# CONTROL OF LATE BLIGHT IN POTATOES

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ONE of the most serious hazards in potato cultivation is the late blight disease caused by the fungus *Phytophthora infestans*. The fungus attacks the foliage, on which it produces the typical symptoms of late blight, as well as the tubers, and causes a considerable reduction of yields. The physiology of the fungus and the symptoms on potato are described in detail by Abeygunawardena and Balasooriya (3). It is also stated there that the susceptibility to late blight is an inherent character.

Plant breeders have been successful in producing high yielding varieties tolerant to late blight. In fact, planting of tolerant varieties is the cheapest means of combating the disease. However, several strains of the fungus have been discovered and even varieties which exhibit tolerance to the disease are not tolerant to all the strains of the fungus. Furthermore, the ability of the fungus to adapt itself in a relatively short time so as to attack new varieties, initially tolerant to the disease, makes the problem more complicated. The breaking down of varieties once tolerant happens all over the potato planting areas of the world. In such cases, the disease makes its appearance suddenly and control measures may not be very effective. It is therefore essential to take preventive measures to avoid such outbreaks.

It has long been known that fungi can be controlled by chemicals. The earlier used copper compounds have been displaced more and more by new fungicides with only a partial copper content and by the organic compounds based on the salts of dithiocarbamic acid with the metals manganese, zinc and iron.

A large number of fungicides are on the market. It was necessary to evaluate the efficacy of at least some of these under the weather conditions prevailing locally. This work was first started in Ceylon by Peiris and de Zilva (4) and continued by Abeygunawardena and

Peiris (1) and by Abeygunawardena (2). While the fungicides tested in the first trials (4) were mainly of the copper type, both the copper and the organic compounds were tested in the subsequent trials. All the trials did not show significant results but it was obvious that the organic fungicides were superior to the pure copper fungicides.

This testing of the various fungicides available in Ceylon has been continued through several years. Much information has been accumulated and conclusions may now be made.

A detailed description of how these trials were laid out is given by Abeygunawardena and Peiris (1). It is not necessary to repeat this and reference will be made only to the more important points. All trials were planted with four replicates. From 1962 the number of replicates was increased to six. The trials were laid in randomized blocks. In the fertilizer dressing, nitrogen was applied at a rate about 20 per cent. in excess of the recommended dosage to stimulate a luxuriant foliar growth. Varieties susceptible to late blight were used and planting periods selected where late blight infection could be expected. Spraying was done weekly. This last point is debatable. In practice, the most effective and most economical spraying should be done according to the prevailing weather conditions. Since trials should be repeated to obtain conclusive results, they should be repeated under the same conditions. But weather conditions will never be the same. It is therefore necessary to find some compromise. The only possibility of achieving such a compromise is to carry out the sprays at fixed intervals regardless of the weather conditions. On the other hand during seasons when weather conditions are always favourable for late blight infection, the question of correlating sprays with weather conditions does not arise. During such seasons regular spraying is essential. Again, it must be assured that the spray solution has time to dry on the foliage. If spraying is immediately followed by rain the controlling effect of the spray will be greatly reduced.

In the evaluation of trials carried out earlier no stress was laid as to the economy of the plant protection measures adopted. Due to the fact that the weather conditions in the Up-country of Ceylon are highly favourable to outbreaks of late blight, more control measures are necessary than in many other potato planting areas of the world. This could mean shorter intervals between sprays or a higher concentration of the fungicide used in the spray wash. It seems that a weekly spraying schedule under these wet conditions is the optimum, and perhaps the maximum possible. Another series of trials on spraying intervals should clear this problem. In some trials of the present series,

double the concentration of fungicide recommended by producers was employed. It was found that such a high concentration was not always economical considering the short intervals of spraying, viz., weekly. Therefore, in later trials only the normal dose was used. The problem will have to be considered afresh if spraying intervals could be changed.

For each of the five trials under review, three types of figures for evaluation are prepared. Table A shows the yield and the development of blight, the observations being taken at weekly intervals. The rainfall during these periods and the number of rain days are also given. Table B shows the costs of spraying and the profit due to the control of late blight. A figure shows the weather conditions under which the trial was carried out. The dates of spraying and the dates of dying of the foliage for each treatment are also indicated. For the development of the late blight fungus an optimum humidity and temperature are required. Therefore, the Fig. gives the daily minimum and maximum temperatures in comparison with the daily relative humidity. The rainfall for each day is also mentioned. Table 6 gives the active ingredients of the fungicides evaluated and the prices which provided the basis for the calculation of costs and profits.

The trials were planted on the following dates: (1) 13.7.61, (2) 24.4.62, (3) 3.10.62, (4) 7.3.63 and (5) 25.7.63. Only trial 2 was a failure due to the heavy blowing in May 1962 which damaged the foliage. Nevertheless, the results are given as the yields, though low, indicate the same tendency as regards the efficacy of the fungicides.

Before arriving at general conclusions, it is necessary to give some explanation for each of the trials. (1) The planting on 13.7.61 assured a fair chance of infection as heavy rains can be expected in the Nuwara Eliya District from September onwards. The rainfall totalling 26.4″ during the vegetation period of 124 days was not very high, but the number of 83 rain days, i.e. 2/3 of the vegetation period being rain days, was a record. In particular, the second half of the vegetation period with high temperatures and a good number of rain days gave conditions ideal for the development of the fungus. The unsprayed control died after 88 days while the best fungicides extended the vegetation period by 36 days more. The assessments of blight development also show that this extension was due to successful spraying. Considering the nett profit from the yields in tons per acre or in rupees, it is obvious that great differences exist between the fungicides. Except for one treatment, all the others gave better results if the normal dosage was doubled. Dithane Z-78 in particular was very effective at the high dosage.

(2) The trial planted on 24.4.62 was subjected to heavy blowing about 5-7 weeks after planting. Much of the foliage was severely damaged by the strong winds and the plants were unable to recover. Since the yields from this trial were very low, only Table A is given. None of the fungicides showed pronounced differences in the single and double dose applications. However, the order of efficiency of the fungicides is similar to that of the previous trial.

(3) In the same year, another trial was planted on 3.10.62. The weather conditions for the development of the fungus were not as ideal as in trial (1). The rainfall during the slightly shorter vegetation period was about the same but the number of rain days was less. One effect with these weather conditions was that differences between the efficacy of the fungicides was less although the same tendency was maintained in regard to the order of efficacy of the fungicides. The second was that the double dose was more effective only in the case of Dithane Z-78 if the profit is given in rupees. On this trial it was concluded that spraying a double dose will be economical only if the weather conditions are particularly favourable for the development of the fungus. But this cannot be expected often. Therefore, the double dose was abandoned in subsequent trials and this also enabled a larger number of fungicides to be evaluated in these.

(4) The next trial was planted on 7.3.63 so as to avoid the heavy blowing during the first half of June. Due to unusually dry weather conditions in May 1963, the rainfall during the vegetation period and the number of rain days was low, but the humidity was generally high. The normal blowing setting in with the beginning of the South-West monsoon in the second half of May somewhat restricted the vegetation period. Therefore, the differences in the vegetation period between the unsprayed control and the fungicidal treatments are not as marked as in the previous trials. However, the differences in the yield were still significant and the inclusion of new types of fungicides changed the order according to their efficacy. Special mention must be made of Brestan 60. Due to an unfortunate mistake, it was overdosed by about 500%. At this dosage it was very toxic to the foliage causing crinkling of the leaves and stunted plant growth.

(5) The last trial planted on 25.7.63 gave somewhat different results similar to those of trial (1) planted during the same season two years earlier. The vegetation period, rainfall and the number of rain days were also similar. The order of fungicides according to their efficacy was similar to that of the previous trial where the same fungicides were tested. Although Brestan 60 was used at the recommended

dosage, the variety Gineke again showed some phytotoxic symptoms resulting in a short vegetation period and a relatively low yield. Further investigations are in progress to determine whether the toxic effect is pecular to this variety and whether such toxic effects could be avoided by spraying at longer intervals or lower concentrations.

For the first time in this series of trials it was possible to determine the starch content of the tubers. There seems to be a positive interrelation between the length of the vegetation period and starch content.

## DISCUSSION AND CONCLUSIONS

Of the five trials under review, four were conclusive while one was more or less damaged by heavy monsoonal winds. Although the weather conditions during the different seasons varied, there were always significant differences between the fungicides. In the two trials where the fungicides were used at two concentrations, i.e., a single dose (normal) and a double dose, some conflicting results were obtained. It appears that a double dose is economical only if the weather conditions are specially favourable for the development of the fungus. Since the purpose of this series of trials was to evaluate different types of fungicides, the question of concentrations was not pursued in the last two trials. The effects of variation of the concentration in relation to different intervals of spraying should be investigated in a separate series of trials and this has already been initiated.

Another criterion in evaluating fungicides is their ability to control the rotting of tubers in storage after harvest due to infection by *Phytophthora infestans*. No difference was observed in the percentage of rotted tubers between the treatments and the untreated controls. However, the percentage of rotting in both cases was negligible.

A short account of the performance of the fungicides evaluated is given below :

(*a*) *Mangan curit* was tested only twice. In both trials it gave very good control of the fungus and the highest yields. The nett profit from spraying was also the highest.

(*b*) *Dithane M 45* was also tested only twice and in both trials it followed Mangan curit very closely in yield and nett profit.

(*c*) *Lonacol M* was included in three trials. It followed in third place after Mangan curit and Dithane M 45 but the difference was not significant. In the absence of these two it gave the highest yield and was bettered by other fungicides only if the latter were used at a double concentration. The difference in

nett profit was not very marked then. The double dose of Lonacol M was not better than the single dose.

(*d*) *Dithane Z 78* was used in all five trials with nearly similar results. At the normal concentration recommended, i.e. single dose, it was inferior to the three fungicides first mentioned. On the other hand, it was the only fungicide characterised by distinctly better results at a double concentration. The effect was so good that the nett profit also increased.

(*e*) *Cupravit ob 21* was tested in three trials with varying results. In one trial Supravit ob 21 and Lonacol M were equally effective and came next to Mangan curit and Dithane M 45, but in the other trials the difference was greater. Although it is not quite clear as to whether it will be successful under all the weather conditions experienced in Ceylon, it can be considered a good fungicide.

(*f*) *Blitane* and *New Blitane* were tested in the last three trials. In the first two of these, the formulation used was Blitane while in the third it was New Blitane. Although the 'New' type seems to be an improvement on the earlier one, the results do not differ very much. In all cases the fungicide was not more than average.

(*g*) *Dithane M 22* was used in all the trials with decreasing success. It gave good results in the first trial. However its controlling effect on blight and consequently the yield decreased progressively until the yield was less than that from the unsprayed control. There is no reasonable explanation for this behaviour.

(*h*) *Tubosan* was included in three trials and was abandoned later as it was not very effective.

(*i*) *Blue copper sandoz,* (*k*) *Miltox,* and (*l*) *Colloidal Copper* were tested only once. While Colloidal Copper does not seem to be very promising, the other two merit further testing.

(*m*) *Duter* was tested only in the first trial with fair results. Unfortunately it could not be obtained for the later trials. A definite conclusion cannot be given yet.

(*n*) *Brestan 60* when first tested was used incorrectly resulting in a very heavy toxic effect. Although the concentration was corrected in the second trial, the variety Gineke appeared to be sensitive under Ceylon conditions. Since Brestan seems to control the fungs quite effectively, a new series of trials is under way to determine the possibilities for its use.

These trials lead to the conclusion that there are a number of fungicides which can control *Phytophthora infestans* effectively under Ceylon conditions. It would be advisable if 4-5 fungicides are

recommended for general usage and their import allowed so as to enable competition and a consequent reduction of prices. Other fungicides, especially those mentioned under (*i*), (*k*) and (*n*) should receive consideration after further testing.

Finally it should be mentioned that there will always be discrepancies between trial results and practical applications. In spraying trials the operations are carried out much more accurately than in farmers' fields. Such intensive control measures involving high rates of fungicidal application coupled with a large number of sprayings may not be quite practicable. Nevertheless the nett profits are high. It is also proved once again that controlling late blight with appropriate spraying of fungicides is always economical.

## SUMMARY

Thirteen fungicides were tested in five trials during different seasons in the up-country of Ceylon to evaluate their efficacy in controlling late blight (*Phytophthora infestans*). In the first trials, each fungicide was used at two concentrations with weekly sprayings. Subsequently the evaluation at two dosages was abandoned and this enabled the inclusion of a larger number of fungicides in the later trials. The problem of regular weekly spraying is discussed. Since the trials gave similar results although conducted under varying weather conditions it is possible to recommend about four or five fungicides as suitable for Ceylon.

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## TABLE 1 (A)—Yield and Blight Assessment

Planted : 13.7.61

Harvested : 15.11.61

Variety : Tedria

No. of replicates : 4

Fertilizer per acre :—

500 lb. Amm. Sulphate

335 lb. Conc. Superphosphate

100 lb. Muriate of potash

5 tons Cattle Manure

Weather conditions :—

Average minimum temperature : 11·4–16·3°C.

Average maximum temperature : 16·7–24·0°C.

Relative humidity : 91·2%

| *Treatment* | *Yield t/acre* | *No. of spray-ings* | *Days P-M** | *Total Rainfall* | *Rainy days* | *Late Blight% 8th–16th week after planting* | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | *12/9* | *19/9* | *26/9* | *2/10* | *10/10* | *17/10* | *24/10* | *31/10* | *7/11* |
| Dithane M 22–S† .. | 7·73 | 13 | 124 | 26·42 | 83 | ·32 | ·75 | ·1 | ·55 | 1 | 1 | 1·77 | 4 | 20 |
| Dithane M 22–D† | 7·54 | 13 | 124 | 26·42 | 83 | ·55 | ·1 | ·75 | ·32 | ·55 | ·77 | 4 | 8 | 31·25 |
| Dithane Z 78–S .. | 5·02 | 13 | 124 | 26·42 | 83 | 2·78 | 4 | 2·78 | 4 | 8 | ·3 | 15·25 | 37·75 | 75 |
| Dithane Z 78–D .. | 8·54 | 13 | 124 | 26·42 | 83 | ·1 | ·75 | ·32 | ·55 | ·77 | 2 | 5· | 14 | 50 |
| Tubosan–S .. | 4·41 | 13 | 124 | 26·42 | 83 | 3·8 | 1·55 | 2 | 10 | 20 | 43·75 | 68·75 | 96·25 | 100 |
| Tubosan–D .. | 5·48 | 13 | 124 | 26·42 | 83 | 1·8 | 1·32 | 2 | 9 | 15 | 32·5 | 50 | 62·5 | 92·5 |
| Duter–S .. | 5·60 | 13 | 124 | 26·42 | 83 | ·32 | ·1 | 2 | 5 | 15 | 26·25 | 31·25 | 56·25 | 81·25 |
| Duter–D .. | 7·01 | 13 | 124 | 26·42 | 83 | ·1 | ·75 | ·75 | 2 | 4 | 5 | 10 | 25 | 50 |
| Blitane–S .. | 4·46 | 12 | 117 | 24·77 | 76 | 3 | 3 | 3 | 5 | 25 | 31·25 | 50 | 96·25 | 100 |
| Blitane–D .. | 6·34 | 12 | 117 | 24·77 | 76 | ·32 | ·12 | ·77 | 10 | 25 | 25 | 56·25 | 75 | 98·75 |
| Unsprayed control | 1·80 | — | 88 | 16·91 | 57 | 26·25 | 20 | 25 | 75 | 100 | 100 | 100 | 100 | 100 |
| $\phi$ .. | 5·81 | | | | | | | | | | | | | |
| L. S. D. .. | 1·10 | | | | | | | | | | | | | |

*P = Planting  *M = Maturity  †S = Single dose.  †D = Double dose.

## TABLE 2 (A)—Yield and Blight Assessment

Planted : 24.4.62

Harvested : 17.7.62

Variety : Tedria

No. of replicates : 4

Fertilizer per acre :—

500 lb. Amm. Sulphate

335 lb. Conc. Superphosphate

100 lb. Muriate of potash

5 tons cattle manure

Weather conditions :—

Average minimum temperature : 12·9°C.

Average maximum temperature : 20·1°C.

Relative humidity : 91·2%

| *Treatment* | *Yield t/acre* | *No. of spray-ings* | *Days P–M** | *Total Rainfall inch* | *Rainy days* | *Late Blight % 7th–11th week* | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | *12/6* | *19/6* | *26/6* | *3/7* | *10/7* |
| Dithane M 22–S† .. .. | 0·80 | 6 | 85 | 21·01 | 50 | 2 | 0·32 | 1·55 | 26·25 | 78·75 |
| Dithane M 22–D† .. .. | 0·74 | 6 | 84 | 21·01 | 50 | 1 | 0·55 | 1·78 | 20 | 83·75 |
| Dithane Z 78–S .. .. | 0·59 | 3 | 80 | 20·53 | 46 | 3 | 1·78 | 21·25 | 85 | 98·75 |
| Dithane Z 78–D .. .. | 0·55 | 6 | 80 | 20·53 | 46 | 3 | 0·55 | 18·78 | 62·5 | 93·75 |
| Tubosan–S .. .. | 0·51 | 6 | 80 | 20·53 | 46 | 3 | 2·78 | 15·25 | 72·5 | 98·75 |
| Tubosan-D .. .. | 0·61 | 6 | 83 | 20·85 | 49 | 3 | 0·55 | 2·78 | 32·5 | 92·5 |
| Tuzet P. H. 50–12–S .. | 0·61 | 5 | 82 | 20·78 | 48 | 3 | 0·55 | 2·78 | 15 | 86·25 |
| Tuzet P. H. 50–12–D .. | 0·64 | 5 | 84 | 21·01 | 50 | 2 | 0·32 | 1 | 15 | 80 |
| Blitane–S .. .. | 0·54 | 6 | 80 | 20·53 | 46 | 4 | 0·55 | 9 | 67·5 | 98·75 |
| Blitane-D .. .. | 0·65 | 6 | 84 | 21·01 | 50 | 2 | 14·25 | 3 | 27·5 | 91·25 |
| Control Unsprayed .. | 0·37 | — | 72 | 17·18 | 38 | 25 | 37·5 | 90 | 100 | 100 |
| $\phi$ .. .. | ·60 | | | | | | | | | |

*P = Planting. *M = Maturity. †S = Single dose. †D = Double dose.

## TABLE 3 (A)—Yield and Blight Assessment

Planted : 3.10.62
Harvested : 24.1.63
Variety : Tedria
No. of replicates : 6

Fertilizer per acre :—
500 lb. Amm. Sulphate
335 lb. Conc. Superphosphate
100 lb. Muriate of potash
5 tons cattle manure

Weather conditions :—
Average minimum temperature : 11.1°C.
Average maximum temperature : 20·1°C.
Reletive humidity : 90·5%

| *Treatment* | *Yield t/acre* | *No. of spray-ings* | *Days P–M** | *Total Rainfall inch* | *Rainy days* | *Late Blight% 6th week–13th week after planting* | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | *14/11* | *21/11* | *28/11* | *5/12* | *12/12* | *19/12* | *27/12* | *2/1/63* |
| Lonacol M-S† .. | 5·07 | 9 | 91 | 18·79 | 47 | 0·01 | 0·03 | 0·03 | 0·03 | 0·08 | 0·23 | 53·33 | 76·66 |
| Lonacol M D† .. | 4·79 | 9 | 91 | 18·79 | 47 | — | — | — | 0·01 | 0·53 | 0·53 | 58·33 | 85·00 |
| Dithane M-22-S.. | 4·91 | 9 | 112 | 25·34 | 58 | — | — | — | — | 0·1 | 0·1 | 45·83 | 62·50 |
| Dithane M-22-D.. | 5·20 | 9 | 112 | 25·34 | 58 | — | 0·03 | 0·03 | 0·03 | 0·03 | 0·1 | 58·33 | 75·00 |
| Dithane Z-78-S .. | 4·89 | 9 | 112 | 25·34 | 58 | — | 0·01 | 0·03 | 0·06 | 0·23 | 0·23 | 58·33 | 85·00 |
| Dithane Z-78-D.. | 5·69 | 9 | 112 | 25·34 | 58 | 0·01 | 0·01 | 0·01 | 0·05 | 0·83 | 1·21 | 45·83 | 57·50 |
| New Blitane-S .. | 4·72 | 9 | 91 | 18·79 | 47 | — | 0·03 | 0·03 | 0·06 | 0·40 | 1·5 | 58·33 | 88·33 |
| New Blitane-D .. | 4·45 | 9 | 91 | 18·79 | 47 | 0·03 | 0·03 | 0·05 | 1·88 | 2·03 | 10·03 | 73·33 | 86·66 |
| Cupravit ob 21-S | 4·54 | 9 | 91 | 18·79 | 47 | — | 0·01 | 0·03 | 0·68 | 2·70 | 12·70 | 70·83 | 98·33 |
| Cupravit ob 21-D | 3·99 | 9 | 91 | 18·79 | 47 | — | 0·01 | 0·03 | 0·38 | 1·51 | 6·18 | 78·33 | 97·50 |
| Tubosan-S .. | 3·83 | 9 | 91 | 18·79 | 47 | 0·01 | 0·01 | 0·03 | 1·28 | 5·51 | 9·66 | 80·83 | 97·50 |
| Tubosan-D .. | 4·11 | 9 | 91 | 18·79 | 47 | — | 0·03 | 0·03 | 0·25 | 1·06 | 5·21 | 65·83 | 85·83 |
| Control .. | 2·03 | — | 80 | 16·97 | 39 | — | 0·53 | 8·33 | 45·83 | 66·66 | 95·00 | 100·00 | 100·00 |
| $\phi$ .. | 4·47 | | | | | | | | | | | | |
| L. S. D. .. | 0·93 | | | | | | | | | | | | |

*P=Planting. *M=Maturity. †S=Single dose. †D=Double dose.

## TABLE 4 (A)—Yield and Blight Assessment

Planted : 7.3.63

Harvested : 22.6.63

Variety : Gineke

No. of replicates : 6

Fertilizer per acre :—

500 lb. Amm. Sulphate

335 lb. Conc. Superphosphate

100 lb. Muriate of potash

5 tons cattle manure

Weather conditions :—

Average minimum temperature : 10·9°C.

Average maximum/temperature : 22·8°C.

Relative humidity : 92·6%

| *Treatment* | *Yield t/acre* | *No. of spray-ings* | *days P-M** | *Total rainfall inch* | *Rainy days* | *Late Blight % 7th week–14th week after planting* | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | *23/4* | *30/4* | *6/5* | *14/5* | *21/5* | *28/5* | *4/6* | *11/6* |
| Mangan curit .. | 5·53 | 8 | 102 | 17·45 | 44 | 0·05 | 0·25 | 4·33 | 9·16 | 10·00 | 15·00 | 24·16 | 70·00 |
| Dithane M-45 .. | 5·33 | 8 | 101 | 17.45 | 44 | 0·18 | 1·21 | 3·00 | 8·33 | 8·33 | 9·16 | 12·50 | 73·33 |
| Cupravit ob 21 .. | 4·89 | 8 | 96 | 17·22 | 42 | 0·33 | 1·06 | 6·50 | 15·00 | 17·50 | 20·00 | 41·66 | 90·83 |
| Lonacol M .. | 4·85 | 8 | 102 | 17·45 | 44 | 0·21 | 2·13 | 6·00 | 11·66 | 11·66 | 16·66 | 20·00 | 70·00 |
| New Blitane .. | 4·80 | 8 | 95 | 17·22 | 42 | 0·05 | 0·90 | 3·16 | 9·50 | 20·83 | 15·83 | 33·33 | 94·16 |
| Dithane Z 78 .. | 4·62 | 8 | 98 | 17·37 | 43 | 0·05 | 0·90 | 3·83 | 10·00 | 10·00 | 16·66 | 20·00 | 88·33 |
| Dithane M 22 .. | 4·35 | 8 | 96 | 17·22 | 42 | 0·83 | 2·18 | 6·00 | 15·00 | 15·00 | 21·66 | 41·66 | 94·16 |
| Brestan 60 .. | 3·34 | 8 | 84 | 13·91 | 36 | 0·25 | 3·01 | 9·16 | 25·00 | 54·16 | 91·66 | 99·16 | 100·00 |
| Control .. | 3·75 | — | 89 | 13·97 | 37 | 0·21 | 6·18 | 16·66 | 30·83 | 50·00 | 85·00 | 98·73 | 100·00 |
| $\phi$ .. | 4·61 | | | | | | | | | | | | |
| L. S. D. .. | 0·66 | | | | | | | | | | | | |

* P=Planting. *M=Maturity.

## TABLE 5 (A)—Yield and Blight Assessment

Planted : 25.7.63

Harvested : 8–23.11.63

Variety : Gineke

No. of replicates : 6

Fertilizer per acre :—

500 lb. Amm. Sulphate

335 lb. Conc. Superphosphate

100 lb. Muriate of potash

5 tons cattle manure

Weather conditions :—

Average minimum temperature : 13·9–14·6°C.

Average maximum/temeprature: 20·5–20·8°C.

Relative humidity : 96·9–98·2%

| *Treatment* | *Yield t/acre* | *Starch %* | *No. of spray-ings* | *days P-M** | *Total Rainfall inch* | *No. of rain days* | *Late Blight %, 8th–15th week after planting* | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | *25/9* | *2/10* | *9/10* | *16/10* | *23/10* | *30/10* | *6/11* |
| Mangan curit .. | 9·40 | 12·5 | 11 | 116 | 28·99 | 81 | 0·3 | 1·1 | 4·5 | 15 | 36·6 | 65 | 77·5 |
| Dithane M 45 .. | 9·01 | 13·75 | 12 | 116 | 28·99 | 81 | 0·05 | 0·1 | 0·5 | 5 | 15 | 36 | 61 |
| Lonacol M .. | 7·91 | 12·5 | 11 | 116 | 28·99 | 81 | 0·9 | 1·1 | 5·4 | 16 | 36·6 | 72·5 | 82·5 |
| Dithane Z 78 .. | 7·66 | 12·75 | 11 | 103 | 27·11 | 78 | 1 | 1·9 | 5·6 | 22·5 | 50 | 84 | 95 |
| Blue copper sandoz .. | 6·82 | 12·0 | 9 | 89 | 22·28 | 60 | 1·9 | 3·5 | 25 | 75 | 95 | 100 | — |
| Cupravit ob 21 .. | 6·51 | 12·25 | 9 | 96 | 23·08 | 64 | 1·9 | 5·2 | 22·5 | 52·5 | 82 | 93 | 100 |
| Miltox .. | 6·47 | 12·0 | 9 | 96 | 23·08 | 64 | 0·4 | 0·17 | 16 | 52 | 77·5 | 97 | 100 |
| New Blitane .. | 6·24 | 12·0 | 9 | 89 | 22·28 | 60 | 1·4 | 6 | 33·3 | 82 | 96 | 99 | — |
| Colloidal copper .. | 5·86 | 12·1 | 9 | 89 | 22·28 | 60 | 1·4 | 6 | 33·3 | 75 | 97 | 100 | — |
| Brestan 60 .. | 5·83 | 11·5 | 9 | 89 | 22·28 | 60 | 0·3 | 9 | 31 | 70 | 90 | 100 | — |
| Dithane M 22 .. | 3·43 | 11·4 | 7 | 82 | 16·43 | 54 | 46 | 81 | 93 | 99 | — | — | — |
| Control .. | 2·99 | 10·6 | — | 82 | 16·43 | 54 | 58 | 85 | 96 | 99 | — | — | — |
| $\phi$ .. | 6·51 | | | | | | | | | | | | |
| L. S. D. .. | 1·28 | | | | | | | | | | | | |

*P=Planting.

*M=Maturity.

**TABLE 1B—Expenditure of Spraying**

| *Fungicide* | *Cost of spraying Rs.* | *Yield in Rupees** | *Nett Profit or loss by spraying* | *Profit or loss of double dose* |
|---|---|---|---|---|
| Dithane M 22 S† | 298.92 | 4328.80 | 3021.88 | |
| Dithane M 22 D† | 456.50 | 4222.40 | 2757.90 | — 263.98 |
| Dithane Z 78 S | 262.09 | 2811.20 | 1541.11 | |
| Dithane Z 78 D | 457.78 | 4782.40 | 3316.62 | + 1775.51 |
| Tubosan S | 237.77 | 2469.60 | 1223.83 | |
| Tubosan D | 406.02 | 3068.80 | 1654.78 | + 430.95 |
| Duter S | * | 3136.00 | — | |
| Duter D | * | 3945.60 | — | — |
| Blitane S | 216.27 | 2497.60 | 1273.33 | |
| Blitane D | 299.42 | 3550.40 | 2242.98 | + 969.65 |
| Control | — | 1008.00 | | |

* Prices for the fungicide in Ceylon were not available.

†S=Single dose. †D=Double dose. *1 ton=Rs. 560

**TABLE 3B—Expenditure of Spraying**

| *Fungicide* | *Cost of spraying Rs.* | *Yield in Rupees** | *Nett Profit or loss by spraying* | *Profit or loss of double dose* |
|---|---|---|---|---|
| Lonacol M–S† | 241.38 | 2839.20 | +1461.02 | |
| Lonacol M–D† | 386.38 | 2682.40 | +1159.22 | — 301.80 |
| Dithane M22–S | 285.01 | 2749.60 | +1427.79 | |
| Dithane M–22–D | 466.40 | 2912.00 | +1308.80 | — 118.99 |
| Dithane Z 78 –S | 250.00 | 2738.40 | +1351.60 | |
| Dithane Z 78 –D | 403.83 | 3186.40 | +1645.77 | + 294.17 |
| New Blitane –S | 195.23 | 2643.20 | +1311.17 | |
| New Blitane –D | 298.38 | 2492.00 | +1056.82 | — 254.35 |
| Cupravit ob 21 –S | 244.92 | 2542.40 | +1160.68 | |
| Cupravit ob 21 –D | 410.14 | 2234.40 | + 687.46 | — 473.22 |
| Tubosan –S | 235.92 | 2144.80 | + 772.08 | |
| Tubosan –D | 400.26 | 2301.60 | + 764.54 | — 7.54 |
| Control | — | 1136.80 | | |

†S=Single dose. †D=Double dose. *1 ton=Rs. 560.

**TABLE 4B—Expenditure of Spraying**

| *Fungicide* | *Cost of spraying Rs.* | *Yield in Rupees (X)* | *Nett Profit or loss by spraying* |
|---|---|---|---|
| Mangan curit | 260.97 | 3096.80 | + 735.83 |
| Dithane M 45 | 262.62 | 2984.80 | + 622.18 |
| Cupravit ob 21 | 240.00 | 2738.40 | + 398.40 |
| Lonacol M | 224.62 | 2716.00 | + 391.38 |
| New Blitane | 193.93 | 2688.00 | + 394.07 |
| Ditane Z 78 | 232.48 | 2587.20 | + 254.72 |
| Dithane M 22 | 249.01 | 2436.00 | + 86.99 |
| Brestan 60 | 402.61* | 1870.40 | — 632.21* |
| Control | — | 2100.00 | |

* Brestan too high rate used. (X) 1 ton=Rs. 560.

**TABLE 5B—Expenditure of Spraying**

| *Fungicide* | *Cost of spraying Rs.* | *Yield in Rupees** | *Nett Profit or loss by spraying* |
|---|---|---|---|
| Mangan curit | 310.13 | 5264.00 | + 3279.47 |
| Dithane M 45 | 414.67 | 5045.60 | + 2956.53 |
| Lonacol M | 346.64 | 4429.60 | + 2408.56 |
| Dithane Z 78 | 356.27 | 4289.60 | + 2258.93 |
| Blue copper sandoz | 367.70 | 3819.20 | + 1777.10 |
| Cupravit ob 21 | 330.00 | 3645.60 | + 1641.20 |
| Miltox | 712.91 | 3623.20 | + 1235.89 |
| New Blitane | 243.50 | 3494.40 | + 1476.50 |
| Colloidal copper | 227.47 | 3281.60 | + 1379.73 |
| Brestan 60 | 209.24 | 3264.80 | + 13 1.16 |
| Dithane M 22 | 270.72 | 1920.80 | — 24.32 |
| Control | — | 1674.40 | |

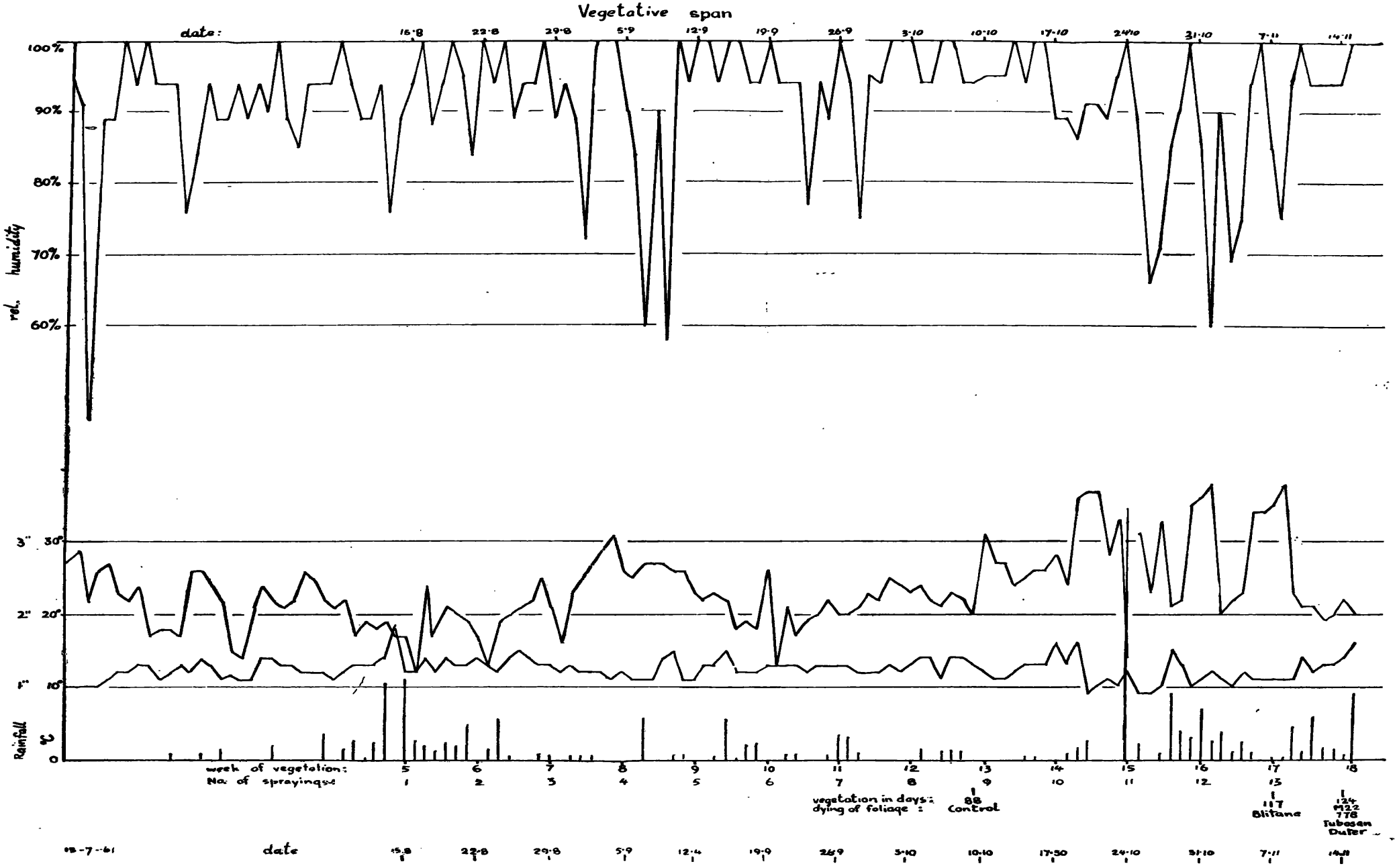
*1 ton=Rs. 560.

**TABLE 6—Prices of Fungicides**

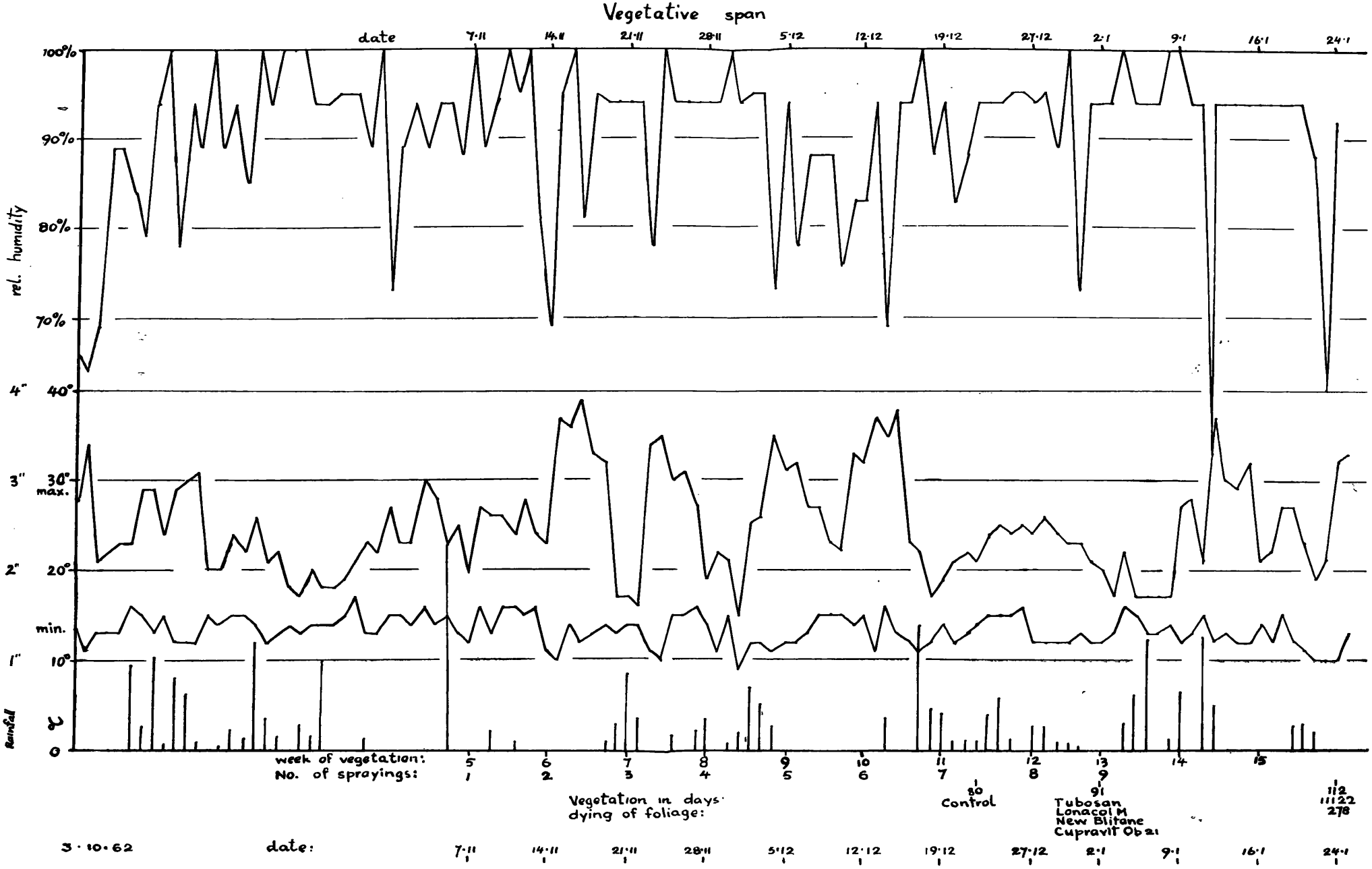
| *Fungicide* | *Active ingredient* | *Wholesale price/lb.* Rs. | *Oz.* Rs. | *Amount to be used recommended by firms* | *1 spraying price/acre* Rs. |
|---|---|---|---|---|---|
| Dithane M 22 .. | 80% Manganese Ethyl. | 4.20 | 0.26 | 2 lb. in 100 gal./acre | 8.40 |
| Dithane Z 78 .. | 65% Zinc Ethyl. | 3.70 | 0.23 | 2 lb. in 100 gal./acre | 7.40 |
| Dithane M 45 .. | 80% Zinc+Manganese Ethyl. | 4.20 | 0.26 | 1–2 lb. in 100 gal./acre | 4.20–8.40 |
| Tubosan .. | 33% Copper sulphate+15% Ziram | +3.67 | 0.23 | 3 lb. in 30–100 gal./acre | 11.00 |
| Lonacol M .. | 70% Manganese Ethyl. | 3.50 | 0.22 | 1½–2 lb. in 100 gal./acre | 5.25–7.00 |
| Cupravit ob 21 .. | 85% Copper oxychloride | 1.91 | 0.12 | 4 lb. in 100 gal./acre | 7.64 |
| New Blitane .. | Copper oxychloride+Manganese Ethyl. | +2.50 | 0.16 | 2 lb. in 100 gal./acre | 5.00 |
| Miltox .. | Copper oxychloride+Zinc Ethyl. | +3.30 | 0.21 | 4–6 lb. in 100 gal./acre | 13.20–19.80 |
| Blue copper sandoz .. | Copper oxychloride | 2.00 | 0.13 | 4–6 lb. in 100 gal./acre | 8.00–12.00 |
| Do. .. | for lcwts. | 1.50 | 0.10 | | 6.00–9.00 |
| Magan curit .. | Copper oxychloride+Manganese Ethyl. | 2.96 | 0.19 | 2 lb. in 100 gal./acre | 5.92 |
| Brestan 60 .. | Triphenyl-tin acetate | 10.36 | 0.65 | 6 oz. in 100 gal. /acre | 3.90 |
| Colloidal copper .. | 20% Mettalic copper | 1.80 | 0.11 | 2½ lb. in 100 gal./acre | 4.50 |

Cost of spraying one acre of potatoes :—

| | |
|---|---|
| 1 man sprays ¾ acre per day—salary for 1 man per day Rs. 5/- .. .. | Rs. 6.25 |
| Transport of 100 gallons of water .. .. .. | Rs. 3.75 |
| | Rs. 10.00 |

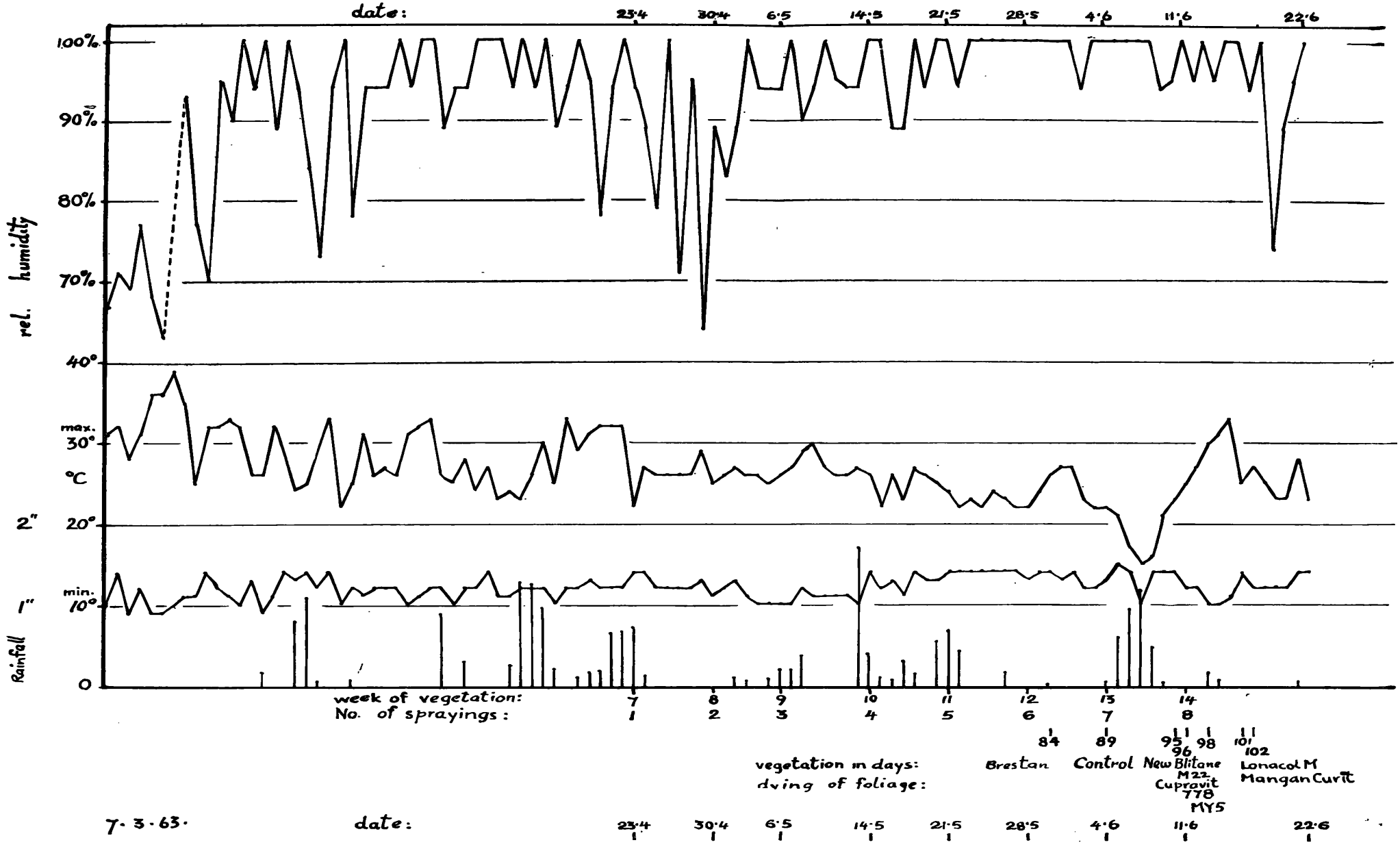



778 above should read Z–78

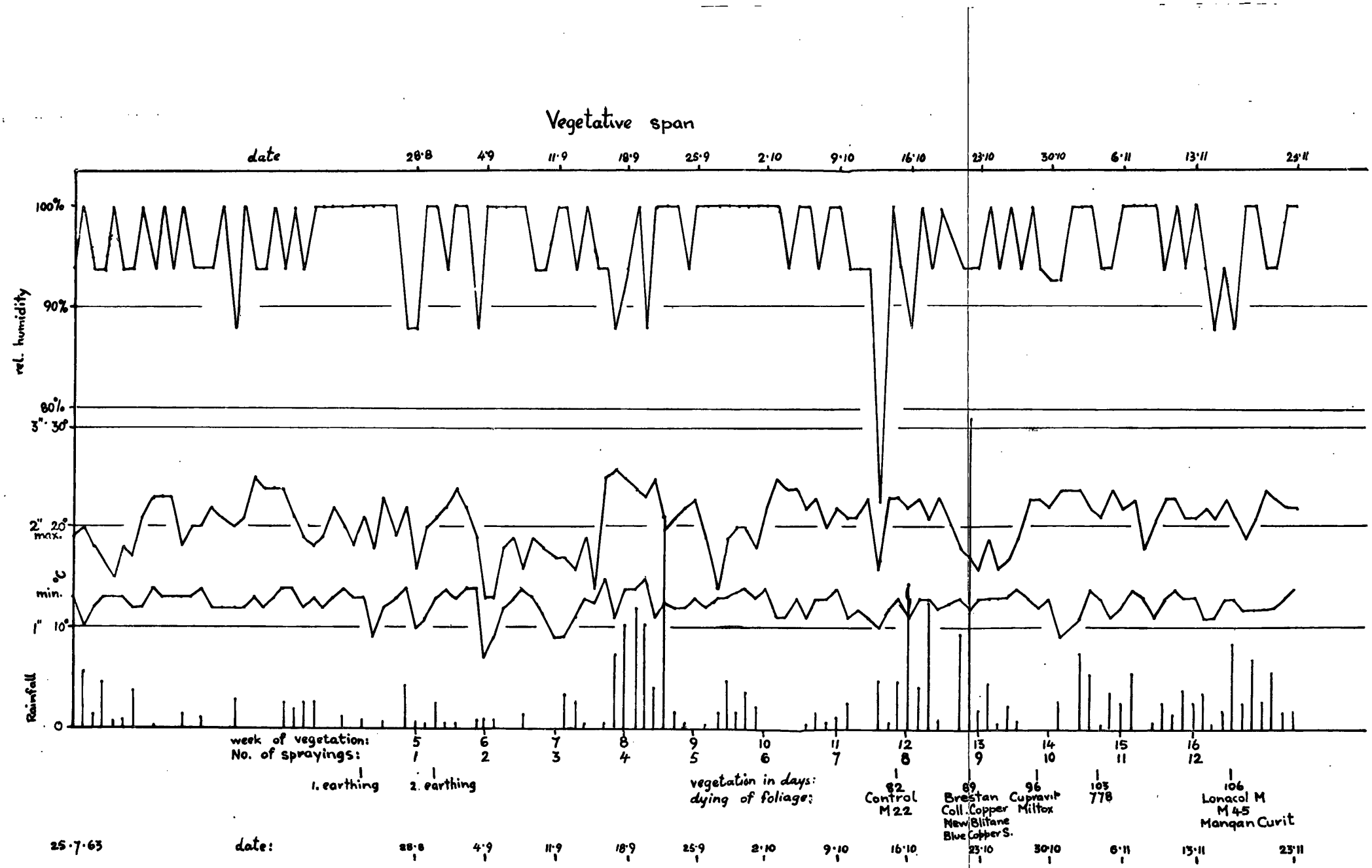



1 1122 and 278 above should read M-22 and Z-78

# Vegetative span.




778 and MY5 above should read Z-78 and M-45


Vegetative span
date
28·8
4·9
11·9
18·9
25·9
2·10
9·10
16·10
23·10
30·10
6·11
13·11
25·11
100%
90%
80%
rel. humidity
3" 30°
2" 20°
max.
°C
min.
1" 10°
Rainfall
0
week of vegetation:
No. of sprayings:
1. earthing
2. earthing
vegetation in days:
dying of foliage:
82
Control
M 22
89
Brestan
Coll. Copper
New Blitane
Blue Copper S.
96
Cupravit
Miltox
103
778
106
Lonacol M
M 4-5
Mangan Curit
25·7·63
Planting
date:
778 above should read Z–78