

Spraying trials on potato blight control with organo-tin and other fungicides

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SUMMARY

In screening trials on the control of late blight of potatoes at Sita Eliya in the hill country wet zone of Ceylon, yields with dithiocarbamate fungicides were consistently superior to those with organo-tin and other formulations. For effective control of the disease, it was important to apply the first spray before the onset of infection, and thereafter approximately seven more sprays at 10 day intervals were adequate to ensure a vigorous healthy crop virtually free from late blight. Phytotoxic effects were associated with the organo-tin fungicides, especially Brestan 60, which caused distortion of foliage, stunting, and depression of yields. These effects were most pronounced during an excessively wet season while during a moderately wet season the performance of the organo-tin fungicides applied on a 10 day spraying schedule compared favourably with that of the dithiocarbamates. The most efficient fungicides were Dithane M-45 and Manzate D (mancozeb), Lonacol M, Dithane M-22 and Mangan Curit (maneb) and Antracol (propineb), all of which gave good control of the disease when applied at the rate of 2 lb/100 gal. The most suitable rates for the organo-tin fungicides were 3 oz/100 gal. for Brestan 60 (triphenyltin acetate + maneb) and 12 oz/100 gal for Du-Ter (triphenyltin hydroxide). Substantial economic gains would accrue from the control of blight by fungicidal spraying and it is apparent that without such measures potato cultivation is not an economic venture under our conditions in the present circumstances.

INTRODUCTION

Late blight has long been recognised as one of the most important diseases of potato. It is common in both the wet and the dry zones of the hill country of Ceylon. Crop losses due to premature defoliation and tuber infection could often be considerable. For the successful cultivation of potatoes it is essential to adopt measures against the disease such as the use of resistant varieties, the selection of planting seasons so as to avoid periods favouring disease incidence, and the

control of the disease by fungicidal spraying (Peiris & de Zilva, 1954 ; Abeygunawardena & Peiris, 1958 ; Abeygunawardena, 1960 ; Abeygunawardena & Balasuriya, 1961 ; Caesar & Ganesan, 1963). Practical considerations, however, have an important bearing on such measures. For instance, the resistance of varieties has been found to break down with time, e.g., Gineke, Dekama and Cosima, while varieties relatively susceptible to blight may have other desirable characteristics to commend them. In the hill country wet zone of Ceylon with a well distributed rainfall, conditions generally favourable to the disease occur during much of the year. In these circumstances fungicidal spraying for the control of blight is an important aspect of potato cultivation.

In previous work on the control of late blight (Peiris & de Zilva, 1954, ; Abeygunawardena, 1960 ; Caesar & Ganesan, 1963), the fungicides chiefly studied in screening trials were the copper and dithiocarbamate formulations. In recent years, organo-tin fungicides have been developed consequent on the discovery of the high fungicidal efficacy of the organic compounds of tetravalent tin. Ventura & Herve¹ (1962) reported the efficacy of triphenyltin acetate against blight and its effects on different varieties including the stunting of terminal leaves and the reduction of yields. In comparative trials with copper, dithiocarbamate, and organo-tin fungicides, Holmes & Storey (1962) reported that triphenyltin acetate alone had a direct effect on the reduction of tuber blight. In the trials reported here, two commercial organo-tin fungicides, Brestan 60 (triphenyltin acetate + maneb) and Du-Ter (triphenyltin hydroxide) were compared with a number of other fungicides including some of the more recent dithiocarbamates such as Antracol, Dithane M-45 and Manzate D. Various rates of application of the fungicides and the effect of spraying before and after the onset of blight infection were investigated.

EXPERIMENTAL METHODS

The trials were conducted during the three seasons Maha 1963-64, Yala 1964 and Maha 1964-65 at Sita Eliya (6,200 ft.) in the hill country wet zone which is characterised by a cool temperate type of climate. In this zone rainfall is evenly distributed throughout the year with two peak periods during the monsoons (Fig. 1).

The development of late blight epidemics is determined mainly by the prevailing conditions of rainfall, dew, humidity, temperature and wind which influence the production of spores and their dispersal,

.. SPRAYING TRIALS ON POTATO BLIGHT

The total rainfall, the number of rain days, and the average minimum and maximum temperatures for 10 day periods from 31-90 days for each of the trials are shown in Fig. 2.

For all the trials, a randomised block design with four replicates was used, the plot size being 12 ft $\times$ 15 ft inclusive of a 1 ft bund and a 1 ft drain. The planting area per plot was 10 ft $\times$ 15 ft which accommodated ninety tubers planted in ten rows of nine tubers per row at a spacing of 1½ ft. between rows and 12-13 in. within rows. The susceptible variety Gineke was used in all the trials. The fertilizer dressing applied was as follows :—

Sulphate of ammonia—500 lb/acre

Conc. superphosphate—750 lb/acre

Muriate of potash—133 lb/acre

Cattle manure—5 tons/acre

Sprays were applied with knapsack sprayers during the morning session. Moveable screens were used to prevent spray drift. Afternoons were often wet in this zone and early spraying allowed adequate time for drying of the fungicidal treatment. As only one particular treatment was applied at a time, the order of spraying of the different treatments was changed on each occasion. This procedure also offset to some extent the adverse effects of light showers on the efficacy of different fungicidal sprays on a few occasions.

Treatments were varied in the trials depending on clear indications as the series progressed. Thus, in the trials during Maha 1963-64, several treatments with Brestan 60 were included, many of which were eliminated in later trials. In Yala 1964, a maneb fungicide (Dithane M-22) was used alternating with and in combination with Brestan 60 to determine whether this would reduce the phytotoxic effects of the organo-tin fungicide. From the early trials it was clear that the first fungicidal spray had to be applied before the onset of infection. In the Maha 1964-65 trials, therefore, the main objectives were to compare the efficacy of the fungicides when applied preventively, and finally to determine whether a 10 day spraying interval would ensure adequate protection in a spary programme commencing before the onset of infection.

Late blight infection was assessed according to the B. M. S. key (Anon. 1947) and phytotoxic effects on a rating scale of 0-5 where 0 = no phytotoxic symptoms and 5=very severe phytotoxic svmptoms.

The fungicide screened in six trials, two each during the season Maha 1963-64, Yala 1964 and Maha 1964-65 are listed in Table 1.

RESULTS

Data on the following six trials are presented in Tables 2-7.

- (1) Maha 1963-64, trial I, planted on 18 October, 1963 (Table 2).
- (2) Maha 1963-64, trial II, planted on 8 November, 1963 (Table 3).
- (3) Yala 1964, trial I, planted on 20 March, 1964 (Table 4).
- (4) Yala 1964, trial II, planted on 20 March, 1964 (Table 5).
- (5) Maha 1964-65, trial I, planted on 18 September, 1964 (Table 6).
- (6) Maha 1964-65, trial II, planted on 5 November, 1964 (Table 7).

The three seasons during which the trials were conducted were representative of the weather conditions that could be encountered in the hill country wet zone. Maha 1963-64 was a very wet season and conditions very favourable to blight were encountered. Yala 1964 was relatively dry and blight was not severe. Maha 1964-65 was again wet and represented the conditions of an average season.

The outstanding fungicides were the dithiocarbamate formulations, Dithane M-45 and Manzate D (mancozeb), Lonacol M, Dithane M-22 and Mangan Curit (maneb), and Antracol (propineb). They achieved excellent control of the disease during all types of seasons, produced vigorous crops free from phytotoxic effects, and gave the highest yields. For the four trials during the Maha seasons, the yields of the best treatments in comparison with the unsprayed controls (taken as 100%) were 254% (Lonacol M, Maha 1963-64, trial I), 284% (Dithane M-45, Maha 1963-64, trial II), 367% (Lonacol M, Maha 1964-65, trial I) and 268% (Manzate D, Maha 1964-65, trial II).

The organo-tin fungicides, Brestan 60 and Du-Ter were very effective in controlling the fungus. However, they also caused adverse effects on the plants which, in general, were somewhat stunted and lacked the health and vigor of plants treated with dithiocarbamate fungicides (Fig. 4, bottom left). Phytotoxic symptoms on the foliage were more pronounced with Brestan 60 (Fig. 4, top left) than with Du-Ter (Fig. 4, top right), and with the former the most severe symptoms were observed during the very wet Maha season of 1963-64. The effect of organo-tin fungicides on tuber blight could not be determined because the incidence of tuber blight in these trials was

SPRAYING TRIALS ON POTATO BLIGHT

negligible. Yields from the organo-tin treatments were lower than those from the dithiocarbamates and the differences between the best dithiocarbamate and organo-tin treatments were, with one exception, significant at the 5% level in all the Maha trials.

In Maha 1963-64, fungicidal spraying commenced after and before the onset of late blight infection in trials I and II respectively. While the best treatment in the former yielded only 3.00 tons/acre, in the latter the highest yield was 5.74 tons/acre. The two yields are not strictly comparable. Nevertheless, these trials indicated the importance of applying fungicidal sprays before the onset of infection and the advantage of this practice on the growth and vigour of the crop was apparent in subsequent trials. Further, with preventive spraying, a 10 day interval between successive sprays was adequate to ensure a vigorous crop and a good yield. In the absence of fungicidal protection late blight invariably caused severe damage (Fig. 4, bottom right).

ECONOMICS OF SPRAYING

Yields are substantially increased by the efficient control of blight and an attempt may be made to determine the economics of fungicidal spraying. In Tables 8 and 9 the cost of fungicides for blight control are worked out for two rates of spray fluid, 100 and 150 gal./acre, and for a total of four, five, six, seven or eight spray applications during a season. The cost of a lb of fungicide has been arbitrarily taken at Rs 4, 5 or 6. The minimum and maximum quantities of fungicides estimated as required for a season to spray an acre are 8 and 24 lb., respectively. If the cost of a lb of fungicide is assumed, for convenience, to be Rs. 5, then the expenditure on fungicides will range from Rs 40 (8 lb) to Rs 160 (32 lb). Yields may be increased by 2-5 tons/acre by the efficient control of blight. Assuming the price of potatoes to be Rs 896/ton, the profits accrued are given in Table 10. In the case of cultivators who carry out the spray operations themselves, this will virtually represent the nett profit. In farms, allowance will have to be made for operational costs. Appropriate changes can also be made in the tables where the cost of fungicides, potatoes, etc., differ from the figures considered.

DISCUSSION AND CONCLUSIONS

Control of late blight of potatoes must be considered in the context of two other important aspects which influence to a great extent the cultivation and extension of the crop in Ceylon. The first is the bacterial

wilt disease caused by *Pseudomonas solanacearum* for which there is as yet no practical means of control and which therefore necessitates the longest possible interval between successive crops on the same soil. The second is the limited acreage available in the potato farms for local seed production. With these two limitations it is essential to eliminate losses from late blight and to maximise the yields from the land cultivated each season.

The trials described indicate clearly the importance of applying the first fungicidal spray before the onset of infection—generally between 25-35 days after planting. Thereafter, an interval of 10 days between successive sprays is adequate to keep the crop practically free from the disease. Under the conditions in Ceylon, the growing season has a duration of about 90-110 days and 6-8 sprays will therefore be required during a season to ensure a vigorous blight-free crop. On the other hand, once the disease has established itself on the crop, fungicidal sprays are much less effective. Thus the timing of the first spray before the onset of infection is of critical importance.

Of the fungicides tested, the following six dithiocarbamates are considered the most suitable—Dithane M-45 and Manzate D (mancozeb), Lonacol M, Dithane M-22 and Mangan Curit (maneb) and Antracol (propineb).

The organo-tin fungicides gave lower yields than the dithiocarbamates. However, they were highly fungitoxic at relatively low rates of application, 3 oz/100 gal with Brestan 60 and 12 oz/100 gal with Du-Ter. The expression of phytotoxic symptoms was most severe during the Maha 1963-64 season but comparatively mild during Maha 1964-65. The rainfall and temperature conditions at the stage when plants are most susceptible to phytotoxic injury during these two seasons are summarised in Table II. This suggests that excessively wet conditions aggravate phytotoxic effects. During Maha 1964-65, the performance of the organo-tin fungicides compared favourably with some of the dithiocarbamates, especially in Maha 1964-65 trial II with a 10 day spraying interval. The use of Brestan 60 at 3 oz/100 gal may perhaps be more economical than the use of dithiocarbamates during a moderately wet season. However, the decision on the choice of a fungicide in such circumstances will depend on whether reduced yields (in comparison with the dithiocarbamates) will be acceptable. Because of the importance of maximising yields from a limited cultivable acreage each season, control of blight by less economical measures which ensure the highest yields may be preferred. However, the

possibility of combining dithiocarbamates with the organo-tin fungicides in a spray programme deserves consideration. The dithiocarbamates can be used for the early sprays when the plants are most sensitive to phytotoxic damage from organo-tin fungicides. In the later stages of the crop the latter can be used. Such a scheme will probably avoid the adverse effects of the organo-tin fungicides while utilizing their beneficial action on the control of tuber blight.

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TABLE 1—Fungicides screened in the trials

<i>Fungicide</i>	<i>Active ingredient</i>	<i>A.I. (%)</i>
Brestan 60 ..	Triphenyltin acetate + manganese ethylenebis-dithiocarbamate (maneb)	60+20
Du-Ter ..	Triphenyltin hydroxide ..	20
Dithane M-45 ..	Complex of zinc and maneb (mancozeb)	80
Manzate D ..	Mancozeb ..	80
Dithane M-22 ..	Maneb ..	80
Lonacol M ..	Maneb ..	80
Mangan Curit ..	Maneb ..	80
Dithane Z-78 ..	Zinc ethylenebisdithiocarbamate (zineb)	78
Antracol ..	Zinc propylenebisdithiocarbamate (propineb)	70
Cupravit (Ob 21) ..	Copper oxychloride ..	50
Fungicide 328 ..	3,3'-ethylenebis (tetrahydro-4,6- dimethyl-2H-1, 3, 5-thiadiazine-2-thione)	75

TABLE 2—Effect of fungicides on the control of late blight in Maha 1963/64, trial I

Planted on : 18.10.63.

Spraying commenced with the onset of infection and sprays were applied at 7 day intervals

Sprayed on : 20.11, 27.11, 4.12, 11.12, 18.12, 24.12 and 1.1.64.

<i>Fungicide</i>	<i>Rate/ 100 gal</i>	<i>Mean % blight at 9 weeks</i>	<i>Mean phytotoxic injury at 9 weeks</i>	<i>Mean yield, tons/acre</i>
Brestan 60 ..	6 oz ..	10.0 ..	3.0 ..	1.79
Dithane Z-78 ..	2 lb ..	} 13.8 ..	0.5 ..	2.37
alternating with Brestan 60* ..	8 oz ..			
Du-Ter ..	1 lb ..	17.5 ..	1.1 ..	2.39
Du-Ter ..	1½ lb ..	11.3 ..	0.8 ..	2.96
Lonacol M ..	2½ lb ..	5.5 ..	0.0 ..	3.00
Dithane Z-78 ..	2 lb ..	16.3 ..	0.0 ..	2.47
Antracol ..	2 lb ..	10.3 ..	0.0 ..	2.73
Antracol ..	2½ lb ..	6.3 ..	0.0 ..	2.82
Control ..	— ..	90.0 ..	— ..	1.18
L. S. D. (P=0.05)				0.55

* Four sprays of Dithane Z-78 and three of Brestan 60 ; first spray with Dithane Z-78.

SPRAYING TRIALS ON POTATO BLIGHT

TABLE 3—Effect of fungicides on the control of late blight in maha, 1963/64, trial II

Planted on 9.8.11.63.

Spraying commenced before the onset of infection and sprays were applied at 7 and 14 day intervals.

Sprayed on: 7 day interval*—29.11, 6.12, 13.12, 20.12, 27.12, 3.1.64, 10.1, 17.1 and 24.1.

14 day interval —29.11, 13.12, 27.12 and 10.1.64.

Fungicide	Rate/ 100 gal	Spraying interval in days	Mean % blight at 9 weeks	Mean phytotoxic injury at 9 weeks	Mean yield, tons/acre
Brestan 60	.. 4½ oz ..	7 ..	0.1 ..	3.1 ..	3.24
Brestan 60	.. 4½ oz ..	14 ..	23.8 ..	0.8 ..	3.14
Brestan 60+S	.. 4½ oz ..	7 ..	0.1 ..	3.5 ..	3.38
Brestan 60+S	.. 4½ oz ..	14 ..	16.3 ..	0.8 ..	3.08
Brestan 60	.. 7½ oz ..	7 ..	0.1 ..	4.1 ..	2.57
Brestan 60	.. 7½ oz ..	14 ..	17.5 ..	1.0 ..	3.22
Brestan 60+S	.. 7½ oz ..	7 ..	0.1 ..	3.8 ..	2.99
Brestan 60+S	.. 7½ oz ..	14 ..	21.3 ..	1.1 ..	2.48
Brestan 60	.. 8½ oz ..	7 ..	0.1 ..	4.1 ..	2.82
Brestan 60	.. 8½ oz ..	14 ..	12.5 ..	1.4 ..	2.83
Brestan 60+S	.. 8½ oz ..	7 ..	0.1 ..	4.3 ..	2.68
Brestan 60+S	.. 8½ oz ..	14 ..	7.5 ..	1.3 ..	3.72
Du-Ter	.. 1 lb ..	7 ..	0.1 ..	0.5 ..	3.94
Du-Ter	.. 1½ lb ..	7 ..	0.8 ..	1.5 ..	3.38
Dithane M-45	.. 2 lb ..	7 ..	0.0 ..	0.0 ..	5.74
Dithane Z-78	.. 2 lb ..	7 ..	0.1 ..	0.0 ..	4.86
Antracol	.. 2 lb ..	7 ..	0.0 ..	0.0 ..	5.04
Antracol	.. 2½ lb ..	7 ..	0.0 ..	0.0 ..	5.35
Control	.. — ..	— ..	95.0 ..	— ..	2.02
L.S.D. (P=0.05) ..					0.90

* Treatments with Brestan 60 and Du-Ter were not sprayed on 24.1.

S—Sticker Agrotin 300 added to spray fluid at the rate of 16 fl. oz./100 gal.

TABLE 4—Effect of fungicides on the control of late blight in Yala, 1964, trial I

Planted on : 20.3.64.

Spraying commenced before the onset of infection and sprays were applied at 7 and 10 day intervals.

Sprayed on : 7-day interval—15.4, 22.4, 29.4, 6.5, 13.5, 20.5, 27.5 and 3.6.

10 day interval—15.4, 25.4, 5.5, 15.5, 23.5 and 2.6.

<i>Fungicide</i>	<i>Rate/ 100 gal.</i>	<i>Spraying interval in days</i>	<i>Mean % blight at 9 weeks</i>	<i>Mean yield, tons/acre</i>
Dithane M-45	2 lb	7	0.0	6.85
Dithane M-45	2 lb	10	0.0	7.36
Lonacol M	2 lb	7	0.0	8.24
Lonacol M	2 lb	10	0.0	6.22
Mangan Curit	2 lb	7	0.0	6.55
Mangan Curit	2 lb	10	0.0	6.55
Dithane Z-78	2 lb	7	0.0	7.79
Dithane Z-78	2 lb	10	0.0	6.73
Antracol	2 lb	7	0.0	6.65
Antracol	2 lb	10	0.0	7.54
Fungicide 328	1½ lb	7	0.0	7.44
Fungicide 328	1½ lb	10	0.0	7.01
Control	—	—	50.0	5.53

Differences were not significant at $P=0.05$.

TABLE 5—Effect of fungicides on the control of late blight in Yala, 1964, trial II

Planted on : 20.3.64.

Spraying commenced before the onset of infection and sprays were applied at 7 and 14 days intervals.

Sprayed on : 7 day interval—15.4, 22.4, 29.4, 6.5, 13.5, 20.5, 27.5 and 3.6.

14 day interval—15.4, 29.4, 13.5 and 27.5.

<i>Fungicide</i>	<i>Rate 100 gal.</i>	<i>Spraying interval in days</i>	<i>Mean % blight at 9 weeks</i>	<i>Mean phytotoxic injury at 9 weeks</i>	<i>Mean yield, tons/acre</i>
Brestan 60+S	8 oz	14	0.0	1.4	6.49
Brestan 60	8 oz	7	0.0	0.4	7.27
alternating with Dithane M-22*	2 lb				
Brestan 60+	8 oz	7	0.0	0.5	6.73
Dithane M-22	1½ lb				
Du-Ter	1 lb	7	0.0	0.0	6.50
Du-Ter+	1 lb	7	0.0	0.0	7.24
Dithane M-22	1 lb				
Dithane M-22	2 lb	7	0.0	0.0	7.58
Control	—	—	58.8	—	6.73

Differences were not significant at $P=0.05$.

* Four sprays of Brestan 60 and four of Dithane M-22; first spray with Brestan 60.

SPRAYING TRIALS ON POTATO BLIGHT

TABLE 6—Effect of fungicides on the control of late blight in maha, 1964/65, trial I

Planted on : 18.9.64.

Spraying commenced with the onset of infection and sprays were applied at 7 day intervals.

Sprayed on : 28.10, 4.11, 11.11, 18.11, 25.11, 2.12, 9.12, 16.12, 23.12, 30.12 and 6.1.65.

<i>Fungicide</i>	<i>Rate/ 100 gal.</i>	<i>Mean % blight at 10 weeks</i>	<i>Mean phyto- toxic injury at 10 weeks</i>	<i>Mean yield, tons/acre</i>
Brestan 60 ..	3 oz ..	1.8 ..	1.4 ..	7.04
Du-Ter ..	12 oz ..	1.6 ..	0.8 ..	7.03
Du-Ter + Dithane M-22 ..	12 oz 4 oz ..	0.1 ..	0.6 ..	7.99
Dithane M-45 ..	2 lb ..			
Manzate D ..	2 lb ..	0.3 ..	0.0 ..	9.92
Dithane M-22 ..	2 lb ..	0.0 ..	0.0 ..	9.06
Lonacol M ..	2 lb ..	0.1 ..	0.0 ..	9.57
Mangan Curit ..	2 lb ..	0.4 ..	0.0 ..	10.49
Dithane Z-78 ..	2 lb ..	0.8 ..	0.0 ..	9.20
Antracol ..	2 lb ..	0.3 ..	0.0 ..	8.57
Cupravit (Ob 21) ..	6 lb ..	0.6 ..	3.1 ..	8.22
Fungicide 328 ..	1 lb ..	2.8 ..	0.0 ..	7.03
Control ..	— ..	31.3 ..	— ..	5.83
L. S. D. ($P=0.05$) ..	— ..	— ..	— ..	2.86

TABLE 7—Effect of fungicides on the control of late blight in Maha, 1964/65, trial II

Planted on : 5.11.64.

Spraying commenced before the onset of infection and sprays were applied at 10 day intervals.

Sprayed on : 12.12, 22.12, 1.1.65, 11.1, 21.1, 30.1 and 9.2.

<i>Fungicide</i>	<i>Rate 100 gal.</i>	<i>Mean % blight at 11 weeks</i>	<i>Mean phyto- toxic injury at 11 weeks</i>	<i>Mean yield, tons/acre</i>
Brestan 60 ..	3 oz ..	0.3 ..	1.0 ..	9.48
Du-Ter ..	12 oz ..	0.8 ..	0.5 ..	9.10
Du-Ter + Dithane M-22 ..	12 oz 4 oz ..	0.1 ..	0.3 ..	10.20
Dithane M-45 ..	2 lb ..			
Manzate D ..	2 lb ..	0.0 ..	0.0 ..	10.46
Dithane M-22 ..	2 lb ..	0.0 ..	0.0 ..	11.95
Lonacol M ..	2 lb ..	0.1 ..	0.0 ..	11.02
Mangan Curit ..	2 lb ..	0.0 ..	0.0 ..	9.83
Dithane Z-78 ..	2 lb ..	0.1 ..	0.0 ..	9.57
Antracol ..	2 lb ..	0.6 ..	0.0 ..	9.92
Cupravit (Ob 21) ..	5 lb ..	0.1 ..	0.0 ..	10.20
Fungicide 328 ..	1½ lb ..	0.8 ..	0.8 ..	8.71
Control ..	— ..	50.0 ..	— ..	9.14
L.S.D. ($P=0.05$) ..	— ..	— ..	— ..	4.46

TABLE 8—Cost of fungicides applied in spray fluid at the rate of 2 lb./100 gal. and 100 gal. to spray an acre

No. of sprays during season	Total volume of spray fluid required gal		Total weight of fungicide required lb		Cost in Rs. of fungicide for price price range Rs 3-6/lb				
					Rs 4	Rs 5		Rs 6	
4	..	400	..	8	..	32	..	40	.. 48
5	..	500	..	10	..	40	..	50	.. 60
6	..	600	..	12	..	48	..	60	.. 72
7	..	700	..	14	..	56	..	70	.. 84
8	..	800	..	16	..	64	..	80	.. 96

TABLE 9—Cost of fungicides applied in spray fluid at the rate of 2 lb./100 gal. and 150 gal. to spray an acre

No. of sprays during season	Total volume of spray fluid required gal		Total weight of fungicide required lb		Cost in Rs. of fungicide for price range Rs 3-6/lb				
					Rs 4	Rs 5		Rs 6	
4	..	600	..	12	..	48	..	60	.. 72
5	..	750	..	15	..	60	..	75	.. 90
6	..	900	..	18	..	72	..	90	.. 108
7	..	1,050	..	21	..	84	..	105	.. 126
8	..	1,200	..	24	..	96	..	120	.. 144

TABLE 10—Economies of fungicidal spraying

Yield increase by fungicidal spraying, tons/acre		Value of increased yield in Rs*		Profit by fungicidal application*†		
				Expenditure on fungicides Rs 40		Expenditure on fungicides Rs 160
2	..	1,792	..	1,752	..	1,632
3	..	2,688	..	2,648	..	2,528
4	..	3,584	..	3,544	..	3,424
5	..	4,480	..	4,440	..	4,320

*Based on the price of potatoes at Rs 896 ton.

†*Appropriate allowance must be made for operational costs where necessary.

SPRAYING TRIALS ON POTATO BLIGHT

TABLE 11—Expression of phytotoxic symptoms

Season	Trial	31-60 days								Phytotoxic symptoms		
		Rain fall				Temperature, °C						
		Amount in in.		Rain days		Av. min.		Av. max.				
Maha, 1963/64	..	I	..	10.14	..	23	..	12.5	..	21.9	..	Severe
Maha, 1963/64	..	II	..	12.63	..	23	..	12.2	..	21.3	..	Severe
Maha, 1964/65	..	I	..	6.86	..	25	..	10.9	..	22.1	..	Slight
Maha, 1964/65	..	II	..	6.40	..	18	..	9.3	..	23.4	..	Slight

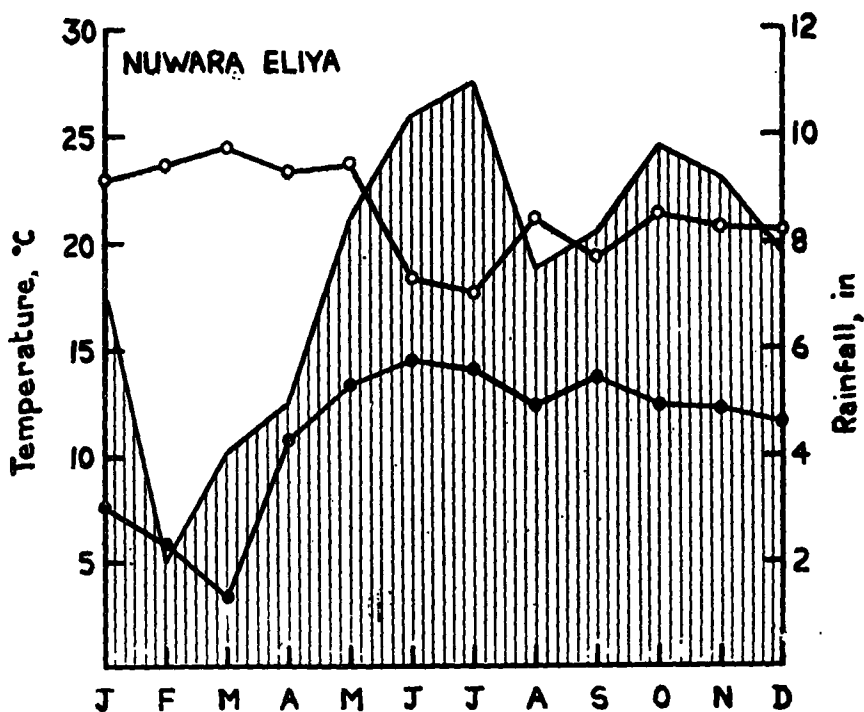


Fig. 1. Temperature and rainfall variation at Nuwara Eliya (hill country wet zone)
 —●—, mean monthly minimum temperature; —○—, mean monthly maximum temperature; vertical stripes, monthly rainfall.

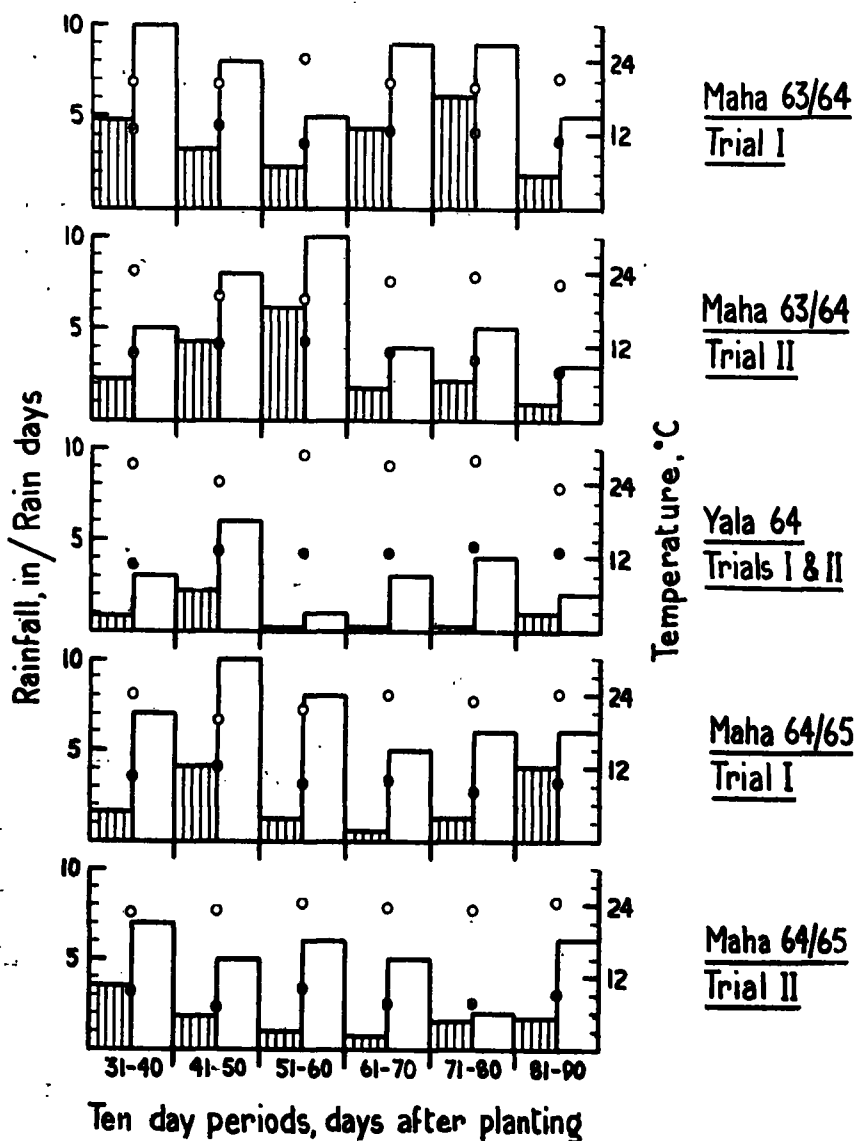


Fig. 2. Weather conditions during the trials at Sita Eliya for 10 day periods from 31-90 days—●—, average minimum temperature ; —○—, average maximum temperature ; vertical stripes, rainfall ; unshaded, rain days.

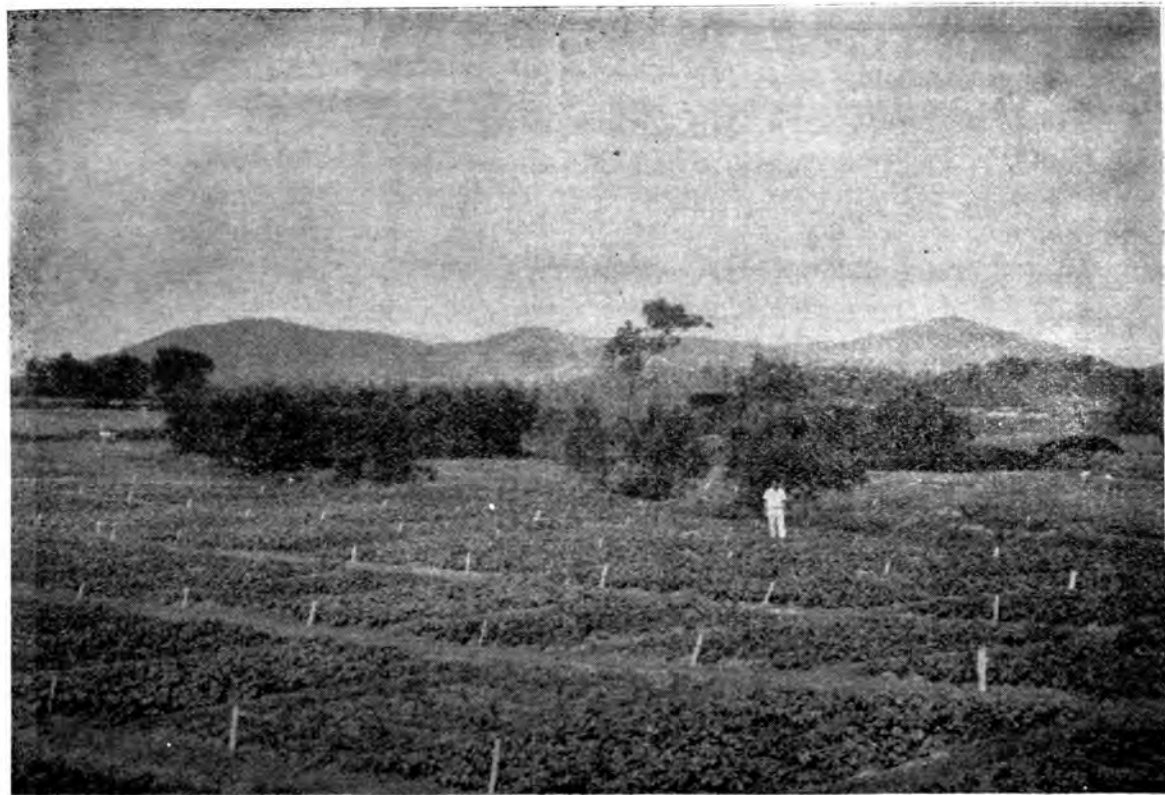


Fig. 3. A general view of a trial. Note the unsprayed control plot in the foreground defoliated by blight.

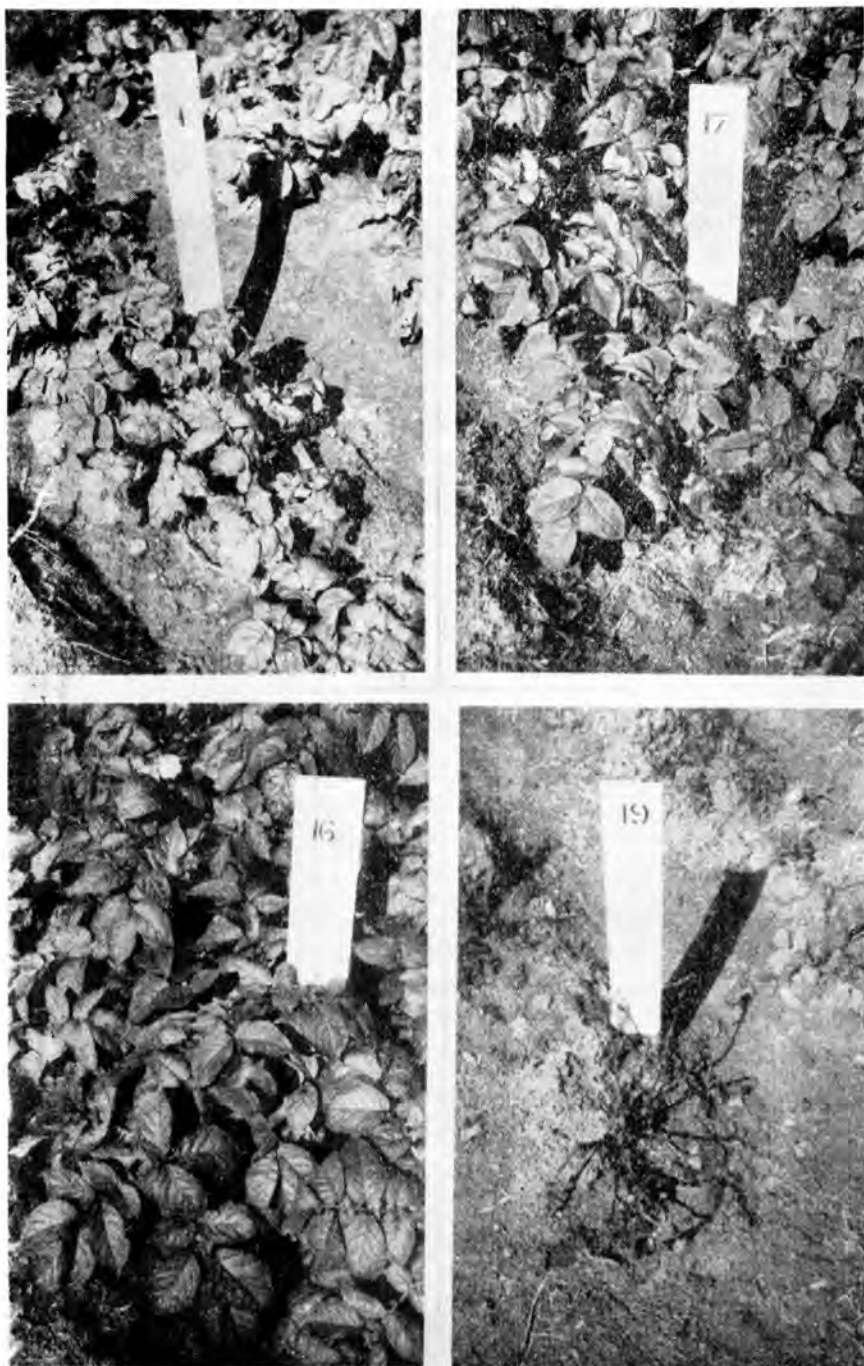


Fig. 4. Treatments from Maha 1963/64, trial II at 65 days after the application of seven sprays. Note the phytotoxic symptoms on the foliage sprayed with organo-tin fungicides which are severe with Brestan 60 ($4\frac{1}{2}$ oz./100 gal., 7 day interval) (top left, 1) and mild with Du-Ter (1 lb./100 gal. 7 day interval) (top right, 17) in comparison with the healthy foliage sprayed with Dithane M-45 (2 lb./100 gal., 7 day interval) (bottom left, 16) and the defoliated unsprayed control (bottom right, 19).