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Control of Bacterial Leaf Blight of Rice - Assay of Chemicals*

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An invitro study was conducted to findout the suitable and effective fungicides and antibiotics to control the leaf blight of rice caused by *Xanthomonas oryzae*. Twelve fungicides and nineteen antibiotics with 50, 100, 200, 400, 500 and 1000 concentrations were sprayed three times at 15 day interval, in the rice variety Karuna. The seedlings were sprayed 24 hours of chemical spray with heavy suspension of bacteria. Among the fungicides mercuric chloride was, superior in its inhibion of bacterial growth followed by duter, kocide and wet ceresan. Similarly the antibiotic tetracycline-Hcl was found to record highest inhibition zone followed by terramycin, ledermycin erythromycin and chloramphenic. The porculture experiments with similar treatments have shown that erythromycin was highly effective followed chloramphenicol, terramycin tetracycline-Hcl, edermycin celdion (T.F. 130) and duter. Regarding fungicides, all the chemical used were effective in reducing the leafblight disease intensity and increase the yield.

The Bacterial Leaf Blight (BLB) of rice caused by *Xanthomonas oryzae* (Uyeda and Ishiyama) Dowson has assumed serious proportions in recent years with the introduction of high yielding varieties. Several chemicals including antibiotics have been tested and used for the control of the disease from time to time (Mizukami and Wakimoto, 1969; Pandey 1970), and under tropical conditions none has been found satisfactory. The results of screening of 12 fungicides and 19 antibiotics are presented in this paper.

Four porcelain cylinders of 10 mm height and 7 mm diameter were placed upon agar media in petridishes which were already uniformly seeded with the test organism. Three of the cylinders were filled with 1 ml each of three different concentrations of the test chemical and one cylinder was filled with sterile water to serve as control. The petridishes were incubated for 48 hours at 25°C. Then the diameter of the zone of inhibition all round the cylinder was recorded. The fungicides and antibiotics screened were Benlate (Methyl 1-(butyl carbomyl)-2 benzimidazole carbomate), Cuman (Zinc dimethyl dithiocarbomate), Dithane Z-78 (zinc ethylene bis dithio carbomate) Duter (Tripenyl tin hydroxide), Fytolan (Copper oxychloride), Kocide (Cupric hydroxide), wet ceresan (Methoxy ethyl mercuric chloride), Zineb (Zinc ethylene bis dithiocarbomate) Sulphacetamide,

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Sulphamicidine, Thiobentazol, Mercuric chloride, Agrimycin-100, Agrimycin-500, Aureofungin, Aureomycin, Amphicillin, Bla-S, chloramphenicol, Celdion (T.F. 130), Dicryticin, Erythromycin, Furacin, Ledermycin, Mycostatin, Penicillin-G, Streptocycline, Streptomycin, Tetracycline, Hcl, Terramycin and Tyrothricin. The different concentrations used were 50, 100, 200, 400, 500 and 1000 ppm.

The rice variety Karuna was used for pot culture studies. Three hills were planted in each pot (9" x 6") and after one month of transplanting the chemicals were sprayed at fortnightly intervals, followed by bacterial suspension. Each treatment was replicated thrice, The chemicals included in the spray were Aureomycin Chloramphenicol, Celdion (T.F. 130), Erythromycin, Ledermycin, Streptocycline, Tetracycline-Hcl, Terramycin, Agrimycin-500 and Duter besides wet ceresan and hot water treatment.

A total of three sprays was given with a hand operated sprayer at 15 days interval. The seedlings were sprayed after 24 hours of chemical spray with heavy suspension of becteria and favourable conditions were provided for disease development. The intensity of the disease was recorded 15 days after the third spraying and the category value was obtained as follows.

$$\text{Disease intensity (category value)} = \frac{\Sigma \text{No. of leaves in group} \times \text{Highest group value}}{\text{Total Number of sample leaves}}$$

The yield of grains per pot was also recorded and statistical interpretations were made.

(i) Assay of fungicides : The efficacy of 12 fungicides was tested on the growth of *Xanthomonas oryzae* and the results are presented in Table I.

TABLE I. Effect of fungicides on the growth of *Xanthomonas oryzae in vitr*

Fungicides	Diameter of inhibition zone in mm.			
	500 ppm	1000 ppm	SE_D	C.D.
Benlate	4.5	9.5*		
Cuman	9.5	15.0		
Dithane Z-78	11.0	14.0		
Duter	15.5	22.0		
Fytolan	3.5	8.5		
Kocide	15.5	19.5	1.68	3.48
Wet Ceresan	14.0	20.0		
Zineb	9.5	13.0		
Sulphacetamide	10.5	12.5		
Sulphamicidine	10.0	12.5		
Thiobentazol	8.5	10.5		
Mercuric Chloride	19.5	38.5		

** Significant at 1% level

* Mean of three replication

Mercuric chloride was significantly superior to all the other fungicides in its inhibition on bacterial growth followed by duter, kocide and wet ceresan. These three fungicides were on par and significantly superior than other treatments and recorded greater inhibition

zone than Dithane Z-78, Cuman, Sulphacetamide, Zineb, Sulphamicidine, and Thiobentazol. Benlate and Fytolan were the least effective fungicides.

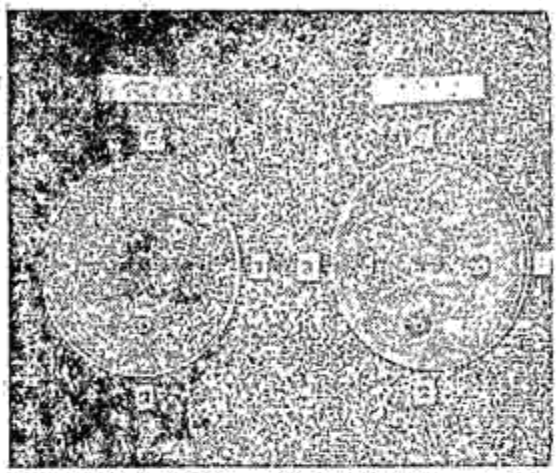


PLATE 1. Assay of fungicides

1. Kocide
2. Duter

C = Control (distilled water)
1 = 50 ppm
2 = 100 ppm
3 = 200 ppm

Except mercuric chloride, duter and kocide, which were effective even at lower concentrations, the other fungicides inhibited the bacterial growth beyond 500 ppm. Hence only the results of 500 and 1000 ppm concentrations were statistically analysed and presented in Table I.

(ii) **Assay of antibiotics :** The results presented in Table II indicated that tetracycline-Hcl was significantly superior and recorded the highest inhibition zone, followed by terramycin, ledermycin, erythromycin and chloramphenicol, which were on par (Plate 2). Streptocycline and aureomycin were on par and recorded significantly greater inhibition zone than the other antibio-

TABLE II. Effect of antibiotics on the growth of *Xanthomonas oryzae in vitro*

Antibiotics	Diameter of inhibition zone in mm							
	50 ppm	100 ppm	200 ppm	400 ppm	500 ppm	1000 ppm	SE_D	C.D.
Aureofungin	8.5	11.0	14.0	21.0	25.0	29.0*		
Chloramphenicol	11.0	17.0	19.0	21.5	26.0	30.5		
Erythromycin	9.5	14.0	17.5	25.0	26.5	33.5		
Ledermycin	9.5	12.5	16.5	25.5	29.5	33.5		
Streptocycline	7.0	10.0	15.0	23.0	26.0	33.5		
Tetracycline-Hcl	11.5	18.0	21.0	26.5	29.0	34.0		
Terramycin	9.5	12.5	18.0	27.5	30.0	34.5		
Agrimycin-100	0.0	8.5	10.0	10.5	11.5	13.0	0.63	1.26
Agrimycin-500	0.0	8.0	11.5	12.5	14.5	16.5		
Aureofungin	0.0	0.0	9.0	10.5	12.5	16.5		
Mycostatin	0.0	0.0	0.0	4.5	12.0	13.5		
Penicillin	0.0	0.0	0.0	4.5	11.5	14.0		
Bla-S	0.0	0.0	0.0	0.0	8.0	11.5		
Furacin	0.0	0.0	0.0	0.0	0.0	8.5		
Tyrothricin	0.0	0.0	0.0	0.0	0.0	10.5		

** Significant at 1% level
* Mean of three replications

tics (Plate2). Furacin was the least effective against *X. oryzae*. The antibiotics streptomycin sulphate, amphiciiin, dicryticin and celdion (T.F. 130) completely failed to inhibit the growth and hence were not included in the statistical analysis.

Higher the concentration greater the efficacy of the chemical in inhibiting the bacterial growth. The maximum inhibition zone was recorded at 1000 ppm with every antibiotic.

(iii) Pot culture experiment : The chemicals which were very effective in *in vitro* studies were used in pot culture study and the disease intensity and yield was recorded and presented in Table III. From the

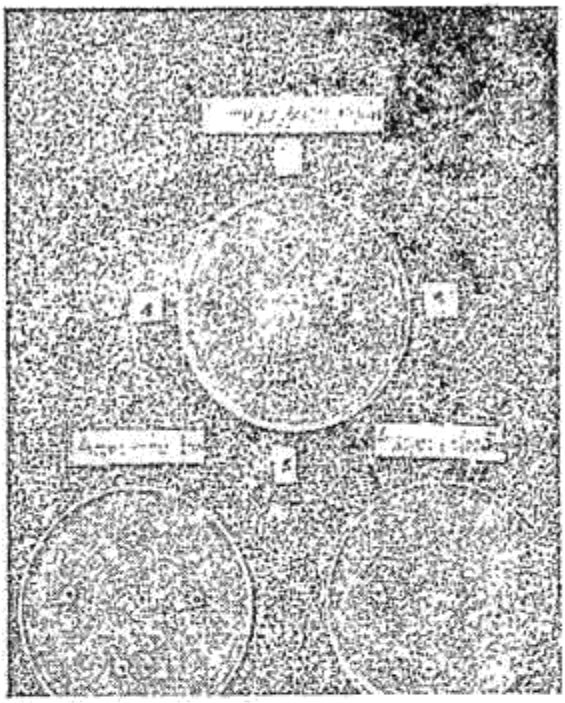
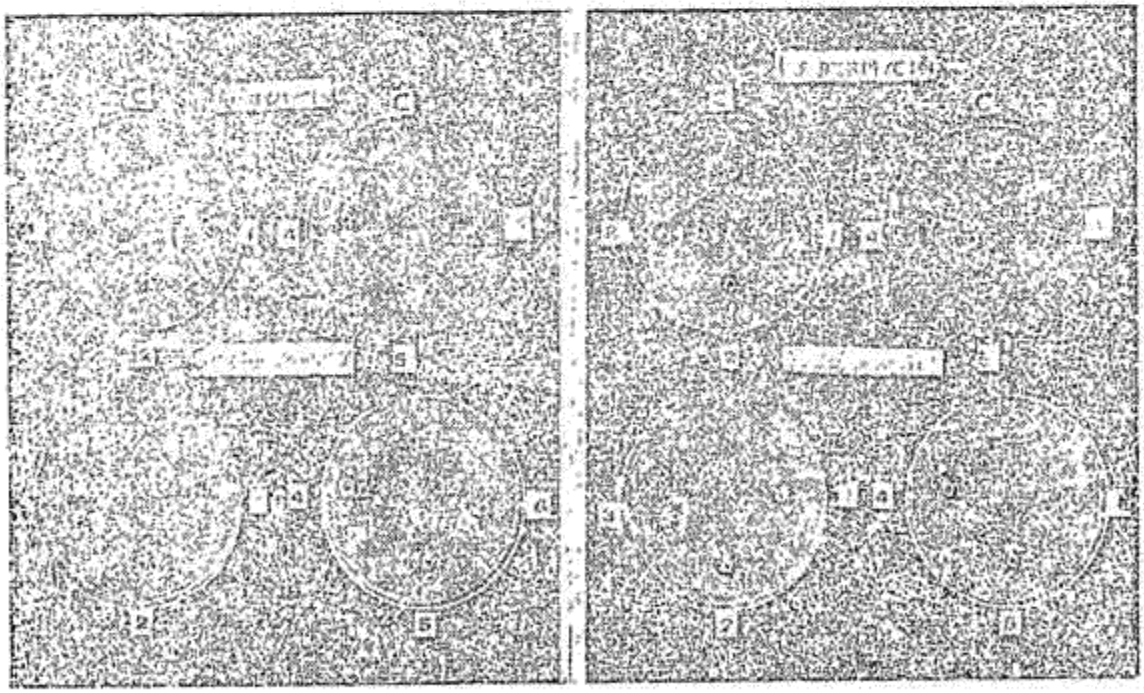


PLATE 2.



PTATE 2. Assay of Antibiotics

C = Control; 1 = 50 ppm; 2 = 100 ppm; 3 = 200 ppm
4 = 400 ppm; 5 = 500 ppm; 6 = 600 ppm.

TABLE III. Effect of various chemicals on the disease intensity and grain yield

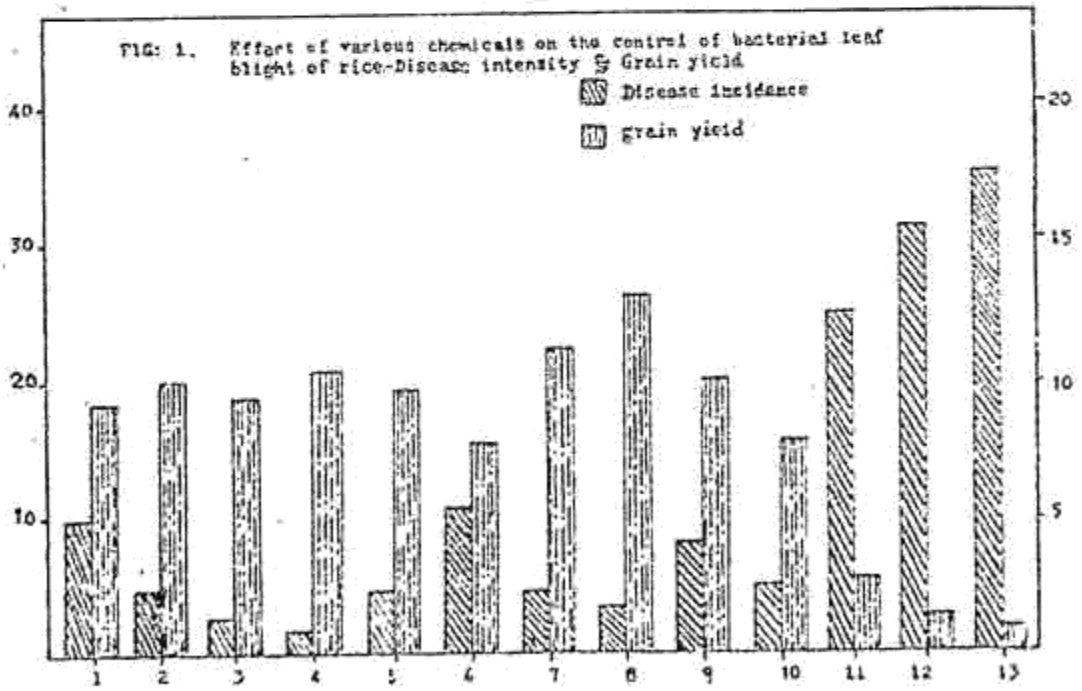
Chemicals	Disease intensity (Category value)	Grain yield per pot in gm.
Aureomycin	9.95	9.42*
Celdion (T.F. 130)	4.78	10.00
Chloramphenicol	2.86	9.39
Erythromycin	1.58	10.31
Ledermycin	4.50	9.64
Streptocycline	10.53	7.70
Tetracycline-Hcl	4.45	11.12
Terramycin	3.31	13.00
Agrimycin-500	8.00	9.95
Duter	4.83	7.83
Wet Ceresan	24.67	2.65
Hot water treatment	31.00	1.33
Control	34.83	0.92
SE.D.	2.85	2.54
C.D.	5.88	5.25

* Mean of three replications

** Significant at 1% level

results, it was infered that erythromycin was highly effective followed by chloramphenicol, terramycin, tetracycline-Hcl, ledermycin, celdion (T.F. 130) and duter which were all on par. In general, all the chemicals were effective in reducing the disease intensity and increase in yield. Wet ceresan and hot water treatment (54-55°C. for 20 minutes) were least effective and recorded maximum disease intensity and less yield (Fig. 1).

The antibiotics ampicilin' celdion (T.F. 130), dicryticin and streptomycin sulphate did not inhibit the *X. oryzae* in culture even at 1000 ppm. Tetracycline-Hcl was highly inhibitory and significantly superior in inhibiting the bacteria followed by terramycin ledermycin, erythromycin and chloramphenicol. Streptocycline and aureomycin also showed considerable inhibitory effect on the bacterium. The other antibiotics were moderately inhibitory



and furancin was found to be the least effective.

Species of *Xanthomonas* have been reported to be inhibited by streptomycin, tetracycline, oxytetracycline, aureomycin and chloramphenicol (Thirumalachar *et al.*, 1956; Padhya *et al.*, 1963). Antibacterial activity of streptomycin and chlorotetraycline-Hcl has been reported against a number of bacterial plant pathogens both *in vitro* and *in vivo* (Morgan and Goodman, 1955; Thirumalachar *et al.*, 1956).

Streptocycline has been reported to be highly inhibitory against *X.oryzae* (Chakravarthi and Rangarajan, 1968; Desai *et al.*, 1967; Devadath and Padmanabhan, 1970; Fukunaga (1967) reported that Chloramphenicol and streptomycin were effective against *X. oryzae*. According to Mizukami and Wakimoto (1969) chloramphenicol is a powerful inhibitor of protein synthesis of the bacterium, *X.oryzae*.

None of the isolates tested were found to be inhibited by streptomycin sulphate even at 1000 ppm. This is contrary to the observation of Thirumalachar *et al.* (1956) and Fukunaga (1967) who reported that streptomycin was effective against *X. oryzae*. Wakimoto (1967) observed streptomycin resistant isolates of *X.oryzae* in nature. The non-inhibition of all isolates by streptomycin may be due to the fact that all isolates may be streptomycin resistant type.

In the pot culture studies, erythromycin followed by chloramphenicol, terramycin, tetracycline hydrochloride ledermycin, celdion (T.F. 130) and duter were found to give better control of the disease in comparison with other treatments. Agrimycin-500 also gave appreciable control of the disease and was on par with duter. Wakimoto (1962) indicated that among many antibiotics which have been proved effective in laboratory tests very few are effective when applied to plant. The results of the present study also corroborate these earlier observations. Jain and Ranga Reddy (1966) reported a limited check with antibiotic sprays on the secondary infection of the bacterium. Ram Nayak Singh (1968) obtained maximum yield by spraying with streptocycline and agrimycin-17.

The chemicals which were found to be effective in the control of the disease intensity, recorded corresponding higher yields except chloramphenicol and duter, in which there was no corresponding increase in yield though found to be effective in reducing the disease intensity.

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