae* (36.56%) and *F. semitectum* (30.52%). *Fusarium fusarioides* gave the least blight severity (13.04%) to cotyledonary leaves. Whereas the rest of the tested species were not able to infect the cotyledonary leaves.

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Figur*cinum* on cotyledons, leaves and bolls of cotton plants (cv. Giza 83).

Response of cotton organs to infection were varied with *Fusarium* spp. and organ tested (Table 7). Cotyledonary leaves were infected by *F. fusarioides, F. moniliforme, F. poae, F. sambucinum* and *F. semitectum*.

Table 7: Diseases severity index (%)[1] caused by *Fusarium* spp. to various organs of cotton plants cv. Giza 83.

Fusarium	Cotyledons	True leaves	Flowers	Bolls
1- *F. fusarioides*	13.04	0.0	25.21	0.0
2- *F. moniliforme*	42.57	23.42	45.19	38.87
3- *F. subglutinans*	0.0	0.0	0.0	0.0
4- *F. oxysporum*	0.0	0.0	0.0	0.0
5- *F. poae*	36.56	0.0	22.38	19.62
6- *F. sambacinum*	17.21	11.24	31.5	21.41
7- *F. semitectum*	30.53	9.14	0.0	0.0
8- *F. solani*	0.0	0.0	0.0	0.0
9- *F. sporotrichioides*	0.0	0.0	0.0	0.0
10- Control	0.0	0.0	0.0	0.0
LSD at 0.05	6.47	0.51	4.44	3.23

[1] **Data were recorded 20 days after inoculation.**

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دراسات مرضية لبعض أنواع الجنس *Fusarium* على نباتات القطن

مـرزوق رجـب عبـد اللطيـف ، زكـرى عطيـة شـحاته ، أنـور عبـد العزيـز جـلال ،عزت محمد حسين[!] وعبد الرحيم السمواتى[١]

كلية الزراعة - جامعة المنيـا - قسم أمراض النبات

[١] معهد بحوث أمراض النباتات ، مركز البحوث الزراعية - الجيزة

تم عزل واحد وأربعون عزلة تنتمى إلى الجنس *Fusarium* من بادرات وجذور نباتات قطن بالغة مصابة بموت البادرات أو الذبول (على الترتيب) وتم تصنيفها حيث وجد أنها تنتمى إلى تسعة أجناس هى فيوزاريوم فيوزاروید وفيوزاريوم مونيليفورمى ، وفيوزاريوم سبجلوتينانس وفيوزاريوم اوكسيسبورم وفيوزاريوم بويا وفيوزاريوم سامبيوسينم وفيوزاريوم سيميتكتم وفيوزاريوم سولانى وفيوزاريوم اسبوروتراكويد

أظهرت اختبارات القدرة المرضية لعزلات جنس الفيوزاريوم تنوع فى القدرة المرضية لهذه الأنواع تجاه أصناف القطن التى أختبرت عليها حيث أظهر النوع سولانى أعلى شدة اصابة ٥٩% فى حين أن النوع فيوزاروید كان أقل الأنواع فى شدة الإصابة ٤٧,٧٥% . من ناحية أخرى فإن أقل شدة اصابة ظهرت على الأصناف المختبرة كانت ٤٠.٤% على صنف جيزه ٨٧ فى حين أن أعلى شدة اصابة ٥٤,٥% ظهرت على صنف جيزة ٩٠ ، وجدير بالذكر أن النوعان فيوزاروید واسبوروتراكويد هما نوعان ممرضان جديدان على أصناف القطن المصرية .

وأظهر الحصر، ومن خلال العينات المصابة التى تم جمعها طوال موسم النمو، أن تكرار عزل جنس الفيوزاريوم المصاحب للبادرات أو النباتات البالغة المصابة تأثراً وتنوع بكل من وقت أخذ العينات والموقع الذى أخذت منه العينات والصنف والمحصول السابق. وجد أن أقل تكرار عزل للفيوزاريوم كان خلال شهر ابريل٢٠٠٠ م (٣٥,٨٥%) فى حين كان أكثر تكرار عزل خلال شهر يوليو ٢٠٠٠ م (٦٩,٢%) كذلك وجد أن تكرار عزل الفيوزاريوم من العينات التى جمعت من حقول كان المحصول السابق للقطن بها فول أكثر من التى كان المحصول السابق بها برسيم .

عند إجراء العزل من بذور ٩ أصناف قطن تجارية وجد أن تكرار عزل جنس الفيوزاريوم المصاحب لتلك البذور تباين باختلاف الأصناف ، وكان الفيوزاريوم أكثر تكراراً عند العزل من بذور صنف جيزه ٨٩ (١٢%) بينما كان أقل تكراراً (٢%) مع الصنف جيزه ٨٥ .

أوضحت الدراسة أن جميع أنواع الفيوزاريوم المختبرة كانت قادرة على اصابة نباتات اللوبيا والكركديه والبامية ، حيث وجد أن أعلى شدة اصابة لأنواع الفيوزاريوم ٣٦,٧% ظهرت على نباتات الكركديه فى حين أن أقل شدة اصابة ٢٤,٥% ظهرت على نباتات الباميا. وجد أيضاً أن أكثر أنواع الفيوزاريوم ضراوة هو النوع مونيليفورمى حيث حقق ٣٨,٣% شدة اصابة بينما كان النوع فيوزاروید هو أقل الأنواع قدرة على احداث الإصابة حيث أعطى ٢٩,١٥% شدة إصابة . كما لوحظ أن نباتات اللوبيا كانت أكثر قابلية للإصابة بواسطة النوع مونيليفورمى بينما نباتات الكركديه أظهرت أعلى قابلية للإصابة ٤٥% عند الإصابة بالنوع اسبوروتراكويد ، أما فى حالة نباتات الباميه فإن أعلى شدة اصابة ٣٠% حدثت عند الاصابة بكل من فيوزاريوم فيوزاروید أو فيوزاريوم سيميتكتم .

قدرة أنواع الفيوزاريوم على احداث الإصابة لنباتات القطن تأثرت بعمر النبات وقت حدوث الاصابة فقد وجد أن شدة الاصابة بجميع أنواع الفيوزاريوم المختبرة كانت أقل ما يمكن ٤,٤% عندما حدثت الاصابة عند عمر شهر مقارنة بحدوث ا لاصابة عند عمر ١٥ يوم أو حدوث الإصابة عند الزراعة .

إختلفت أجزاء نبات القطن المختلفة من أوراق فلقية أو أوراق حقيقية أو أزهار أو لوز فى قابليتها للإصابة بأنواع الفيوزاريوم المختلفة. كلاً من فيوزاريوم مونيليفورمى وفيوزاريوم سيميتكتم كانا قادرين على اصابة جميع الأجزاء النباتية التى أختبرت فى حين أن فيوزاريوم بويا أصاب الأوراق الفلقية والأوراق الحقيقية واللوز بينما فيوزاريوم فيوزاروید اصاب فقط الأوراق الفلقية واللوز ، من ناحية أخرى فإن باقى الأنواع كانت غير قادرة على اصابة أجزاء نبات القطن المختلفة التى أحدث لها اصابة .