ACTA MYCOLOGICA
VOL. XXI (1): 117-124
1985

Studies on the genus Pythium in Egypt. V.
Test of pathogenicity of some common root-infecting fungi

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Mazen M. B., Moubasher A. H., El. Sharouny H. M.: *Studies on the Genus Pythium in Egypt. V. Test of Pathogenicity of Some Common Root-Infecting Fungi in Egypt.* Acta Mycol. XXI(1) : 117 - 124, 1985.

Pathogenicity tests of various species of *Pythium*, *Fusarium* and *Rhizoctonia solani* were made on five plants namely cotton, pea, tomato, maize and wheat.

Pythium ultimum proved to be the most destructive species to tomato and cotton seedlings. The four species of *Fusarium* tested showed considerably different pathogenic abilities. Isolate of *Rhizoctonia solani* (A — from soil) showed slight pathogenicity to all test plants and isolate (B — from cotton seedlings) was highly destructive to cotton and pea.

INTRODUCTION

Species of *Pythium* have been recognized for years as major pathogenes infecting seedlings and fine roots of many plants. *P. ultimum* and *P. debaryanum* were judged to be the most common (Middleton 1943; Drechsler 1953). Numerous studies have been made on *Pythium* species associated with specific hosts. In Egypt, numerous studies have been made dealing with the pathogenicity of *Pythium* species on various hosts (Moubasher 1954; Ashour, El-kadi 1955; Ashour 1956, 1957; El-Helaly et al. 1962b, 1970; Abdel-Kader 1977 and others).

Lal, Saksena (1977) and Rao et al. (1979) reported that *Fusarium moniliforme* was highly pathogenic to maize seedlings. *F. moniliforme* and *F. oxysporum* were found to be pathogenic to all wheat cultivars (Zrazhevskays 1979). Moustafa (1959) El-Helaly et al. (1962a), and Moustafa, Moawad (1965) reported that *F. solani*, *F. equiseti*, *F. oxysporum* and *F. moniliforme* were pathogenic

to onion, cotton and maize. Moubasher et al. (in press) also reported in their study on the genus *Fusarium* in Egypt that *F. oxysporum* and *F. solani* were mostly associated with infected seedlings of cotton, pea, wheat and tomato, and *F. moniliforme*, *F. oxysporum* and *F. solani* with maize seedlings.

On the other hand, *Rhizoctonia solani* has been proved to be highly pathogenic and responsible for the damping-off of cotton, herbaceous, vegetable, and ornamentals in many countries and in Egypt (Abdel-Salam 1933; Moubasher 1954; Ashour 1956; Moustafa, Nor El-Din 1957 and others).

The aim of the present investigation was to study the possible role played by *Pythium* (seven species), *Fusarium* (four species) and *Rhizoctonia solani* (two isolates) in inducing damping-off disease of five economically important plants. These fungi were isolated from soil or from the roots of some plants.

MATERIALS AND METHODS

A mixture in the proportion of 30 gm cornmeal to 100 gm dry sand was placed in a 500 ml flask to which added 50 ml water, then sterilized and inoculated with the test fungus and incubated at 28°C for 3 weeks. Soil was sterilized at 20 lbs for 2 hours and then aerated for at least 2 weeks. Fungal inoculum was added at the rate of 3 gm of the inoculated sand cornmeal mixture to 100 gm air-dry soil. Water was added to give a medium moisture content and the soil so inoculated was held at 20-25°C for 3 weeks. Control soils were inoculated with sand cornmeal mixture free from the fungus. An equivalent of 100 gm air of the inoculated soil was placed in a plastic pot and sown with 10 seeds of the test plant. Three replicates were used for each test fungus and plant. Emergence and postemergence damping-off counts were made over a period of 3 weeks at the end of which the numbers of damped-off and surviving seedlings were recorded.

RESULTS

Gossypium barbadense. *Pythium ultimum* proved to be the most harmful species of *Pythium* (Tab. 1). It induced the highest pre-emergence phase of the disease resulting in the lowest survival of seedlings. However, its post-emergence phase was milder than those of *P. butleri* and *P. debaryanum*. *P. heterothallicum*, *P. aphanidermatum* and *P. irregulare* were very slightly pathogenic to cotton seedlings.

The four species of *Fusarium* tested were all pathogenic to cotton seedlings but various degrees. *F. moniliforme* incited the highest percen-

tage of pre-emergence (15%) and the lowest percentage of post-emergence (0%). *F. equiseti* showed exactly the reverse effect; it induced no pre-emergence phase and the highest percentage of postemergence phase among *Fusarium* species (25%). The final stand of seedlings showed that all species of *Fusarium* were moderate or weak incitants of damping-off disease.

The two isolates of *Rhizoctonia* showed considerably different pathogenic abilities. Isolate A, recovered from soil, induced no pre-emergence phase of the disease and a serious post-emergence phase so that the final survival was 60%. Isolate B, recovered from damped-off cotton seedlings, was more severe and induced 15 and 45% mortality for the two phases respectively. Generally the two isolates were more severe than the other tested fungi and this was mainly due to the post-emergence phase of disease which was the most aggressive among all tested fungi.

Pisum sativum. The lowest survival of seedlings (40%) was recorded in case of isolate B of *Rhizoctonia solani* (Table 1). In case of the pre-emergence phase of the disease, *P. heterothallicum*, *P. ultimum* and *F. solani* were the most severe inducing 35,25 and 25% mortality. The

Table 1

Pre- and post-emergence damping-off and survival of cotton, pea, tomato, maize and wheat seedlings raised in soil inoculated and non-inoculated with various fungi /%/

Disease phase / pecies	Cotton					Pea					Tomato					Maize					Wheat				
	IN			MIN		IN			MIN		IN			MIN		IN			MIN		IN			MIN	
	Pr	Po	S	S	at 5%	Pr	Po	S	S	at 5%	Pr	Po	S	S	at5%	Pr	Po	S	S	at5%	Pr	Po	S	S	at5%
thium ultimum Trow	40	15	45	95	12.5	25	0	75	100	11.6	70	15	15	90	20.0	15	0	85	100	19.5	20	0	75	90	17.6
butleri Subram.	10	25	65	95	19.1	5	5	90	90	20.0	40	30	30	90	15.6	30	0	70	100	20.0	10	0	90	90	14.1
intermedium de Bary	0	15	85	100	10.6	0	30	70	80	4.7	5	0	95	95	8.2	20	0	80	100	6.7	15	0	85	95	6.7
heterothallicum Campb.	5	0	95	100	6.7	35	15	50	95	8.2	5	15	80	85	11.6	10	0	90	100	6.7	45	0	55	90	15.6
debaryanum Hesse	5	20	75	90	21.6	15	30	55	80	15.7	20	10	70	90	6.7	0	0	100	100	0.0	10	0	90	95	6.7
aphanidermatum /Edson/ Fitzp.	0	10	90	95	25.3	0	25	75	80	14.1	10	10	80	90	14.1	0	0	100	100	0.0	0	0	100	100	9.4
irregulare Buisman	5	5	90	95	9.4	5	5	90	95	14.2	5	0	95	95	8.2	0	0	100	100	0.0	0	0	100	100	4.7
sarium oxysporum Schlecht.	5	20	75	95	13.3	0	45	55	80	28.3	15	35	50	90	14.1	15	0	85	100	13.3	65	10	25	90	17.3
solani Sacc.	5	15	80	100	17.6	25	0	75	85	8.2	45	0	55	95	13.3	0	0	100	100	0.0	10	0	90	90	16.3
equiseti Corda/ Sacc.	0	25	75	100	17.6	10	0	90	90	14.2	0	0	100	100	0.0	15	0	85	95	8.2	20	0	80	95	16.3
moniliforme Sheldon	15	0	85	100	13.3	5	30	65	80	11.6	5	10	85	85	14.9	60	0	40	90	19.4	15	0	85	100	6.7
isoctonia solani Kühn.																									
olate A	0	40	60	95	8.2	0	25	75	90	12.5	0	30	70	90	9.4	25	0	75	100	13.3	10	0	90	95	14.2
olate B	15	45	40	95	19.4	0	60	40	90	9.4	0	10	90	90	16.6	10	0	90	100	13.3	0	0	100	100	0.0

IN - Inoculated soil MIN - Non inoculated soil S - Survival seedlings
Pr - Pre-emergence Po - Post-emergence

two isolates of *Rhizoctonia solani* were completely non-pathogenic at this phase of the disease.

With regard to the post-emergence phase, isolate B of *R. solani* was the most deleterious test fungus (60% mortality), followed by *F. oxysporum* (45%), *P. debaryanum* and *P. intermedium* (30% each).

Solanum lycopersicum. The most destructive fungi were *P. ultimum* and *P. butleri* followed by *Fusarium oxysporum* and *F. solani*. Isolate A of *Rhizoctonia solani* showed moderate pathogenicity, whereas isolate B supported equal seedling survival to that of the control.

In case of the post-emergence phase of the disease, *P. butleri*, *F. oxysporum* and isolate A of *Rhizoctonia solani* were the most harmful among all tested fungi.

With regard to the pre-emergence phase, *P. ultimum* was the most harmful among the test ed fungi causing 70% mortality of seedlings, followed by *F. solani* and *P. butleri* which induced 45 and 40% mortality, *F. equiseti* and the two isolates of *R. solani* were completely non--pathogenic of this phase of the disease.

Zea mays. All tested fungi did not induce the postemergence phase of the disease. In case of the pre-emergence phase *F. moniliforme* was the most deleterious among the tested fungi, whereas *P. debaryanum*, *P. aphanidermatum*, *P. irregulare* and *F. solani* were *completely* non--pathogenic.

Triticum vulgare. *Fusarium oxysporum* proved to be the most harmful species. It induced the hoghest pre-emergence phase of the disease and the lowest survival of seedlings (25%). It was also the only fungus that incited the post-emergence phase (10%). *P. heterothallicum* and *P. butleri* came next in their virulence giving percentage survivals of 55 and 75% respectively.

Isolate A of *Rhizoctonia solani* showed a slight pathogenic ability, whereas isolate B caused equal seedling survival to that of control.

DISCUSSION

In an attempt to clarify the possible role played by various species of *Pythium* and *Fusarium* and *Rhizoctonia solani* in inducing damping--off disease, pathogenicity tests were made on five economically important plants.

The seven species of *Pythium*, collected during previous investigation showed various degrees of pathogenicity. *P. ultimum* proved to be the most destructive species to tomato and cotton seedlings, whereas it was weakly pathogenic to the other tested plants. *P. ultimum* and *P. debaryanum* were judged to be the most common among *Pythium* spp.

which caused damping-off (Middelton 1943; Drechsler 1953). Arndt (1943) reported that *P. ultimum* was the most destructive pathogen to cotton seedlings as well as to pea and beans (Kraft, Burke 1971). *P. butleri* was seriously pathogenic to tomato (30% survival), and moderately pathogenic to cotton (65%) and weakly pathogenic to pea and wheat. El-Helaly et al. (1972) reported that *P. butleri* was the main pathogen to soybean damping-off in Egypt. *P. heterothallicum* was actively non-pathogenic to the remaining test plants. *P. debaryanum* showed moderate pathogenicity to pea, cotton and tomato and no pathogenicity to wheat and maize. *P. debaryanum* is one of the causal agents of damping-off in cotton and tomato seedlings in Egypt as reported by Ashour and El-Kadi (1955), Ashour (1957) and El-Helaly et al. (1962b). *P. aphanidermatum* and *P. irregulare* pathogenicity ranged from weakly to completely non-pathogenic to all test plants.

The four species of *Fusarium* tested showed considerably different pathogenic abilities. *F. oxysporum* was more severe to wheat seedlings than to the other test plants. It was moderaterately pathogenic to tomato and pea. *F. solani* proved to be non-pathogenic to maize and wheat moderately pathogenic to cotton, pea and tomato. *F. equiseti* was moderately pathogenic to cotton and tended to be non-pathogenic to the other test plants. *F. moniliforme* was the most harmful to maize (40% survival), very slightly pathogenic to cotton, pea and wheat and non-pathogenic to tomato seedlings. *F. moniliforme* was also reported to be highly pathogenic to maize seedlings (Lal, Saksena 1977; Rao et al. 1979). *F. moniliforme* and *F. oxysporum* were found to be pathogenic to all wheat cultivars (Zrazhevskaya 1979) and *F. moniliforme*, *F. oxysporum* and *F. solani* to maize seedlings (Moubasher et al. in press).

Isolate A of *Rhizoctonia solani*, recovered from soil, showed slight pathogenicity to all test plants whereas isolate B, recovered from damped-off cotton seedlings was non pathogenic to tomato and wheat, very slightly pathogenic to maize and highly destructive to cotton and pea. Ashour (1956) and Tolba, Moubasher (1955, 1957) reported that *B. solani* is the main causal agent of damping-off disease of cotton in Egypt. Tolba and Moubasher (1955, 1964) also concluded that the origin of *R. solani* isolate was exerts a profound effect on its pathogenicity.

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