J. Mycopathol. Res. 31(2) : 93-97 (1993) *Printed in India*

Some factors affecting growth of *Fusarium udum* in soil

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Some factors affecting growth of *Fusarium udum* on the surface and through soil were studied. Both on and through the soil growth occurred at a temperature range of 17°—32°C, the optimum being 28°C. Better growth was recorded under low moisture levels. With increase in soil moisture growth decreased. Although growth on the surface of soil was observed upto 100% MHC of soil at a much slower rate, growth through soil ceased at soil of 70% MHC and above. Among the soils of different localities of West Bengal, best growth was recorded in soil of Berhampore. In soils of different treatments, chlamydospore production was observed after 5 days of incubation.

Key words : *Fusarium udum*, Pigeonpea wilt, Fungal growth in soil

INTRODUCTION

Wilt of pigeonpea, *Cajans cajan* (L.) Huth., caused by *Fusarium udum* Bult. is a destructive disease of the crop. In absence of the host, *F. udum* is known to perennate in soil for considerable period in infected pigeonpea crop residues or as chlamydospores. Although some studies have been made on factors affecting survival of *F. udum* in soil (Dasgupta and Sen Gupta, 1989 ; Singh and Bhargava, 1981 ; Singh and Singh, 1983) no information is available on the mycelial growth of the fungus on the surface and in the soil, which is the means of spread of the fungus in the soil. Studies were, therefore, undertaken on the effect of some soil factors on the mycelial growth of *F. udum*, the results of which is presented in this paper.

MATERIALS AND METHODS

Except for the experiment on the effect of soil types, the soil used in the present studies was collected from the University Experimental Farm, Kalyani (sandy

clay loan, pH 6.2). After discarding the upper surface, soil sample upto plough depth (15 cm), was collected and dried in air. It was then powdered and passed through a 2 mm seive to remove coarse patticles and stored in the laboratory for future use.

Growth of the fungus over and through the soil was studied following the method of Booth and Taylor (1976). For studies on growth over soil petridishes containing 100 g soil were inoculated at the centre with a 6 mm disc cut out from the margin of a young culture of *F. udum* on PDA. The growing side of the inoculum was placed in touch with the soil. Growth outwards from the inoculum was measured at periodic intervals under a binocular microscope.

For studying mycelial growth through soil, fungal inoculum was placed at the bottom of the petri dishes with the fungal growth on the upper side. The petri dishes were then filled up with 100 g soil so that the thickness of soil in the petridishes remained at 1 cm. The time required (in days) for the mycelia to appear on soil surface from the buried inoculum was taken as the parameter of growth through soil.

For studying the effect of soil temperature, the moisture level of the soil in the petridishes was adjusted to 20% MHC and for that of soil moisture, the temperature was maintained at 28°C. The experiment on the effect of soil type was also conducted at 28°C with 20% MHC of soil. Three replications were maintained for each experiment.

RESULTS

The effect of a temperature range from 7°C to 37°C on the growth of *F. udum* was studied (Table 1). At 7°, 12° and 37°C no fungal growth occurred. Within the range of 17°C to 32°C, growth over and through soil increased with increase in temperature, the optimum remperature for growth being 28°C. Above this temperature growth was again reduced.

Higher moisture levels showed an adverse effect on the growth of *F. udum* on and through soil (Table 2). With the increase in moisture level there was a corresponding decrease in mycelial growth. A moisture level of 10% to 30% MHC of soil was found to be most favourable for mycelial growth. The adverse effect of high soil moisture was more pronounced particularly on growth through the soil. At lower soil moisture levels (10-30% MHC) the hyphal growth appeared much earlier on soil surface. At 50%MHC, growth through soil was very much reduced and at 70% MHC of soil or above, no growth was observed even after 10 days, although moderate to slow growth on the soil surface was noted at these soil MHC's.

Table 1. Effect of temperature on growth of *Fusarium udum* on the surface and through soil

Temperature (°C)	Time intervals (days)*						
	Growth on soil surface (cm)		No. of buried inoculum appearing on soil surface				
	5	10	2	4	6	8	10
7	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0
17	1.81	1.99	0	1	1	1	1
23	2.26	2.54	0	1	1	2	2
28	3.37	3.81	1	1	2	3	3
32	1.96	2.12	0	0	1	2	2
37	0	0	0	0	0	0	0
C. D. (P=0.05)	0.18	0.38					

* Average of 3 replicates

Table 2. Effect of soil moisture on growth of *Fusarium udum* on the sarface and through soil

MHC of soil (%)	Time intervals (days)*						
	Growth on soil surface (cm)		No. of buried inoculum units appearing on soil surface				
	5	10	2	4	6	8	10
10	4.22	4.34	0	2	2	3	3
20	3.61	3.70	0	1	2	3	3
30	3.34	3.36	0	1	2	3	3
50	2.67	2.74	0	0	1	1	2
70	2.41	2.45	0	0	0	0	0
90	2.14	2.18	0	0	0	0	0
100	1.65	1.70	0	0	0	0	0
C. D. (P=0.05)	0.42	0.43					

* Average of 3 replicates

Difference in growth rate was also observed in soils of different localities of West Bengal (Table 3). Growth rate, both on surface and through soil, was significantly higher in soils of Canning, Berhampore and Sushunia. Slowest growth was observed in soil of Mohitnagar.

In all the experiments growth on the soil surface occurred mainly during the first five days, growth there after being negligible. Small amounts of mycelial growth on soil surface were taken, stained in lactophenol-cotton blue and examined under the microscope. Formation of chlamydospores was observed in all the treatments after 4-6 days growth.

Table 3. Effect of soil types on the growth of *Fusarium udum* on the surface and through soil

Locality	pH	Time intervals (days)*						
		Growth on soil surface (cm)		No. of burried inoculum units appearing on soil surface				
		5	10	2	4	6	8	10
Kalyani	6.1	2.33	2.56	0	1	2	3	3
Chinsurah	6.8	2.42	2.58	0	1	2	3	3
Canning	7.9	3.17	3.27	0	2	3	3	3
Berhampore	8.2	3.63	3.81	1	2	3	3	3
Mohitnagar	5.2	1.87	2.00	0	1	1	2	2
Sushunia	7.5	3.45	3.78	0	2	2	3	3
C. D. (P=0.05)		0.53	0.41					

* Average of 3 replicates

DISCUSSION

The mycelial growth of soil borne plant pathogens through or on the surface of soil is of considerable importance, as this is the means of spread of the pathogen in soil and such growth is, evidently influenced by some biotic and abiotic factors of soil.

Fusarium udum has been found to be a comparatively slow grower in soil. The rate and extent of mycelial spread was affected by temperature, moisture and type of soil. Spread of *F. udum* was faster at soil temperature of 23°—28°C. A more or less similar temperature range has been reported to be conducive to development of wilt of pigeonpea (Mundkur, 1935).

Mycelial spread was better at comparatively lower soil moisture levels. The adverse effect of high soil moisture was more pronouced on growth through soil than on growth on the surface of soil. Growth on the surface of soil was observed even at 100% MHC of soil, although at a much slower rate. On the other hand, growth through soil at 50% soil MHC was very much

reduced and at MHC of 70% and above no hyphal growth was noticeable even after 10 days. Perhaps, growth through the soil, the inoculum remaining buried in the soil, is more influenced by the effect of high soil moisture than the case with the inoculum remaining on soil surface for radial growth. Several factors may be responsible for the adverse effect of high soil moisture on growth. It may be due to a decline in soil aeration with an increase in moisture content and consequently an increase in CO_2 concentration. High soil moisture might have stimulated bacterial activity, which in turn might have resulted in mycelial lysis. At a moisture level of 30% saturation, no bacterial action against hyphae of *Macrophomina phaseolina* was reported while at 80% moisture level considerable bacterial attack was followed by complete lysis of mycelium (Kavoor, 1954).

In soils of different localities of West Bengal growth rate, both on the surface and through soil, was significantly higher in soils of Berhampur, Sushunia and Canning and slowest in soil of Mohitnagar. It appeared that the higher soil pH favoured better growth of the fungus. It was also interesting to note that soil of Canning, known to be highly salinic, supported good growth of *F. udum*.

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(Accepted for publication 28 August 1993)