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Effect of Certain Chemicals on the Population Dynamics of *Fusarium oxysporum* f.sp. *lycopersici* in Tomato Field Soil

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Effects of nine chemicals falling under the categories of fungicides (bavistin, difolatan, captan), nematicides (carbofuran, temic, phorate) and insecticides (BHC, lindane and nuvacron) in concentrations ranging from 100–1000ppm were studied on the population of *Fusarium oxysporum* f. sp. *lycopersici*, a causal agent of tomato, in natural tomato field soil. Population of the test pathogen was recorded 4 times at fortnightly intervals on modified Czapek's medium with malachite green. Amongst the test chemicals only fungicides checked the population of the test pathogen, completely. At 500 and 1000ppm complete inhibition of the test pathogen was observed with all the fungicides except with difolatan in which case the least population was recorded at 500 ppm only at the 1st sampling.

Key Words: *Fusarium oxysporum* f. sp. *lycopersici*, **Population dynamics, Fungicides, Tomato wilt**

Introduction

In recent years much attention has been paid to the chemical control of plant pathogens (Singh & Prasad 1973, Phipps & Stripes 1975). Such chemicals are reported to cause considerable change in soil mycoflora (Oblisami et al. 1977, Sreenivasalu & Rangaswami 1973). There are also many records to control fusarial wilt of tomato by different chemicals (Dimond et al. 1952, Keyworth & Dimond 1952, Richardson 1959, Sen & Kapoor 1974). Very little work has been done on the effect of nematicides and insecticides on *Fusarium oxysporum* f. sp. *lycopersici*. This paper aims at the study of the effect of amendment of certain chemicals on the population of this pathogen in natural tomato field soil.

Materials and Methods

(*i*) *Preparation of inoculum of* Fusarium oxysporum *f. sp.* lycopersici

The inoculum was prepared as follows: 200g of maize meal and sand (in the ratio of 1:9 and moistened with 15 ml water) was autoclaved for 1 hr at 1.06 kg/sq. cm in 500 ml Erlenmeyer flask twice and thereafter inoculated with three mycelial agar discs (5 mm dia.)

cut from the margin of one week old colony and incubated at 25±2°C for 10 days.

(*ii*) *Chemicals used in the present studies*

Fungicides

Bavistin — 2-(Methoxy-carbomoyl)-benzimidazole

PCNB — Pentachloronitrobenzene

Difolatan — cis-N-(1,1,2,2-tetrachloro-ethyl) (thio) 4-cyclohexane 1, dicarboxymide

Nematicides

Carbofuran — 2, 3-dihydro-2,2-dimethyl-7 benzofuranyl methyl-carbomate

Temic — 2-methyl-2-(methylthio) propionaldehyde-0-(methyl-carbomoyl) oxime

Phorate — 0,0-diethyl-5-(ethylthl) phosphorodithioate

Insecticides

BHC — Benzene hexa chloride

Lindane — 1, 2, 3, 4, 5, 6 Benzene hexa chloride

Nuvacron — dimethyl-1-methye-2-methyl-carbomyl-vinyl phosphate

(*iii*) *Amendment af natural soil with inocula of the test pathogen and chemicals*

Tomato field oil (*p*H 6.9) was air-dried and sieved and a 100 g sample was taken in each of small earthenware pots in which equal amount of inoculum of *Fusarium oxysporum* f. sp. *lycopersici* was thoroughly mixed.

100, 200, 500 and 1000 ppm of the test chemicals were added individually in each pot and thoroughly mixed with soil. Soil without addition of the pesticides and that without inoculum of *Fusarium* and chemicals served as controls. Water was added to these pots at regular intervals to maintain the original moisture content. Samplings were done four times at 15 day intervals to record the population of the pathogen on agar plates.

Results

Effect of fungicides (table 1) Complete inhibition of *Fusarium oxysporum* f. sp. *lycopersici* was noted in case of 500 and 1000 ppm of each fungicide except with difolatan in which case very little population was recorded at 500 ppm only at the Ist sampling. Its population decreased at successive samplings. Higher population of the test pathogen was recorded in bavistin-treated soil at 100 ppm than with difolatan and captan. In bavistin-treated soils, population declined more at 200 ppm as compared with 100 ppm, but at 3rd and 4th samplings the decline was almost similar, whereas at 200 ppm marked decline was recorded at all the samplings. With difolatan at 100 ppm minimum population (100 colony/g soil) was recorded at the 3rd sampling while the population of the test pathogen increased at 4th sampling (150 colony/g) soil. Reduction in population of the test pathogen was observed with captan also. Amongst the fungicides tested, difolatan was the most effective to cause a decline in the population.

Effect of nematicides

Nematicides were only weakly effective against the test pathogen. Temic was effective at 100 ppm and population of the test pathogen at the first and second sampling was higher than the control, which declined at 3rd and 4th samplings. The population declined at 500 and 1000 ppm in all the samplings with temic. Carbofuran checked the population of the test pathogen but it was higher than temic at 100 ppm. Minimum population (100 colony/g soil) was noticed with temic at 500 ppm after 2 months. Phorate showed almost the same pattern of results as the

Table 1 *Effect of fungicides on population of* Fusarium oxysporum *f. sp.* lycopersici *in natural soil*

Treatment in ppm	Average no. of colonies per g soil (in thousand)											
	Bavistin				Difolatan				Captan			
	Period of sampling (days)				Period of sampling (days)				Period of sampling (days)			
	15	30	45	60	15	30	45	60	15	30	45	60
100	0.50	0.32	0.25	0.25	0.17	0.17	0.10	0.15	0.27	0.22	0.20	0.20
200	0.30	0.27	0.17	0.12	0.02	0.07	0.05	0.07	0.25	0.20	0.17	0.15
500	0	0	0	0	0.01	0	0	0	0	0	0	0
1000	0	0	0	0	0	0	0	0	0	0	0	0
*C.A.					1.40	1.17	0.77	0.67				
**C.B.					0.40	0.30	0.27	0.17				

*C.A.=Control inoculated
**C.B.=Control uninoculated
} Same values for all the treatments
Significant at $p=0.01$
0 = nil

other two nematicides at different day samplings and at different concentrations.

Effect of insecticides

Insecticides also showed variable effects at different concentrations and at different samplings. The population of the test pathogen declined as the concentration of BHC was increased. Minimum population was recorded at 1000 ppm after the 4th sampling. Lindane was phytotoxic and could not check the test pathogen. Minimum population was recorded at 1000 ppm after one month and maximum at 100 ppm after 15 days. In general the population increased with increase of concentration. With nuvacron, a maximum increase in the population of the test pathogen was found at 200 ppm at 15 days samplings, whereas minimum population size was recorded at 500 and 1000 ppm at second and fourth samplings.

Discussion

It is evident from the results that with the exception of the fungicides, the chemicals proved either ineffective or only partially effective in checking *Fusarium oxysporum* f. sp. *lycopersici*. Dwivedi and Pathak (1977, 1979) have reported that difolatan and bavistin showed better results with tomato roots in soil in comparison with soil without roots. Only a low population of *Fusarium oxysporum* f. sp. *lycopersici* was recorded in soil with the host plant as compared with the natural soil without plants using the same fungicides. It is likely that bavistin being systemic in nature, might be synthesizing some fungitoxic chemicals in the host tissues.

Though nematicides and insecticides are considerably effective against a large number of nematodes and insect pests respectively, yet in the persent work most of the test chemicals were found to be nearly ineffective against the test pathogen. Richardson (1959) reported that thc populatiou of *Fusarium oxysporum* increased with treatment of lindane. Singh and Prasad (1973) also recorded an increased fungal population in the nematicide-treated soil.

Table 2 *Effect of nematicides on the population of* Fusarium oxysporum *f. sp.* lycopersici *in natural soil*

Treatment in ppm	Average no. of colonies per g soil (in thousand)											
	Temic				Carbofuran				Phorate			
	Period of sampling (days)				Period of sampling (days)				Period of sampling (days)			
	15	30	45	60	15	30	45	60	15	30	45	60
100	0.77	0.75	0.62	0.52	1.12	1.00	0.52	0.90	0.92	0.32	1.12	0.92
200	1.80	1.37	0.62	0.45	1.15	0.80	0.40	0.55	0.47	0.37	0.82	0.62
500	0.77	0.82	0.20	0.30	0.90	0.47	0.22	0.10	0.87	0.70	0.45	0.25
1000	0.65	0.52	0.22	0.20	0.72	0.55	0.32	0.17	0.50	0.45	0.40	0.32
*C.A.					1.40	1.17	0.77	0.67				
**C.B.					0.40	0.30	0.27	0.17				

*C.A. = Control inoculated
**C.B. = Control uninoculated
} Same values for all the treatments

Significant at $p = 0.01$ (only at 500 and 100 ppm)

Table 3 *Effect of insecticides on the population of* Fusarium oxysporum *f. sp.* lycopersici *in natural soil*

Treatment in ppm	Average no. of colonies per g soil (in thousand)											
	BHC				Lindane				Nuvacron			
	Period of sampling (days)				Period of sampling (days)				Period of sampling (days)			
	15	30	45	60	15	30	45	60	15	30	45	60
100	0.85	0.52	0.37	0.37	0.95	0.72	0.60	0.62	0.92	0.67	0.90	0.75
200	0.57	0.65	0.32	0.32	0.82	0.67	0.52	0.42	1.12	0.42	0.67	0.65
500	0.47	0.30	0.25	0.32	0.82	0.40	0.45	0.35	1.02	0.72	0.62	0.25
1000	0.35	0.20	0.15	0.15	0.90	0.22	0.50	0.27	0.97	0.30	0.50	0.22
*C.A.					1.40	1.17	0.77	0.67				
**C.B.					0.40	0.30	0.27	0.17				

*C.A. = Control inoculated
**C.B. = Control uninoculated
} Same values for all the treatments

Significant at $p = 0.01$ (only at 500 and 100 ppm)

The reason for the ineffectiveness of chemicals may be attributed to the inter-microbial competition with pesticides. Not only fungi but even bacteria and actinomycetes may play an important role in degrading the pesticides in the natural soil. Chacko et al. (1966) isolated certain organisms capable of degrading chlorinated hydrocarbons such as DDT, dieldrin, and PCNB. They also reported that certain forms of fungi had the capacity of degrading PCNB in soil. Bartnicke et al. (1969) have also studied the biological and non-biological degradation of hologenated nematicides and their breakdown products.

It is well recognised that a significant increase in seedling damage by pathogenic fungi not sensitive to PCNB may occur when PCNB is added to soil. Combined treatment of fungicides and nematicides may be useful to check the fusarial wilt as well as namatode infection.

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