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Plant Pathology

STUDIES ON FUSARIUM-WILT OF TOMATOES IN IRAQ

II. Nonsusceptible Hosts as Carriers of Wilt Fusaria in Basrah Area

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The tomato wilt pathogen, *Fusarium oxysporum* f. sp. *lycopersici* survives in nonhost plants and has the capacity to colonize them to different extent without showing any appreciable disease symptoms. Out of 18 plant species screened, 7 were found to be colonized by the pathogen.

Introduction

For the past several years the principal problem in growing tomatoes in Basrah is the Fusarium-wilt disease. In an earlier investigation, Ismail & Abdullah (1976) demonstrated the occurrence of two physiological races of *F. oxysporum* f. sp. *lycopersici* in the area. Moreover, all the local tomato cultivars were found to be susceptible to the isolates of the pathogen.

Armstrong and Armstrong (1948) revealed that apart from soil, some wilt-fusaria may survive in non host plants without showing any wilt symptoms. Wait & Dunlap (1953) isolated panama-wilt fungus from the roots of several grass species and weeds growing in banana plantations. Similarly, Katan (1971) reported that roots of weeds belonging to the genera *Oryzopsis, Digitaria, Amaranthus* and *Malva* were often colonized with *F. oxysporum* f. sp. *lycopersici.*

In order to study the existence and spread of tomato-wilt disease in Basrah area, some weeds and cultivated plants were screened to find out if they act as carriers of wilt fusaria. In another experiment the seedlings of some cultivated plants were artificially inoculated to find the colonization potential.

Materials and Methods

Eighteen healthy weeds and cultivated plants were collected from Zubair and Mediana area during November-April, 1974 (tomato-growing season). None of these plants has shown any wilt symptoms. Small segments from the roots were dipped in 70% ethanol and flamed. After peeling off the outer layer, tiny pieces of deeper tissues were plated out on P.D.A. and incubated at 27°C for 5–7 days. The resulting fungal colonies were marked and transferred to P.D.A. slants. Usually for each plant species 20 segments of roots drawn from 5 or more plants were utilized for plating on P.D.A.

In order to determine the forma speciale and physiological races of *F. oxysporum*, isolated from these non-host plants, three test varieties of tomatoes, 'Bonny Best', 'Floradel' and 'Walter' (Ismail & Abdullah, 1976) were utilized. The isolates were grown on thinly poured P.D.A. plates at 27°C for 7 days. The fungal growth was then harvested and inoculum suspension was obtained by macerating the mat of one plate with 100 ml of distilled sterile water. Seeds of tomato cultivars were grown in steam sterilized soil in the greenhouse. Fourteen-day-old seedlings were uprooted and their roots washed in the running tap water. Seedlings of each variety were then dipped in a suspension of the inoculum for one minute. The plants were then replanted in wooden boxes. Each isolate was tested on 20 tomato seedlings of each variety and disease symptoms were recorded after 2–4 weeks. Similarly, potential for colonization of the pathogen on some local cultivated plants was recorded by the root dip method. For this purpose 13 species of cultivated plants which grow locally were utilized. Ten seedlings of each plant species were artificially inoculated. These were then replanted in sterilized soil, in wooden boxes, and kept for 25 days in the greenhouse at a temperature between 25 and 27°C. The percentage of colonization of roots and stems was determined by plating out segments on acidified P.D.A. For this purpose 5 cm long portions from roots as well as stems of each plant were cut out and from these 2 mm segments were obtained for plating. The stem portions were taken 5 cm above the ground. The percentage of colonization for each plant species was calculated by the total number of plates prepared and the resultant colonies.

RESULTS AND DISCUSSION

Out of 18 plant species screened (Table I) 12 were found to be carrying one or more of the *Fusarium* species, while 6 were free from the fungus. In addition to *F. oxysporum*, two more species, *F. solani* and *F. equiseti* were also isolated. When various isolates of *F. oxysporum* were tested on differential varieties of tomato (Table II) it was found that only the isolates derived from *Allium sativum*, *Cressa cretica*, *Malva rotundifolia*, *Digitaria sanguinalis*, *Ranunculus* sp., *Solanum melongena* and *Sorghum vulgare* were pathogenic to cultivar 'Bonny Best'. The inability of other isolates derived from *Allium cepa*, *Raphanus sativus*, *Sinapsis arvensis*, *Citrullus vulgaris* and *Melieotus indicus* to infect the variety 'Bonny Best' indicated that these isolates were not forma speciale lycopersici but might be some other forma speciale of *F. oxysporum*. The results in Table II also indicate that isolates derived from *A. sativum*, *C. cretica* and *M. rotundifolia* from Zubair area belong to race 1. Similarly, isolates derived from *D. sanguinalis*, *S. melongena* and *S. vulgaris* from Mediana also belong to race 1. However, isolates obtained from *Ranunculus* sp. from Mediana belong to race 2 as they were able to induce wilt in cultivar 'Floradel'.

The results of the second experiment (Table III) performed to study the potential for colonization of the pathogen on some cultivated plants indicate that these are colonized to different extents. The highest percentage (97 %) of colonization was found in the roots of *Cucumis sativus*, while the lowest (12 %) was in the roots of *Cucurbita pepo*. On the other hand, it was observed that roots and stems of *Abelmoschus esculentus* were not colonized at all. The results also indicate that in the roots of *Lagenaria leucantha*, *Capsicum annuum*, *S. melongena* and *Cucumis sativus* the colonization was fairly high

TABLE I

Colonization of roots of some weeds and cultivated plants by Fusarium oxysporum *and some other* Fusarium *species*

Plant species	Colonized by *Fusarium oxysporum*	Colonized by other *Fusarium* species	Time of collection (1974)	Locality
Allium cepa L.	+	+	Dec.-Feb	Zubair
Allium sativum L.	+	+	Dec.-Feb.	-do-
Cressa cretica L.	+	+	Feb.	-do-
Helianthus annuus L.	—	—	Dec.	-do-
Malva rotundifolia L.	+	—	Feb.	-do-
Medicago sativa L.	—	+	Feb.-March	-do-
Raphanus sativus L.	+	+	Feb.-March	-do-
Sinapsis arvensis L.	+	—	Feb.	-do-
Abelmoschus esculentus Moench.	—	—	Nov.	Mediana
Citrullus vulgaris Schrad.	+	—	Nov.	-do-
Digitaria sanguinalis (L.) Scope	+	+	Nov.-Feb.	-do-
Convolvulus sp.	—	—	Dec.-Feb	-do-
Imperata cylindrica (L) Beavu	—	—	Nov -Dec	-do-
Melilotus indicus (L.) All.	+	—	Nov -Dec.	-do-
Phragmites communis Trin	—	—	Nov.-Feb.	-do-
Ranunculus sp.	+	—	April	-do-
Solanum melongena L.	+	+	Nov.	-do-
Sorghum vulgare Pers.	+	+	Nov.-Dec.	-do-

+, colonized; —, not colonized.

TABLE II

Reaction of Fusarium oxysporum, *isolated from roots of weeds and cultivated plants, on differential tomato varieties (determination of forma speciales and physiological races)*

Source of isolate	Reaction of differential tomato varieties		
	Bonny Best	Floradel	Walter
Allium cepa L.	—	—	—
Allium sativum L.	+	—	—
Cressa cretica L.	+	—	—
Malva rotundifolia L.	+	—	—
Raphanus sativus L.	—	—	—
Citrullus vulgaris Schrad.	—	—	—
Sinapis arvensis L.	—	—	—
Digitaria sanguinalis (L.) Scope	+	—	—
Melilotus indicus (L.) All.	—	—	—
Ranunculus sp.	+	+	—
Solanum melongena L.	+	—	—
Sorghum vulgare Pers.	+	—	—

+, wilted; —, not wilted

TABLE III

Colonization and symptom development in some local cultivated plants as a result of artificial inoculation with Fusarium oxysporum *f. sp.* lycopersici

Plant species	Percentage of colonization		Symptoms
	Root	Stem	
Lagenaria leucantha (Duchi) Rusby	94	20	Stunting and yellowing of leaves
Cucurbita pepo L.	12	0	No symptoms
Citrullus vulgaris Schrad.	18	0	No symptoms
Solanum melongena L.	84	0	Stunting of the plants
Gossypium hirsutum L.	23	0	No symptoms
Capsicum annuum L.	60	0	Stunting of the plants
Zea mays L.	33	0	No symptoms
Cucumis sativus L.	97	32	Stunting of the plants and yellowing of leaves
Triticum aestivum L.	40	0	No symptoms
Abelmoschus esculentus Moench	0	0	–do–
Beta vulgaris L.	31	0	–do–
Linum usitatissimum L.	34	0	–do–
Sorghum vulgare Pers.	50	0	–do–
Lycopersicon esculentum Mill var. Bonny Best*	100	100	Stunting, yellowing, wilting and finally death of the plants
Lycopersicon esculentum Mill. var. Floradel*	100	88	Stunting, yellowing, wilting and finally death of the plants

*Wilted seedlings plated out 15 days after inoculation.

and varied between 60% and 97%. Stem colonization was observed only in *Lagenaria leucantha* and *Cucumis sativus*, while stems of all other plant species remained uncolonized. Along with these 13 cultivated plants two varieties of *Lycopersicon esculentum* namely, 'Bonny Best' and 'Floradel' were also treated similarly. In both varieties percentage of colonization in roots was 100%, while in stems it was 100% and 80% respectively. The data in Table III also reveal that the pathogen incites the wilt disease symptoms only in tomatoes. The rest of the plants developed no wilt symptoms although they were colonized by the pathogen. However, changes in morphology and development were noticed in some plants. Both, *L. leucantha* and *C. sativus* exhibited stunting and yellowing of leaves, while *S. melongena* and *C. annuum* exhibited stunting only.

These experiments prove the earlier findings that the pathogen survives in nonhost plants and has the capacity to colonize them to different extent without showing any appreciable disease symptoms. These plants are the symptomless disease carriers of the pathogen. It is certainly possible that the survival of the pathogen in the carrier plants in the Basrah area contributes to the persistence and severety of the disease.

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