

SOME STUDIES ON TOBACCO DISEASES IN CEYLON—IV

THE ECONOMICS OF FIELD-SPRAYING FOR THE CONTROL OF FROG-EYE (*CERCOSPORA NICOTIANAE* E. & E.)

MALCOLM PARK, A.R.C.S.,
ACTING DEPUTY DIRECTOR OF AGRICULTURE,
AND
M. FERNANDO, Ph.D., B.Sc., D.I.C.,
RESEARCH PROBATIONER IN PLANT PATHOLOGY

THE results obtained in a preliminary experiment on the control of frog-eye (*Cercospora nicotianae* E. & E.), published in a previous article of this series (Park and Fernando, 1937 b), were so promising that it was decided to carry out a further and more detailed experiment during the *maha* season (October-November to March-April) of 1937-38 : the results of this experiment are published in another part of this journal (Park and Fernando, 1938). At the same time, it was felt that spraying should be tried on a relatively large scale to estimate the approximate costs of the operation and the technical difficulties involved. It was hoped that it would be possible by this means to ascertain therefrom if spraying would be a practical and economic proposition. An account is given in this note of this field trial and of the results obtained.

The trial was carried out at the Wariyapola Experiment Station. At this station, about 14 acres of cigarette tobacco of the Harrison's Special variety were grown during the season as part of the regular rotation. The nursery practice and the methods of cultivation were normal and were as described in previous articles (Park and Fernando, 1937 a and b). The nursery plants were sprayed regularly and, at the time of transplanting, were free from frog-eye. Frog-eye subsequently developed in the field and, at about two months after transplanting, every plant was infected to a greater or lesser extent. By the time the plants had grown to the topping stage it was seen that, as a general rule, frog-eye infection was confined to the lowest leaves of the plants, the uppermost leaves (usually 10 to 12 in number) being free from spotting.

The tobacco used for the trial was transplanted about October 20, 1937. The field spraying was done on January 19, 1938—about three months after transplanting. It was estimated that two-thirds of the plants had been topped at the time of spraying. The tobacco was well-grown and was a fairly representative sample of the whole area, being neither the best nor the worst. The tobacco was planted in rows, 3 feet by 3 feet. The area was divided into half-acre strips, about 18 yards wide and about 150 yards long, each strip being separated by a drain. Between every other strip, *i.e.*, separating each acre, there was, in addition a path 3 feet wide. This division of the area was well suited for the spraying machine used since the two hoses, each 60 feet long, were just long enough to allow of the complete sprayings of the rows, laterally.

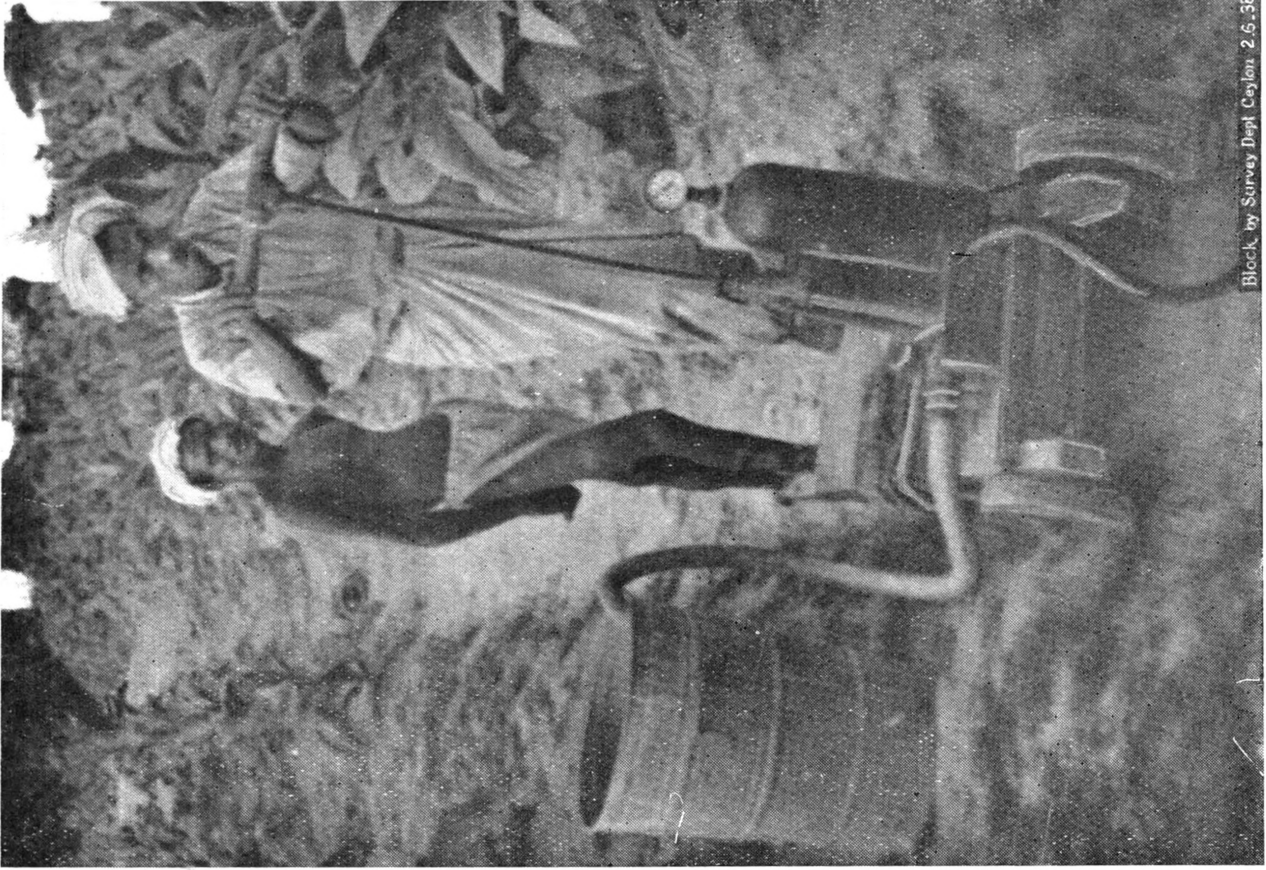
The sprayer used was a "Four Oaks" "Vesey" pattern spraying outfit, consisting of a double barrel pump mounted on a simple trolley with the spray delivered through two hoses, each 60 feet long, which terminated in short lances. Single nozzles of the "Marvellous" pattern, mounted on angle-bends, delivered the spray in the form of a fine mist. The illustration accompanying this note shows the sprayer in action.

The fungicide used was the same as that which proved satisfactory in the preliminary experiment referred to above and was, by good chance, the one which proved to be the most successful of the fungicides used in the experiment described elsewhere in this journal. The spray was made up in the following proportions :—

Proprietary "colloidal copper" compound	..	4 oz.
Proprietary neutral spreader	..	$\frac{1}{4}$ oz.
Water	..	4 gall.

TECHNIQUE

Water was available at distance of about 100 yards from the point at which the spraying was started. It was carried in buckets to the sprayer where it was poured into galvanized iron bins with a capacity of 16 gallons each. Two of these bins were used. The spray was mixed in the first and the second was carried to a point where it would be required when the first bin was emptied. It was found that, with little supervision, ordinary labourers were able to measure and mix the required quantities of the concentrated fungicide and of the spreader. The actual spraying in this trial was done by the writers as it was necessary to see that the personal factor should be as constant as possible, but there is no doubt that, with suitable tuition, it could be done equally well by ordinary agricultural labourers. Spraying from the two hoses was started between rows four rows apart, *i.e.*, the first man started between rows 1 and 2 and the



Block, by Survey Dept. Cayman, 2.5-35



Block, by Survey Dept. Cayman, 2.6-39

FIELD SPRAYING OF TOBACCO.

second between rows 5 and 6. The spraying of two rows was done at one time and proceeded to the far end of the rows, which was also the limit of the hose. The hoses were then lifted over two rows, *i.e.*, to between rows 3 and 4 and 7 and 8 respectively, and these rows were sprayed backwards to the beginning. The sprayer was then moved up eight rows and the process repeated, so that with each move of the sprayer, eight rows of 18 or 19 plants each were sprayed. One man easily kept up the pressure required (150 lb. per sq. in.).

While spraying was in progress it was found necessary for two men to be stationed on each hose, in addition to the person spraying, to ease the hose along and to prevent any damage being done to the plants. The four men so employed fetched water during the time when each fresh lot of fungicide was being mixed.

It was found that 16 gallons of spray were used for 16 rows of plants in most of the area and, at one end where growth was not so good, for 24 rows. Each row consists of 18 or 19 plants so that the amount of spray used per plant was just less than half a pint.

The time-table given below shows the progress of the spraying :—

TABLE I

Time	No. of rows sprayed	Quantity of spray used gall.
10.20 A.M. — 11.30 A.M.	16	16
11.30 A.M. — 12. 5 P.M.	16	16
12. 5 P.M. — 1.10 P.M.	16	16
(Lunch)		
2.40 P.M. — 3.15 P.M.	16	16
3.15 P.M. — 3.45 P.M.	16	16
3.45 P.M. — 4.25 P.M.	24*	16
4.25 P.M. — 4.55 P.M.	—	16
(Spraying of half-acre completed at 4.55 P.M.).		
4.55 P.M. — 6.00 P.M.	28	32
		144

* Plants smaller ; vacancies numerous.

At first some difficulty was experienced with nozzles. The trouble was found to be due to washer defects and after these were replaced no further hitch occurred.

It will be seen from the above that it generally took about 35 minutes to mix and apply 16 gallons of spray, and that about 300 plants were sprayed in this time.

The total area sprayed during the day was 0·672 acre—a little over two-thirds of an acre. The late start was unavoidable and it is probable that, with practice, it should be possible to spray at least one and probably one and a half acres in one day.

The organization for fetching water, mixing the spray and applying it offered no difficulty and the whole operation went very smoothly, so smoothly that there seems to be no objection to its adoption as a routine measure. The systematic spraying of two rows at a time is simple : it is necessary to be systematic or plants are apt to be overlooked or sprayed twice. Practically no trouble was experienced with choked nozzles. Very little damage was done to the plants by the breaking of leaves but this has to be watched carefully.

COSTS

Cost of Spray.—The amount of spray used was 144 gallons and the cost of this was Rs. 11·59. The cost of spray for one acre would therefore be Rs. 17·26.

Cost of Labour.—As is stated above, the spraying was actually done by the writers but, for the purpose of costing, it is assumed that it would be done by two ordinary labourers. In addition there were two labourers on each hose and one pumping, making a total altogether of 7 labourers. A full day was not worked at the time of the trial and it can be assumed that these seven labourers would be able to spray one acre in one day. At 45 cents a day for each, the cost for labour would be Rs. 3·15 per acre.

The cost of spray materials and labour therefore amounted to Rs. 20·41 per acre, without taking into account depreciation charges for the machine and cost of supervision. The cost of the sprayer is about Rs. 600, landed in Ceylon, but without practical experience, it is impossible to estimate the amount that could be fairly charged to depreciation. The cost of upkeep is low and the sprayer used has been in regular use for about two years without requiring much attention. With this type of sprayer, however, it would not appear to be possible to spray more than 15 to 20 acres of tobacco in one year, since it has been shown elsewhere that the optimum time for spraying is limited. Depreciation costs would therefore be high. Assuming that the life of the sprayer would be as little as three to four years, depreciation might be assessed at about Rs. 10 per acre. Including charges for supervision and minor repairs to sprayer, the cost of spraying might therefore be estimated not to exceed Rs. 35 per acre.

FIELD OBSERVATIONS

The sprayed area was kept under observation. Particular attention was given to the occurrence of spray scorch. The spraying was done in bright, hot, sunny weather with a strong wind blowing—conditions conducive to spray scorch. On the plants sprayed in the heat of the day there was some scorch of the type that would have occurred if water had been used instead of a fungicide, a scorching due entirely to the lens action of the drops and accumulations of liquid in bright sunshine. Of purely phytocidical injury, *i.e.*, scorching due to the chemical action of the spray on the leaves, there was none. The scorching that did occur was present only on plants sprayed at midday and in the early afternoon and did not occur on the greater part of the area. Even in the affected area the scorching occurred on a few plants only and was negligible in effect.

No difference in the relative severity of spotting on sprayed and unsprayed plants was observed until about ten days after spraying and thereafter the difference between sprayed and unsprayed plants was most noticeable. In harvesting, leaves which were badly spotted were not suitable for flue-curing and were therefore harvested separately and air-cured.

HARVESTING

Harvesting started at the beginning of February and the leaves were harvested at intervals of one week thereafter. Barnloads of leaf were collected in the usual manner from the whole area under tobacco but the sticks bearing the leaves from the sprayed area were labelled and were placed together in the barn in each barnload. Otherwise, they were treated in exactly the same way as the others. When curing was completed, all the tobacco was bulked together and the tobacco from the sprayed area was marked off from the remainder merely by placing pieces of string over the heap, below and above the sprayed leaf.

When curing was completed, the flue-cured tobacco was graded and in table II are given the yields in the different grades from the sprayed and unsprayed tobacco.

TABLE II

Grade of cured leaf	Actual yields (lb.)		Yields per acre (lb.)	
	Sprayed (0.6715 acre)	Unsprayed (13.3 acres)	Sprayed	Unsprayed
1	130	725	193.6	54.4
2	25	279	37.2	20.9
3	03	355	4.5	26.6
4	22	165	32.8	12.4
5	22	236	32.8	17.7
Total	202	1,760	300.9	132.0

The low general yield of flue-cured tobacco is attributed to rain which fell just as the leaves were about to mature. This rain delayed the harvesting of the tobacco and, in consequence, a larger proportion of the crop than usual was unfit for flue-curing.

The figures given above cannot of course be taken as a reliable guide to the yields which normally can be expected from sprayed and unsprayed tobacco. The more precise figures obtained in the detailed experiment recorded elsewhere do, however, confirm that the differences obtained are not likely to be unusual. When it is considered that grade 1 flue-cured tobacco fetches at least Re. 1 per lb. it will be realized that the spraying was extremely profitable, the difference in value in the grade 1 tobacco from the sprayed and unsprayed tobacco alone being about Rs. 140 per acre.

DISCUSSION

In most tobacco-growing countries frog-eye, though present, is not sufficiently damaging to warrant the adoption of elaborate control measures in the field. In Ceylon, however, the disease occurs with epidemic severity every tobacco season, and promises to be, unless effectively checked, the limiting factor to profitable cigarette tobacco growing. The trial described in this paper demonstrates the practicability of economic control of the disease. With a single sprayer of the type used, it should be possible to spray, at the optimum time of spraying, fifteen to twenty acres of tobacco. The extra profit per acre is likely to be greatly in excess of the cost of the spraying which, including all charges, is estimated not to exceed Rs. 35 per acre. The local representative of a large cigarette manufacturing company, to whom the final product was submitted for report, expressed the opinion that the spraying had in no way affected the leaf adversely.

It is anticipated that field spraying against frog-eye will be adopted as a routine measure at the Government tobacco stations at Wariyapola and Ganewatta during the next tobacco season. It is unlikely that at either station, in any season, an area of more than fifteen to twenty acres will be laid under tobacco; a single spraying machine can accordingly cope with the work at each station. With improved organization, the area sprayed per unit time can, however, be considerably extended. For example, in this trial, the fungicidal mixture was made up by the nozzle men, and the men who carried the hose were responsible for the haulage of water; there was accordingly a periodic interruption of the spraying operation. The inclusion in the spraying team of separate labourers for mixing up the fungicide and for hauling water would allow uninterrupted and consequently speedier spraying without an increase in labour costs.

In a previous article in this series (Park and Fernando, 1938), the possibility of substituting home-made copper sprays for the proprietary colloidal copper was explored. Two formulae were tested out, *viz.*, copper emulsion and ammoniacal copper emulsion. The substitution of the copper emulsion would result in a reduction in the cost of spray materials from Rs. 17·26 per acre to Rs. 8·71 per acre. With the ammoniacal copper emulsion the cost of spray materials would be only Rs. 7·44 per acre. The performance of both these home-made sprays is, however, rather inferior to that of the proprietary article. Besides, both of them cause a certain amount of spray injury which, though small and probably preventable, may prejudice tobacco growers against spraying.

An item that has not received consideration in the estimate of profits from spraying, is the residual value of spraying. It has been suggested in a previous article in this series (Park and Fernando, 1937 a), that the main source of initial infection of frog-eye in the field is the conidial inoculum left behind in the soil by the preceding tobacco crop. It is not unreasonable to expect that as a result of the cumulative effect of spraying in successive seasons, the survival level of the fungus would be lowered eventually to a point approaching complete eradication.

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