

IN VITRO SENSITIVITY OF THREE PLANT PATHOGENIC BACTERIA TO SOME FUNGICIDES AND INSECTICIDES

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The study on the sensitivity of the plant bacteria to 38 fungicides and 10 insecticides revealed that four fungicides (thiram, brestan, macuprax and cafex) were inhibitory to *Xanthomonas oryzae*, *Pseudomonas solanacearum* and *Bacillus polymyxa* and two insecticides (sumithan, fundal) were inhibitory to *X. oryzae* and *Ps. solanacearum* only. None of the insecticides tested were inhibitory to *B. polymyxa*. In all the other cases, the test-organisms showed varied sensitivity to different fungicidal and insecticidal compounds.

INTRODUCTION

Fungicides are in very common usage for control of plant diseases of bacterial origin (Jain *et al*, 1965; Michell, 1969; Helton and Williams, 1969) being rarely backed by *in vitro* data (Raj and Moniz, 1967; Zehr, 1968; Singh and Joshi, 1969). A preliminary knowledge in this regard appeared to be essential for meaningful utilization of these products in bacterial disease control.

An *in vitro* screening of such fungicides along with some insecticides against plant pathogenic bacteria was conducted to understand the sensitivity of the plant bacteria to such formulated products.

MATERIALS AND METHODS

Xanthomonas oryzae (Uyeda & Ishiyama) Dowson, *Pseudomonas solanacearum* Smith and *Bacillus polymyxa* (Prazmowski) Mace, respectively the causal organisms of bacterial blight of rice, wilt of tomato and soft rot of potato were isolated in pure culture from diseased leaves, stems and tubers and used as test bacteria in the assay. *In vitro* assay was conducted following fish-spine method on PSA medium (Mondal and Mukherjee, 1975). Solutions of the products, prepared on the whole formulation basis were used fresh or stored at 5°C when necessary. Fish-spines (7mm dia.) dipped in solutions and excess drained were placed on seeded plates at 3-4 per plate with sterilized forceps. The plates were incubated at $30 \pm 1^\circ\text{C}$ for 48 hr and inhibition zones were measured as diameter in mm. The chemicals tried were blitox-50 (Cu-oxochloride 50%), perenox (copper oxide 50%), ceresan dry (Phenyl mercury acetate 2.5%), tafasan-6, ceresan wet, agallol-3 (methoxy ethyl mercury choride), agrosan GN (tolyl mercury acetate), sultaf 80 WP (elemental sulphur), dithane M45 (mixture of zinc and manganese ethylene bis dithiocarbamate), Ionacol 75WP (zinc ethylene bisdithiocarbamate), ZDMC (zinc methyl dithiocarbamate), shankel (nickel dimethyl dithiocarbamate), thiram (tetramethyl thiurum disulphide), vapum (sodium methyl dithiocarbamate), brestan (triphenyl tin acetate), brestanol (triphenyl tin chloride), duter (triphenyl tin hydroxide) starcft (n-trichloromethyl tetrahydrophthalimide), difolatan (n-tetrachloro ethylthio cyclobex -4-azo-1-2-dicarboximide), brassicol (pentachloronitro benzene) hinosan (O-ethyl-S-S-diphenyl phosphorodithioate), morocide, (2-1-methyl propyl -4-6-dinitrophenyl 3-methyl crotonate), morestan (6-methyl 2-3-quinoxalin dithiolcyclic carbonate), mylone (3,5dimethyl tetrahydro thiazidine-2-thione), benlate (methyl 1-butyl carbamoyl 2-benzimidazole carbamate), demosan (1-4 dichloro-2-5-dimethoxy benzene), vitavax (2-6-dihydro 2-methyl 1-4 oxathin 3-carboxanilide), bavistin (2-methoxy carbamoyl benzimidazole), benodanyl (-2 iodobenzoic anilide), calixin (n-tridecyl-2-6-dimethyl morpholine), topsin (1-2-bis-3-methoxycarboxyl thioureido benzene thiophosphate methyl), allisan (2-6 dichloro-4-nitroaniline), busan (2-thiocyano thiomethyl thio benzothiazole), RH-124 y (2-hydroxypropyl methane thiosulphonate), sicarol (2-methyl-5-6-dihydro-4H-p-3-

-carboxylic acidanilide), macuprax (mix of Cupric sulphate and Mn-ethylene bis dithiocarbamate), cafax EC (crude phenolic preparation), and RH-893 (unknown Indofil Product) amongs the fungicides and diazinone (diethyl-2-isopropyl-6-methyl-4 pyrimidinyl phosphorothionate), accothion (dimethyl-0 3-methyl-4 nitrophenyl phosphorothioate), rogor (0-0 dimethyl-s-N methyl carbamoyl methyl phosphoro dithioate), ekatin (0-0:dimethyl-s-ethyl thioethyl dithiophosphate), dimecron (2-chloro-2-ethyl carbamoyl methyl vinyl dimethyl phosphate), metasystox (0-0dimethyl-S-2-ethyl sulfinyl ethyl thiophosphate), furadan (2-3-dihydro-2-2-dimethyl-7-benzofuranyl methyl carbamate), sevin (1-naphthyl-n-methyl carbamate), fundal (n-3-methyl carbamidophenyl thiol formamidine) and sumiltion (0-0-dimethyl-0-3-methyl-4-nitrophenyl phosphorothioate) among the insecticides.

RESULTS AND DISCUSSION

Results show that among the 38 fungicides four namely thiram, brestan, macuprax and cafax were inhibitory to all the test bacteria. Fourteen others namely blitox 50, shankel, brassicol, hinosan, morocide, morestan, difolatan, benlate, demosan, topsin, botran, RH 124, and sicarol on the other hand were totally ineffective. While *X.oryzae* was sensitive to perenox, ceresan dry, ceresan wet, agallol, tafasan, agrosan GN, sultaf, vapam, brestanol, dithane M45, lonacol, RH-893, duter, busan, vitavax, bavistin and benodanyl, *B. polymyxa* to ceresan dry, tafasan, ceresan wet, agallol, sultaf, vapam, brestanol, starcraft, mylone, RH 893, calixin, and busan and *Ps. solanacearum* to only the four named early (Table 1).

Amongs the ten insecticides only three namely accothion, sumithion and fundal were inhibitory to *X.oryzae*. *Ps. solanacearum* was inhibited by four namely furadan, sumithion, sevin and fundal. None of the insecticides were inhibitory to *B. polymyxa* (Table 2).

X.oryzae appears to be very sensitive to many fungicides followed by *B. polymyxa*. Insensitivity of *Ps. solanacearum* to most of the fungicides is also worth recording. Tolerance of the plant bacteria in general to copper fungicides is another important finding. Inhibitory properties of organic sulphur group of fungicides in this regard is also noteworthy.

Table 1 Sensitivity of three plant bacteria to some fungicides at 5000 ppm concentration (average of 6 replicates)

Fungicide	ppm of a. i. in solution	pH	Diameter of inhibition zone in mm.		
			X. oryzae	P. solanacearum	B. polymyxa
Blitox 50	2500	6.0	0	0	0
Perenox 50	2500	6.5	11.16	0	0
Ceresan D	95	6.0	16.60	0	35.0
Tafasan 6	300	9.0	34.6	0	33.0
Ceresan W	150	9.0	25.3	0	32.0
Agrosan GN	150	5.6	12.5	0	0
Agallol 3	150	9.0	25.3	0	32.0
Sultaf 80	4000	6.0	14.6	0	13.0
Dithane M 45	3900	5.9	14.6	0	0
Lonacol 75 WP	3750	6.0	10.0	0	0
ZDMC 100	5000	5.0	0	0	0
Thiram 75 WP	3750	4.5	13.0	19.5	10.5
Vapam 32.7	1635	7.5	14.0	0	12.0
Brestan 60	3000	5.0	9.6	9.0	10.83
Duter 40	2000	6.3	10.2	0	0
Brestanol 45	2250	5.8	9.5	0	02.0
Shankel	3750	5.9	0	0	0
Starcraft 83	4150	6.0	0	0	05.0
Difolatan 80	4000	6.0	0	0	0
Brassicol 75	3750	6.0	0	0	0
Hinosan 50	1750	6.0	0	0	0
Morocide 40	2000	4.5	0	0	0
Morestan 25	1250	4.5	0	0	0
Mylone 85	4250	6.6	—	0	0
Benlate 50	2500	6.0	0	0	0
Demosan 65	3250	6.9	0	0	0
Vitavax 50	2500	6.0	12.0	0	0
Bavistin 50	2500	5.0	10.50	0	0
RH—893(Indofil)		6.0	11.50	0	35.20
Benodanyl 50	2500	5.9	10.00	0	0
Calixin 75	3750	5.6	0	0	9.3
Topsin M 70	3500	6.6	0	0	0
Allisan 50	2500	5.8	0	0	0
Busan 72	3000	5.8	8.00	0	13.00
RH 124.80	4000	5.80	0	0	0
Sicrarol 50	2500	7.0	0	0	0
Cafax EC	5000	7.6	11.80	10.00	10.50
Macuprax	4000	6.0	22.00	13.66	10.60

—, Data not available

Table 2. Sensitivity of these plant bacteria to some insecticides at 5000 ppm concentration (average of 6-8 replicates)

Insecticides	ppm a.i. in solution	pH	Diameter of inhibition zone in mm		
			X.oryzae	P.solanacearum	B.polymyxa
Diazinon 5G	250	6.8	0	0	0
Accothion 100EC	5000	6.0	12.0	—	0
Rogor 30 EC	1500	6.5	0	0	0
Ekatin 25 EC	1250	6.5	0	0	0
Dimecron 100 EC	5000	6.5	0	0	0
Metasystox 25 EC	1250	6.8	0	0	0
Furadan 3 G	150	—	0	11.66	0
Sumithion 50 EC	2500	—	8.5	10.0	0
Sevin 50 WP	1500	—	0	9.0	0
Fundal 59	2500	—	8.5	10.0	0

— Data not available.

Only a few among the systemics namely vitavax, bavistin and SH-893 and calixin have some antibacterial properties *in vitro*. Success of compounds like bavistin or vitavax against vascular pathogen namely *X.oryzae* makes their careful *in vivo* trial imperative.

The findings as such are encouraging and forms a basis for their trial *in vivo* against bacterial diseases of crop plants. Success of vitavax against bacterial leaf streak of rice (Shekhawat and Srivastava, 1971) or busan against bacterial blight of cotton (Verma and Singh, 1972) are some such records in this area. Results from insecticides is encouraging, particularly in case of furadan and sevin for *Ps.solanacearum* since these are known to be translocated through xylem of the plant which is also the locale which the bacterium invades.

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