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EFFECT OF SOME EDAPHIC FACTORS ON GROWTH OF *FUSARIUM SOLANI* AND ITS INOCULUM DENSITY ON WILT OF BHENDI

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Fusarium solani which incites wilt in bhendi (*Abelmoschus esculentus*) at different soil temperatures, soil pH and soil textures, cannot grow and multiply in soil free from host tissues, but in light soils at 27°C and pH 6, it exists quite well. Fairly small amount of inoculum of this fungus produces good infection in bhendi seedlings and increase in density of the inoculum does not correspondingly increase the disease incidence.

INTRODUCTION

Wilt of bhendi or okra (*Abelmoschus esculentus*) caused by *Fusarium solani* (Mart.) App. and Wr. emend. Snyder and Hansen was first reported by Chattopadhyay and Basu (1957) from West Bengal in India. The fungus with a fairly wide host range is well distributed in different parts of the state (Chattopadhyay and Sengupta, 1955 & 1956 ; Bose and Sengupta, 1961 and Chattopadhyay and Sengupta, 1967) and it remains alive in soil for about 105 weeks with hos tissues and 60 weeks without them (Mustafee, 1969). In this paper information

on growth and multiplication of *F. solani* at different levels of soil temperature, soil pH and soil textures has been reported and effect of inoculum density of the pathogen on wilt development in bhendi has been presented.

Materials and Methods

Fresh isolate of *F. solani* was collected from the infected roots of bhendi plant and 300 g of air-dried field soil was taken in each glass bottle following the methods as described by Mustafee and Chattopadhyay (1971). The soil in the bottles was autoclaved, inoculated with the test fungus at 50 per cent saturation and wrapped with black paper.

To study the effect of soil temperatures, the inoculated bottles were kept in controlled chambers at temperatures 20°, 24°, 27°, 30°, and 35°C. Periodic observation on temperature of the soil kept as check was taken in each case and was found to be the same as that of the controlled chamber.

To adjust pH of the soil at 5·0 to 7.0, field soil having pH 7.1 was treated with worm 0.IN hydrochloric acid and HCl—extract of soil was tested with N-ammonium oxalate to detect the presence of calcium, if any. Ca-free soil was washed with hot distilled water and then 0.0IN solution of calcium carbonate was added to adjust pH of the soil to 5 0—7.0. For increasing soil pH above 7.0, field soil was treated with 1 per cent solution of sodium carbonate, washed for several times, dried and pH tested. Soils of different pH were inoculated as before and incubated under controlled condition in darkness at 27°C.

For investigation under different soil textures, air-dried soil was passed through a 80-mesh sieve to separate sand particles and then by mechanical analysis silt and clay content were determined (Piper, 1966). Soils of various textures (light, medium, medium heavy and heavy) were prepared by mixing pure and washed sand with separated silt and clay in different proportions (Table 2). inoculated with the test fungus and incubated at 27°C.

Quantitative estimation of the population of the fungus in soil was made having adopted the dilution plating technique using peptone-dextrose agar. Data representing an average of three replications are recorded in Tables 1 and 2.

Table 1 *Prevalence of* F. solani *at different soil temperatures and soil pH*

Counting (days)	Population (x10⁶)/g of soil on dry wt. basis								
	Soil temperature					Soil pH			
	20°C	24°C	27°C	30°C	35°C	pH5	pH6	pH7	pH8
0	4.03	4.14	3.96	4.07	4.10	4.54	4.25	4.43	4.32
2	3.33	3.52	3.85	3.59	3.30	2.97	3.04	3.37	3.00
4	3.26	3.08	3.66	3.52	3.15	2.45	2.64	3.44	2.93
7	2.53	2.86	3.44	3.00	2.23	2.31	2.56	2.89	2.12
12	1.94	2.53	2.34	2.20	1.94	2.12	2.20	2.45	2.09
20	1.46	1.98	2.05	1.76	1.10	1.35	1.94	2.09	1.43
Mean	2.75	3.01	3.21	3.02	2.63	2.62	2.77	3.11	2.64
	SEm =±0.111%CD at 5% 0.3274					SEm =±0.083; CD at 5%; 0.2528			

Table 2. *Prevalence of* F. solani *at different soil textures*

Soil	Percentage of			Population (x 10⁶)/g of soil on dry wet basis						Mean
				Count intervals (days)						
	Sand	Silt	Clay	0	2	4	7	12	20	
Light	55	30	15	3.81	3.15	3.44	2.64	1.87	1.65	2.76
Medium	40	40	20	4.03	2.93	2.38	2.01	1.65	1.54	2.42
Medium heavy	25	50	25	4.07	2.23	1.76	1.35	1.17	0.88	1.91
Heavy	10	60	30	3.96	2.20	1.65	1.32	0.99	0.66	1.79
SEm										±0.113
CD at 5%										0.3404

Table 3. *Assessment of infection incited by* F. solani *in bhendi*

Grade	Disease symptoms	Severity Index	value
0	No disease symptoms	0	0
1	Seedling with drooping and drying of apical region	trace to 33	30
II	Seedling with hypocotyl region at ground level turning brown	34 to 66	60
III	Seedling completely wilted with decay of cortical tissues or killed before or after emergence	67 to 100	90

Table 4. *Wilt of bhendi by* F. solani *in relation to inoculum concentrations*

Inoculum Soil ratio	Inoculum —	Infection value Observation period (days) 7	14	21
0 : 15 (Control)	0.0	0.0	0.0	0.0
1 : 14	6.6	5.2	20.8	55.2
2 : 13	13.3	10.0	18.4	58.8
3 : 12	20.0	9.6	25.6	56.0
4 : 11	26.6	14.4	41.6	64.0
5 : 10	33.3	13.6	38.4	60.0
6 : 9	40.0	16.8	48.0	66.0
7 : 8	46.6	18.8	53.6	70.8
8 : 7	53.3	14.4	46.0	64.4
9 : 6	60.0	13.6	38.4	61.6
10 : 5	66.6	15.6	35.6	62.4
11 : 4	73.3	14.0	40.8	63.2
12 : 3	80.0	7.6	24.8	60.0
13 : 2	86.6	11.2	34.0	56.8
14 : 1	93.3	8.8	27.6	60.4
15 : 0 (Only inoculum)	100.0	10.0	28.0	61.2

In the study of disease development in response to inoculum density, a stock inoculum was prepared as described earlier (Chattopadhyay and Mustafee, 1977) and then by mixing with it various proportions of sterilized soil, different levels of inoculum were obtained (Table 4). Surface sterilized healthy seeds of bhendi (variety: Pusa swani) were sown in earthen pots containing various levels of inoculum and the pots were kept under controlled condition in diffused sunlight. Regular observations were taken and assessment of infection made (Table 3). Infection values (I.V) were calculated in each case by multiplying the number of plants in grades O,I,II and III by O, 30, 60 and 90 respectively, adding all the resulting figures and then dividing by the total number of plants in all the grades. Thus the formula used was as :

$$\text{I. V.} = \frac{\textit{Summation of No of diseased Plants in each grade X Value of each grade}}{\textit{Total No. of plants in all grades}}$$

Results and Discussion

(a) *Soil temperature* : *F. solani*, at all levels of temperature, was found to be incapable of growing in soil which is free from any host tissues as judged by population (Table 1). Although there was a steady decline in population of the fungus after inoculation, but at temperature 27°C, it was not significant upto 7 days of growth. At all other temperatures, the fall was more or less steady and significant.

Korobeinikova (1961) noted that best development and highest pathogenicity of *F. solani* occurred at 18° to 23°C whereas Lockwood (1962) observed highly susceptible reaction of the fungus at 28° to 32°C in soil. On the basis of present observation it may be stated that *F. solani* can survive well at 24° to 30°C in soil and in that respect temperature 27°C seems to be optimum for the fungus.

(b) *Soil pH* : The behaviour of *F. solani* with relation to soil pH was similar as noted in soil temperature study, i. e., at all pH levels, there was no growth of the fungus in soil. As mallincrease in population was noted after a fall for two days at pH 7, but such rise was never upto or beyond the original level at the time of introduction into the soil (Table 1). The effect of other levels of pH was more or less same and in this respect pH 5 appeared to be comparatively less effective. Korobeinikova (1961) reported that *F. solani* showed maximum response in soil at pH 6—8. Chattopadhyay and Bhattacharyya (1968) noticed that development of guava wilt by this fungus was most severe at pH 6 and decreased both at pH 4 and 8. This obviously means that *F. solani* prefers neutral or slightly acid or alkaline soil for preponderance and pathogenic reactions.

(c) *Soil texture* : It appears from Table 2 that the fungus acted upon more or less identically in different soil textures. In soils containing 40-55 percent sand (medium to light soil), the fungus was found to exist well, and decline in population was less as compared to soils with 10—25 percent sand (heavy to

medium heavy soil). Although the fungus showed a slight rise in population in light soil but it was not upto or above the original level. In heavy soil types, however fall of fungal population was always steady. The present observation is in agreement with the findings of other workers who have reported that many species of *Fusarim* favour sandy to sandy loam soil for their active phase of life and survivability in soil (Kiely 1961, Salgado *et al.* 1966. Mathur and Mathur, 1966 and Mustafee, 1969).

(d) *Inoculum density and disease development F. solani* was virulently pathogenic to bhendi plants at all levels of inoculum (Table 4). While wilt development was minimum at 6 percent inoculum a fairly high degree of infection was noticed at 40—53 percent with maximum incidence of 70.8 percent recorded at 46 percent concentration. There was no increase of infection at inoculum concconcentrations above 46 percent, on the other hand, a tendency of depression to the level of infection was noted Disease development progressed considerably with time at all levels of inoculum density but infection above 70.8 percent was not obtained even in only inoculum.

Pathogenic activity of an organism is not always related to inoculum density. Severity of the disease was recorded at lower levels of inoculum in many cases (Das and Western 1959; Rao and Rao, 1963; Chattopadhyay and Mustafee, 1977). The possible reason is that a pathogen may show mutual inhibitory reactions at higher levels of inoculum density resulting in reduction of disease severity.

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