Field investigations on the control of "Late Blight" of Potato

I. Screening of Fungicides.

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Results of three fungicide screening trials against the late blight of potato carried out at Sita Eliya are reported. Of the sixteen proprietory products tested Manzate D, Vondozeb and Difolatan 80 W were found to be very promising. Some of the fungicides which have been shown to be promising in previous trials were found to be breaking down in their efficacy. As such, the necessity to carry out regular and requent fungicide screening trials against late blight is strongly indicated.

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INTRODUCTION

The economic importance of the late blight disease of potato (*Phytophthora infections* (Mont. de Bary) in Sri Lanka has been discussed in several papers (Peiris & de Silva, 1954; Abeygunawardena & Peiris, 1958; Abeygunawardena, 1960; Abeygunawardena and Balasooriya, 1961; Caesar & Ganesan, 1963, and Seneviratne, 1970). The need to adopt chemical measures of control despite varietal resistance to this disease has been indicated by all these authors.

Seneviratne (1970) found several dithiocarbamate fungicides to be very promising against late blight. Out of these fungicides Antracol, Dithane M-45 and Manzate D are commonly used by potato cultivators in the hill country districts. In the trials described in the present paper these three standard fungicides, together with Brestan 60, were compared with some of the more recently introduced dithiocarbamate and other organic fungicides (Table 1).

EXPERIMENTAL METHODS

The trials were conducted during the period Yala 1971 to Maha 1972-73 at the Agricultural Research Station in Sita Eliya (1900 m). The potato variety "Arka" was used in all the trials.

In the first trial, carried out during Yala 1971, fifteen fungicides (Table 2) were screened using a square lattice design with five replicates. On the basis of the results obtained from this trial a few fungicides were selected for further screening in trials carried out during Maha 1971-72 and Maha 1972-73, using randomized complete block designs with four replicates.

The plot size for all three trials was 360 cm. × 450 cm. and included a 30 cm. bund and 30 cm. drain thus making the total planting area per plot 300 cm. × 450 cm. Ninety tubers were planted per plot. in ten rows, on a spacing of 45 cm. between rows and 35 cm. within a row. A single basal dressing of Sulphate of ammonia 560 Kg/ha, Conc. superphosphate 840 Kg/ha, Muriate of potash 150 Kg/ha and cattle manure 12.5 m/ha was applied just before planting.

The fungicides were applied on a 10 day schedule, using a high volume knapsack sprayer, at concentrations recommended by the manufacturer. Moveable screens were used during spraying to prevent spray drift. The first spray application was made 35-40 days after planting, and in all three trials no late blight infection was observed at the time the first spraying was carried out.

Late blight infection assessments, based on the B. M. S. Key (Anon., 1947), were taken at 7-10-day intervals beginning 4 weeks after planting.

RESULTS

Yala 1971 Trial: Although there was no late blight infection observed at the time of the first spraying a severe outbreak of the disease occured about the sixth week after planting with the onset of monsoonal rain and strong winds. An average degree of infection of 45% (at 8 weeks) was recorded even with the fungicide which gave the best degree of control in the trial. As a result yields were found to be relatively poor in all the treatments in the trial. The course of development of blight infection in the control treatment, in relation to weather, is shown in Fig. 1. Phytotoxic symptoms were observed only with the fungicide Brestan 60.

Relatively good control was achieved with following fungicides which gave significantly better yields (at 5% level) than the check treatment (Table 2) : Vondozeb, Harrison's Zineb 65 WP, Manzate D, Wopromanzin, Dithane M-45, Antracol and Difolatan 80 W. There was no significant difference between Vondozeb, Harrison's Zineb 65 WP and Manzate D, in regard to their efficacy in controlling the disease.

Maha 1971/72 trial: Unlike in the Yala 1971 trial the degree of late blight infection remained relatively low in all treatments till about the tenth week after planting when, with the onset of very humid weather, the level of infection rose abruptly to nearly 100% in the control plots. The relationship between the development of blight infection and weather is shown in Fig. 2. Wtih the exception of Antracol satisfactory and significant control in terms of yield was achieved with all the fungicides tested, and there was no significant difference (5% level) between the fungicides which showed promise (Table 3).

Maha 1972/73 trial: Owing to the relatively dry weather conditions prevalent during the first two months of the crop the degree of blight infection remained very low till about the ninth week after planting (Fig. 3). All the fungicides tested gave satisfactory and significant control of the disease. Manzate D was significantly better (5% level) than the rest of the fungicides tested excepting Vondozeb. There was no significant difference between Manzate D and Vendozeb (Table 4).

DISCUSSION AND CONCLUSION

Surveys carried out recently in the Badulla and Nuwara Eliya Districts have shown that bacterial wilt disease caused by *Pseudomonas solanacearum* is becoming an increasingly important factor which would greatly limit the cultivation of potato in these two districts. The only means of control of this disease available at present is the use of long crop rotations. This method, however, is very rarely practised by our local cultivators. Therefore, as pointed out by Seneviratne (1970) the need to eliminate losses from late blight as far as possible by using very effective and economical measures of control is strongly indicated.

The chief object of the studies reported in this paper was to select a few fungicides which would give adequate control of the disease. In general the organic fungicides, particularly the dithiocarbamates, were found to be superior to the copper based fungicides tested. Manzate D gave the best degree of control in two out of the three screening trials. Other fungicides which showed consistent results were Vendozeb and Difolatan 80 W. These fungicides together with a few others which had been regularly used hitherto against late blight were further tested in trials designed to find the optimum dosage, frequency and timing of fungicide application. These trials are reported in part II of this paper and the economics of control in the light of findings from these trials is discussed.

From the results obtained in the Yala 1971 trial it is apparent that under weather conditions which greatly favour late blight infection it is difficult to achieve satisfactory control of the disease with a ten-day spraying schedule even if the first spray application is made between 25-35 days after planting and before the onset of infection as suggested by Seneviratne (1970). Such weather conditions characterized by moderate rains, mist, strong winds and relatively little sunshine are almost regularly experienced from about May to August in the Nuwara Eliya District. A much more frequent application of fungicides may perhaps give better control of the visual symptoms of the disease. However, considering the relatively poor yields obtained particularly owing to the physically damaging effects of severe blowing on the growth of the crop it is doubtful whether such frequent application of fungicides would serve any useful purpose. As such it seem more advisable to avoid the cultivation of potato in the Nuwara Eliya District during the period May to August.

It is apparent from the results obtained in the screening trials that the efficacy of at least some of the fungicides which had hitherto shown promise in controlling late blight are now breaking down gradually. It is possible that the very wide use of these fungicides in the recent past by cultivators had led to the appearance of new strains of the pathogen which are apparently resistant (Sisler & Cox, 1960) to these fungicides. Such breakdown in efficacy with time obviously indicates the necessity to carry out more frequent and regular fungicide screening trials against the late blight disease.

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TABLE I.—Fungicides tested

Fungicide	*Active Ingredient*	*A.I.*(%)
Antracol	Zinc propylene bisdithiocarbamate (propineb)	70
Bayer Maneb	Manganese ethylene bisdithiocarbamate (maneb)	70
Benlate	1– (buthlcarbamoyl)– 2– benzimidazole carbamic acid methyl ester	50
Brestan 60	triphenyl tin acetate+maneb	60+20
Cupravit Ob 21	copper oxychloride	50
Difolatan 4F	cis–N– (1, 1, 2, 2, tetrachloroethyl) thier– cyclohexene– 1, 2– dicarboximide	39
Difolatan 80W	do.	80
Dithane M45	complex of zinc and maneb (mancozeb)	80
Manzate D	maneb with zinc	80
Mildrex	zineb+copper oxychloride	
Miltex	do.	
Perenox	cuprous oxide	50
Tiexine	zinc ehtylene bisdithio carbamate (zineb)	80
Vondozeb	Complex of zineb and maneb	80
Wopromanzin	Maneb+ zinc. compound	80
Wopromanzin Supra	do.	80
Zineb 65 W. P. (Harrison's)	zineb	65

TABLE 2.—Effect of fungicides on the contol of late blight

YALA 1971—TRIAL

Planted on 8.5.71.

Sprayed on—7.6, 17.6, 26.6., 6.7 and 16.7

Fungicide	*Rate*/1,000 *l*	*Mean %blight at 8 weeks*	*Mean yield metric tons/ha*
Vondozeb	2 Kg	45.0	4.68
Harrison's Zineb 65 WP	2 Kg	71.0	3.55
Manzate D	2 Kg	50.0	3.42
Benlate+Manzate D	0.5 Kg–1 Kg	74.4	3.34
Wopromanzin	2 Kg	70.0	3.32
Dithane M–45	2 Kg	66.0	3.07
Antracol	2 Kg	65.0	3.02
Miltex	2 Kg	69.0	3.99
Difolatan 80 W	1.25 Kg	73.0	2.82
Cupravit Ob 21	6.5 Kg	80.0	2.52
Midrex	2 Kg	75.0	2.46
Percnox	6.5 Kg	77.0	2.14
Brestan 60	0.4 Kg	82.0	1.86
Difolatan 4F	4.21 Kg	80.0	1.81
Benlate	0.5 Kg	90.6	1.40
Control	—	98.0	1.52
L.S.D. (P.=0.05)			1.30

TABLE 3.—Effect of fungicides on the control of late blight

MAHA 1971/72 TRIAL

Planted on : 16.9.71

Sprayed on : 23.10, 3.11, 13.11, 23.11, 3.12, 14.12 and 23.12.

Fungicide	*Rate/1000 l*	*Mean % blight at 10 weeks*	*Mean yield metric tons/ha*
Manzate D ..	2 Kg ..	20.0 ..	14.49
Vondozeb ..	2 Kg ..	23.8 ..	12.83
Dithane M—45 ..	2 Kg ..	23.8 ..	12.55
Difolatan 80 W ..	1.5 Kg ..	33.8 ..	12.30
Wopromanzin ..	2 Kg ..	32.5 ..	12.22
Harrison's Zineb 65 WP	2 Kg ..	25.0 ..	11.22
Antracol ..	2 Kg ..	52.3 ..	10.26
Control ..	..	73.75 ..	7.52
L.S.D. (P=0.05)			3.70

TABLE 4.—Effect of fungicides on the control of late blight

MAHA 1972/73 TRIAL

planted on : 9.8.72

Sprayed on : 9.9, 19.9, 29.9, 9.10, 19.10, 29.10 and 7.11.

Fungicide	*Rate / 1000 l*	*Mean % blight at 10 weeks*	*Mean yield metric tons/ha*
Manzate D ..	2.5 Kg ..	5.4 ..	25.17
Vondozeb ..	2.5 Kg ..	15.4 ..	22.43
Difolatan 80 W ..	1.5 Kg ..	18.4 ..	21.31
Bayer Maneb ..	2.5 Kg ..	11.0 ..	21.08
Wopromanzin Supra ..	2.5 Kg ..	18.6 ..	21.06
Difolatan 4 F ..	5.61 l ..	21.3 ..	20.92
Tiezine ..	2.5 Kg ..	56.2 ..	19.88
Antracol ..	2.5 Kg ..	51.5 ..	17.65
Dithane M—45 ..	2.5 Kg ..	51.2 ..	15.27
Control ..	..	98.5 ..	9.85
L.S.D. (P=0.05)			3.50

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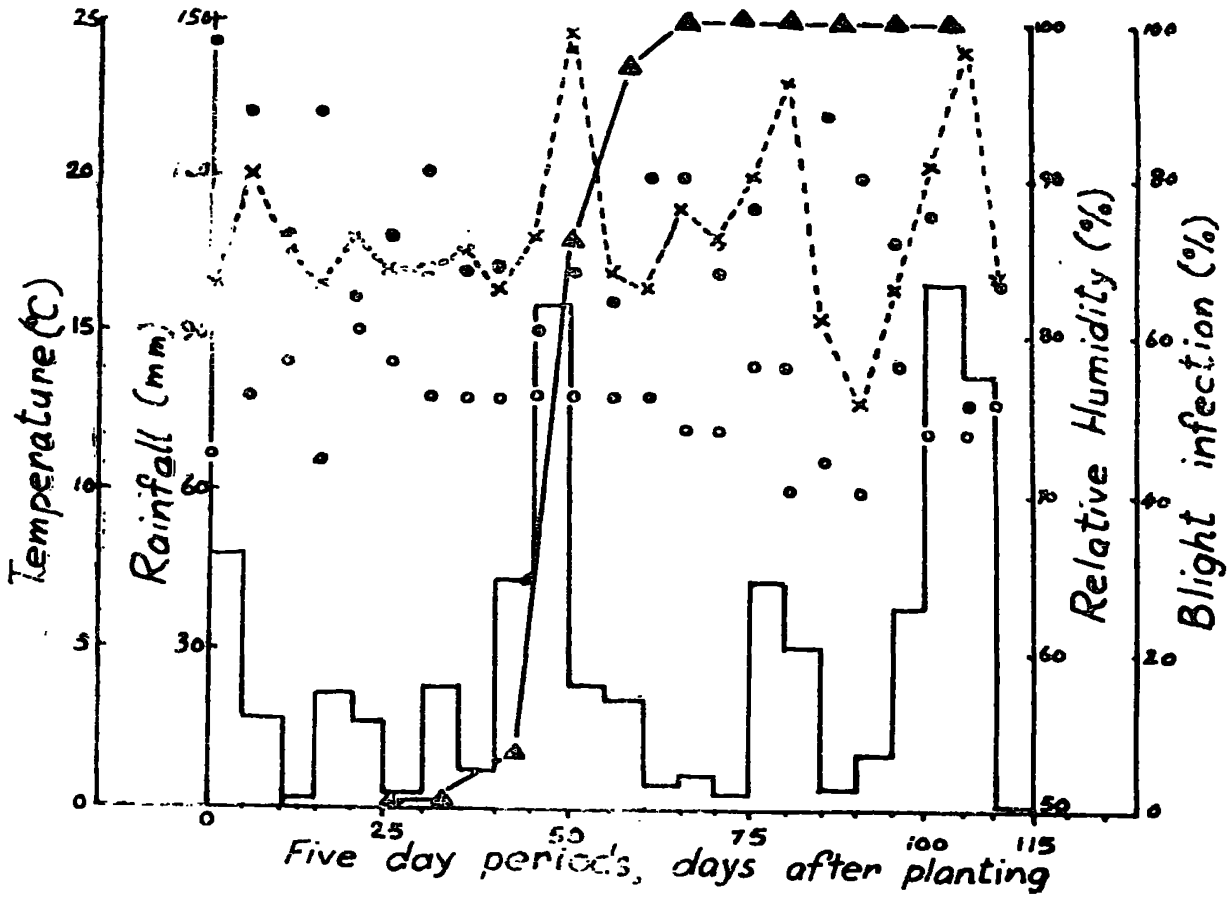
Fig. 1.—Blight infection and weather conditions during the Yala 1971 trial for five day p riods from the time of planting.



Average relative humidity

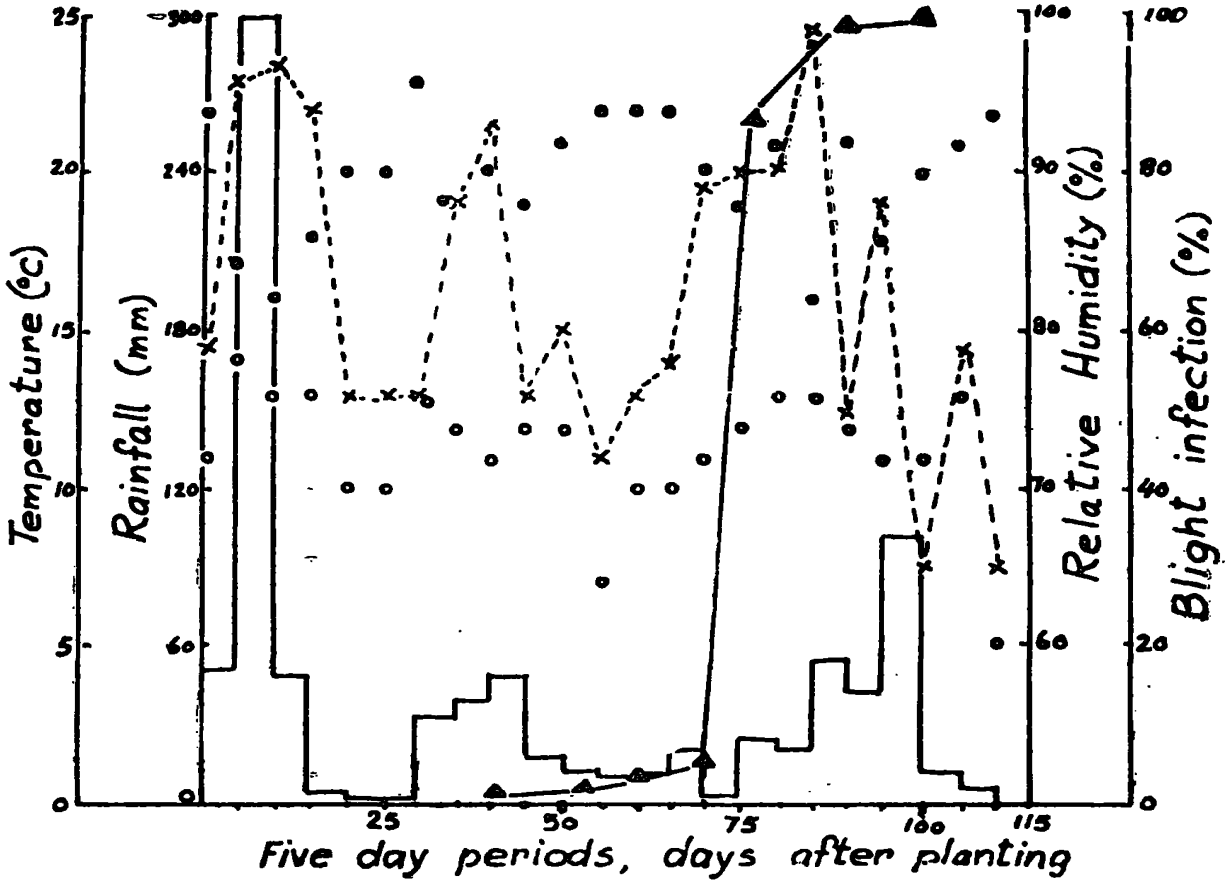
Blight infection in control treatment

Maximum temperature

Minimum temperature

Histogram : indicate total rainfall for 5 day periods

Fig. 2 Blight infection and weather conditions during the Maha 1971/72 trial for five day periods from the time of planting.



Average relative humidity

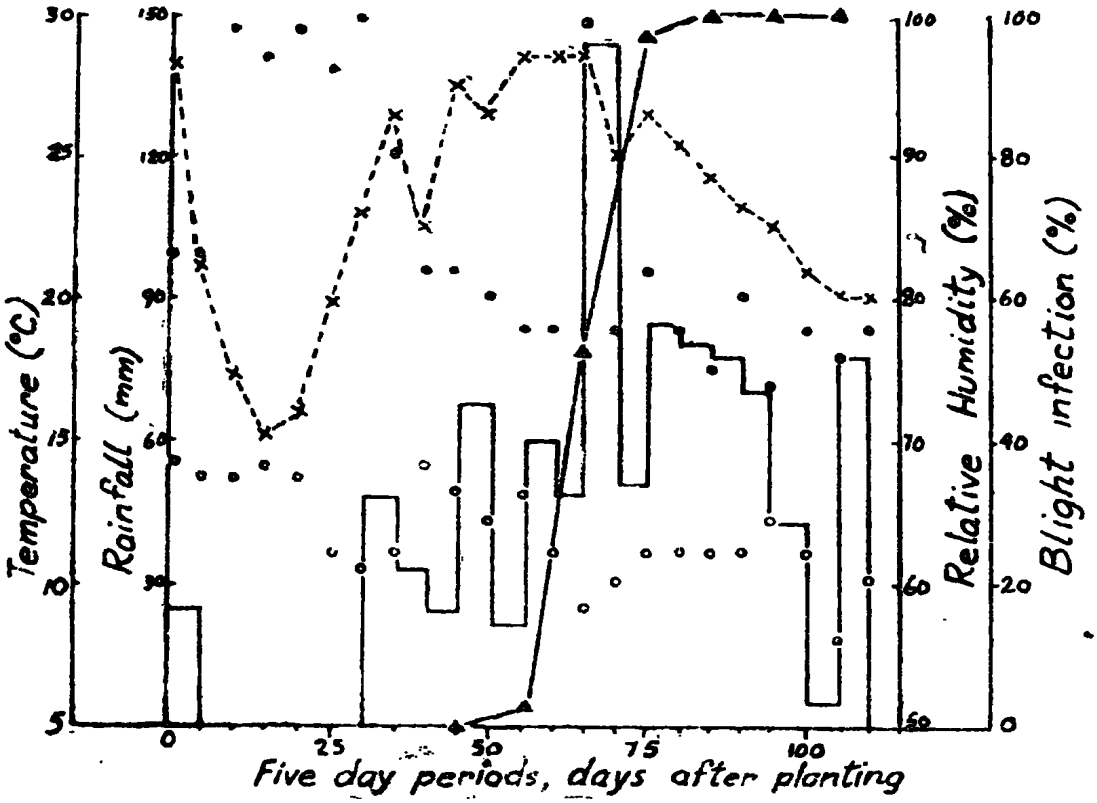
Blight infection in control treatment

Maximum Temperature

Minimum Temprature

Histogram: indicate total rainfall for 5 day periods.

Fig. 3. Blight infection and weather conditions during the Maha 1972/73 trial for five day periods from time of planting.



Average relative humidity

Blight infection in control treatment

Maximum Temperature

Minimum Temperature

Histogram : indicate total rainfall for 5 day periods