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POPULATION DYNAMICS OF *FUSARIUM OXYSPORUM* F. *LYCOPERSICI* IN THE FUNGICIDES AMENDED SOIL

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Autoclaved and unautoclaved field soil, artificially infested with *Fusarium oxysporum* f. *lycopersici*, was treated with 100 to 800 ppm (W/W) of PCNB, Dithane Z-78, Difolatan and Zincop. Population was recorded after 20, 50 and 80 days' intervals. Population of the test fungus tolerated all the PCNB concentrations in both the soil conditions. Though Dithane Z-78 and Zincop were effective, yet they could not check the population completely even at the highest concentration treated. Minimum population was recorded after 20 days' interval in natural soil. Difolatan was the most lethal of all the fungicides tested. It checked completely the fungal colony at 800 ppm in both the soil types.

INTRODUCTION

Fusarial wilt is one of the most prevalent and serious diseases of tomato crop. The role of chemicals for the control of pathogenic soil fungi has been studied by different workers (Domsch, 1964; Abeygunawardena, 1957; Georgopoulus & Zaracovitis 1967; Bagdadi, 1970; Singh & Singh, 1970 and Dekkar, 1976). Very little information is available on the effect of soil amendment with fungicides in respect to control of fusarial wilt and also on the population of *Fusarium* in soil. Hence an attempt has been made in the present paper to study the effect of certain fungicides amended with soil on population of *Fusarium oxysporum* f. *lycopersici* at different time intervals.

MATERIALS AND METHODS

(i) *Preparation of Fusarium inoculum*

The inoculum was prepared by the method described by Rao (1959), with some modifications (Singh & Singh, 1970). The mixture of oatmeal and sand (in the ratio of 1 : 9 and moistened with 15 ml. water) was autoclaved for 1½ hr at 15 p.s.i. and subsequently inoculated with three mycelial discs (0.5 mm diam. cut from the margin of one week old colony) per 250 ml Erlenmeyer flask containing 100 g of the sand : oatmeal mixture and incubated at 25 ± 1°C for 10 days.

Tomato field soil (*p*H 6.9) was divided into two lots : one lot was sterilized while the other was left with its naturul microflora. 0.5 kg soil was taken from

each lot and equal amount of inoculum of *Fusarium oxysporum* f. *lycopersici* was thoroughly mixed with sterilized and unsterilized soil.

(ii) *Fungicides chosen for amendment of soil*

The following fungicides were chosen for the present study :

PCNB	—	Brassicol (Pentachloronitro benzene)
Dithane Z=78	—	Zinc ethylene bisdithiocarbomate
Difolatan	—	Captafol content 80%
Zincop	—	Copper oxychloride and Zinc ethylene bisdithiocarbomate mixture

100, 200, 400, and 800 ppm fungicides were added individually in sterilized and non-sterilized soil. Soil without addition of fungicides served as control. The isolation of *Fusarium oxysporum* f. *lycopersici* was done after 20, 50 and 80 days' interval on a selective medium (Czapek-Dox agar medium containing melachite green described by Singh & Nene, 1965 and modified by Sharma & Singh, 1973).

RESULTS

The average number of colonies of *Fusarium* population recorded per g of soil is shown in Tables I-IV.

TABLE I

Effect of PCNB on population of Fusarium oxysporum *f.* lycopersici *in autoclaved and unautoclaved soil*

Treatment (in ppm)	Average No. of colonies per g soil (in thousand)					
	Sterilized soil Period of inoculation (days)			Unsterilized soil Period of inoculation (days)		
	20	50	80	20	50	80
100	3·95	3·65	2·30	3·75	3·75	2·10
200	4·90	4·50	2·75	4·35	3·55	1·90
400	5·90	4·35	2·95	49·5	3·50	1·40
800	5·55	4·35	2·25	3·75	2·90	1·10
Control	5·40	5·05	2·35	4·90	4·80	1·85

TABLE II

Effect of Dithane Z-78 on population of Fusarium oxysporum *f.* lycopersici *in autoclaved and unautoclaved soil*

Treatment (in ppm)	Average No. of colonies per g soil (in thousand)					
	Sterilized soil Period of inoculation (days)			Unsterilized soil Period of inoculation (days)		
	20	50	80	20	50	80
100	3·35	2·20	0·95	2·75	1·00	0·20
200	1·75	1·20	0·70	1·50	0·35	0·25
400	1·35	0·60	0·30	0·75	0·20	0·05
800	0·85	0·45	0·20	0·65	0·20	0·05
Control	5·40	5·05	2·35	4·90	4·80	1·85

TABLE III

Effect of Difolatan on population of Fusarium oxysporum *f.* lycopersici *in autoclaved and unautoclaved soil*

Treatment (in ppm)	Average No. of colonies per g soil (in thousand)					
	Sterilized soil Period of inoculation (days)			Unsterilized soil Period of inoculation (days)		
	20	50	80	20	50	80
100	0·40	0·75	0·39	0·25	0·50	0·20
200	0·15	0·20	0·20	0·15	0·30	0·50
400	0·10	0·15	0·10	0·05	0·15	0·45
800	—	—	—	—	—	—
Control	5·40	5·05	2·35	4·90	4·80	1·85

TABLE IV

Effect of Zincop on population of Fusarium oxysporum *f.* lycopersici *in autoclaved and unautoclaved soil*

Treatment (in ppm)	Average No. of colonies per g soil (in thousand)					
	Sterilized soil Period of inoculation (days)			Unsterilized soil Period of inoculation (days)		
	20	50	80	20	50	80
100	1·65	1·85	0·70	1·65	1·35	1·00
200	1·25	1·85	0·60	1·10	1·65	0·50
400	1·10	1·25	0·55	1·05	1·00	0·40
800	0·40	0·40	0·45	0·35	0·20	0·20
Control	5·40	5·05	2·35	4·90	4·80	1·85

Effect of PCNB (Brassicol)

PCNB is actually unable to control the *Fusarium* population in amended soil. At 100 and 200 ppm little inhibition was found in both non-sterilized and sterilized soils. The maximum population was recorded at 400 ppm in sterilized soil which is higher in comparison with control. Little variation in the population was recorded at 20 and 50 days' intervals but much reduction was recorded at 80 days in both types of soil. The population of *Fusarium oxysporum* f. *lycopersici* was less reduced in unsterilized soil than in the sterilized one.

Effect of Dithane Z-78

This fungicide was effective for the reduction of *Fusarium* population. 100 ppm was less effective after 20 days but after 80 days the population was much reduced even at the lowest concentration as in case of PCNB. Reduced population was recorded after 80 days' inoculation, while at 800 ppm population was very much reduced in natural soil.

Effect of Difolatan

This fungicide was more toxic than others in both types of soil. Population of the test pathogen was very much suppressed at 100 ppm and at 800 ppm not even a single colony could grow. In non-sterilized soil population was very much reduced compared to sterilized one. More population was recorded in each concentration at 50 days' interval in comparison with 20 and 80 days of autoclaved and unautoclaved soil.

Effect of Zincop

Zincop was not so effective as difolatan but was more effective than PCNB and Dithan Z-78. Increased number of colonies was recorded in autoclaved soil. In the latter soil, population of *Fusarium* at 80 days of inoculation was recorded more than that of at 20 days and 50 days in all the concentrations. But in the case of unsterilized soil maximum population was recorded at 50 days at 100 and 200 ppm and at 20 days at 400 and 800 ppm. Minimum population was found after 80 days at 800 ppm.

Discussion

It is clear from the result that the test fungus has the capacity to tolerate the effect of PCNB. Though this is an effective fungicide against a large number of microorganisms, yet in case of *Fusarium* it stimulated the growth at some concentration in comparison to control.

Development of resistance to a fungicide may be due to changes in the fungal cell that inhibit the fungicide, to a greater or lesser extent, from reaching the site of action. Such changes induce a decreased permeability to the protoplast membrane to the fungicide detoxication before the site of action is reached (Dekkar, 1976). Conversion of pentachloronitrobenzene (PCNB) into pentachloroaniline and pentachlorothioanisol by the same fungus is also considered as detoxication mechanism (Nakanishi & Oku, 1969). But it was also interesting in this case that after 400 ppm, *Fusarium* population decreased in autoclaved and unautoclaved soil. It might be possible that the conversion of pentachloroaniline and pentachlorothioanisol from PCNB has an ability for a definite concentration of a fungicide.

Difolatan was recorded as more effective fungicide to check the *Fusarium* population than all other fungicides used. In the case of Difolatan and zincop the reduction in *Fusarium* population was found but after 50 days' inoculation more population was recorded. It might be due to disinfection of fungicide in soil. It was also observed that the least population was recorded after 80 days in each treatment. It might be due to (a) the culture medium which is toxic to conidia and chlamydospores and yield colonies only from hyphae (Singh & Singh, 1970), (b) most of the hyphal parts exist in the rhizosphere of host plant, in the soil only conidia and chlamydospores survive (McKeen & Wensley, 1961).

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