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TOBACCO BLUE MOULD (PERONOSPORA TABACINA ADAM) IN NORTH QUEENSLAND. 3. FUNGICIDE SCREENING AND EFFICACY EXPERIMENTS

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SUMMARY

The results of blue mould control studies including fungicidal screening trials, field spray trials and method-of-application trials are presented.

The bisdithiocarbamates maneb, zineb, mancozeb and Antracol were superior to other fungicides tested and good control of blue mould was obtained even during epiphytotic conditions.

Misting, with good coverage, gave results comparable with those from high-volume spraying; dusting was not quite so efficient.

Chemical analyses, taint testing and quality appraisals of cured leaf failed to reveal any appreciable or consistent differences due to fungicide application.

I. INTRODUCTION

The invesigations reported here are a continuation of work previously described (Pont 1959) on the problem of control of blue mould (*Peronospora tabacina* Adam) in tobacco by the use of fungicides. This work has been conducted along two main lines: firstly, screening trials to ascertain the most promising fungicides, and secondly, field trials to determine the efficacy of the selected fungicides under field conditions.

Work has also been done on the relative efficiency of various methods of application of fungicides, including high-volume and medium-volume spraying, misting and dusting; the effect of fungicides on leaf quality; the chemical composition of cured leaf; and the possible tainting of cured leaf by fungicidal residues.

(b) Results

The results from the various trials are combined in Table 1.

TABLE 1

RESULTS OF SCREENING TRIALS, 1960–1964

Fungicides	1960	1961 Trial A	1961 Trial B	1962	1963	1964
Zineb (zinc ethylene bisdithiocarbamate) 0·13% a.i.*	72†	..	..	..	..	..
Zineb 0·13% a.i. + benzyl salicylate 0·1%	28	..	..	..	..	..
Zineb 0·13% a.i. + benzyl salicylate 0·1% + cottonseed oil 0·75%	55	..	..	..	..	..
Zineb 0·24% a.i.	40	80	5	0·3	0·6	0
Zineb 0·24% a.i. + benzyl salicylate 0·1%	13	0·3	0·3	0	..	..
Zineb 0·24% a.i. + benzyl salicylate 0·1% + cottonseed oil 0·75%	35	..	..	..	..	..
Zineb 10% (dust)	39	..	..	..	..	..
Zineb 10%-zinc salicylate 2% (dust)	14	..	..	..	..	..
Maneb (Manganese ethylene bisdithiocarbamate) 0·08% a.i.	..	9	..	..	..	..
Maneb 0·08% a.i. + benzyl salicylate 0·1%	..	0	..	..	..	..
Maneb 0·16% a.i.	3	0·6	0	0	0·6	1
Maneb 0·16% a.i. + benzyl salicylate 0·1%	1·3	0	0	0	..	..
Maneb 0·16% a.i. + benzyl salicylate 0·1% + cottonseed oil 0·75%	1·6	..	..	..	..	..
Maneb 0·3% a.i.	0·6	0·3	0	0	..	..
Maneb 0·3% a.i. + benzyl salicylate 0·1%	0	0	0	0	..	..
Maneb 0·3% a.i. + benzyl salicylate 0·1% + cottonseed oil 0·75%	2	..	..	..	..	..
Benzyl salicylate 0·1%	..	41	..	..	..	..
Brestan (triphenyl tin acetate) 0·03% a.i.	..	..	..	..	..	..
Hoe 2817 (Brestan + Maneb) 0·15%	..	0	..	..	..	..
Hoe 2819 (Brestan + Zineb) 0·15%	..	99	..	..	..	..
Duter (triphenyl tin hydroxide) 0·04% a.i.	..	..	..	..	..	1
Delan (dithianon–dicyano–dithioanthraquinone) 0·11% a.i.	..	100	..	..	..	..
Iron omadine (ferric salt of 2 pyridinethiol–1 oxide) 0·2%	..	100	..	..	..	..
Copper curit (copper oxychloride–zineb) 0·375%	..	100	..	..	..	..
Cuprous oxide–maneb 0·25%	..	99	..	..	..	..
Cuprous oxide–zineb 0·375%	..	99	..	..	..	..
Mancozeb (co-ordination product of zinc ion and maneb) 0·16% a.i.	..	..	0	0	0·3	1
Bayer 5078a (50% zinc propylene bisdithiocarbamate) 0·1% a.i.	..	..	0	..	..	..
Bayer 5078a 0·125% a.i.	..	..	..	0	..	..
Bayer 5078b (Antracol—70% zinc propylene bisdithiocarbamate) 0·14% a.i.	..	..	..	..	0·3	..
Ortho 5865 (N–(1, 1, 1, 1–tetrachloroethyl-sulphonyl)–Cis 4–cyclohexine–1, 2–dicarboximide) 0·2%	..	..	..	7	..	..
Metiram (reaction product of mixture of zineb and polyethylene thiuram disulphide) 0·16% a.i.	..	..	6	..	..	..
Dichloran (2, 6 dichloro–4–nitroaniline) 0·1% a.i.	..	..	..	..	7	..

TABLE 1—continued

RESULTS OF SCREENING TRIALS, 1960–1964—*continued*

Fungicides	1960	1961 Trial A	1961 Trial B	1962	1963	1964
Dupont Fungicide 328 (3,3¹–ethylene bis (tetrahydro–4,6–dimethyl–2H–1, 3, 5–thiadiazine–2–thione) 0·15% a.i.	..	..	..	..	41	..
Diram (41% solution of sodium dimethyl dithiocarbamate) ·06% a.i.	..	..	..	..	62	..
Dyrene (2, 4–dichloro–6–0–chloroaniline–5–triazine) 0·16% a.i.	..	..	..	..	87	..
Cyprex (dodecylguanidine acetate) ·048% a.i.	89	..	..	..	..	..
R.D. 7901 (2 : 4 dinitrophenyl–n–pentyl sulphone) 0·1% a.i.	..	..	..	..	..	87

* Concentration is expressed wherever possible as percent active ingredient.

† The number of infected seedlings for each of the spray treatments (mean of 3 or 4 replicates) is expressed as a percentage of the mean figure for the check treatment in the particular trial.

II. SCREENING TRIALS

(a) Materials and Methods

Trials were carried out each year during the period 1960-1964 at the Kamerunga Horticultural Research Station in coastal northern Queensland. All trials followed a similar pattern. The test fungicides were applied twice each week by means of a bucket pump to randomized plots (dimensions 4 ft by 2 ft) of tobacco seedlings, three or four replicates of each treatment being employed. Zineb (0·24% a.i.) and maneb (0·16% a.i.) were included in each trial as standard fungicides. Unsprayed check plots were also included. The full list of treatments is given in Table 1.

Spray applications generally commenced within 3 weeks of germination and within the next 3 weeks the seedlings were inoculated by watering on a suspension (concentration at least 1 x 10^4/ml) of spores of *Peronospora tabacina.* Treatments were terminated when the unsprayed check plots became heavily infected with blue mould. Disease appraisals were then made by an individual examination of 100 seedlings plucked from each plot.

The bisdithiocarbamates as a group were superior to the other groups, which included heterocyclic N compounds, halogenated and nitrated aromatics and organo-metallic compounds.

Maneb (0·16%), mancozeb (0·16%) and Bayer 5078B (Antracol) (0·14%) were overall more efficient than zineb (0·24% a.i.), which gave unsatisfactory results in the first two trials (1960, 1961A). In all later trials zineb at this concentration gave a satisfactory level of control.

The addition of benzyl salicylate increased the efficacy of the ethylene bisdithiocarbamates, particularly of the less efficient sprays—zineb 0·24% and maneb 0·08%—in the first 1961 trial. However, the mixtures were undesirably phytotoxic. Benzyl salicylate alone was inefficient.

Dichloran, Brestan and Duter were extremely phytotoxic; Brestan killed the sprayed seedlings. The Brestan-maneb mixture (Hoe 2817) was also phytotoxic. The phytotoxicity of the Brestan-zineb mixture (Hoe 2819) was much less but its fungicidal efficiency was very low. The copper-dithiocarbamate mixtures were completely ineffective.

III. FIELD SPRAY TRIALS

Field trials were conducted annually during the seasons 1961-62 to 1964-65. Blue mould incidence in the 1963-64 trial was negligible and the only data obtained were for tainting of cured leaf. These are incorporated in Table 7.

(a) Materials and Methods

The treatments used each season are listed in Tables 2–4. Spray applications were made at weekly intervals, unless otherwise specified, with a self-propelled, inter-row, high-pressure spray plant using hoses and hand spray lances in the early stages of growth and a horizontal boom with droppers in the late stages. Spraying commenced 7–10 days after planting out and terminated 7–10 days before harvesting commenced. Spray volumes varied from approximately 36 gal/ac for the first two sprays to approximately 200 gal/ac for the last three. The total number of applications made was eight or nine, depending on the growth rate of the crop. The total quantity of fungicide used per acre during the course of the various trials was in the vicinity of 22 lb formulated product in the case of maneb and those fungicides used at 0·16% a.i. concentration and 42 lb for zineb (0·24% a.i.).

The results were assessed in the following manner:—

(1) A whole-plant percentage index of infection was derived for a number of plants in each plot. This was obtained by appraising the amount of damage (expressed as percentage leaf surface destroyed) on each leaf and then calculating a mean figure for each plant.

(2) In order to gauge the effect on yield, any leaf with 40% or more of its lamina covered by blue mould, as assessed by visual examination, was considered as lost because it undoubtedly would not have been harvested and cured. A mean figure for leaves lost per plant or alternatively sound leaves per plant was calculated for each plot.

(3) In most cases stem mould counts were made and the results expressed as percentage stem mould infection per plot.

As trials at Parada Research Station in the Mareeba-Dimbulah Area in 1959-60 and 1960-61 had not given satisfactory results due to low disease incidence, it was decided to conduct five trials in 1961-62, each to consist of two

replications of four treatments, in different locations in the Mareeba-Dimbulah district. Large plots, averaging about one-sixth of an acre in size, were employed, the aim being to increase the chances of satisfactory disease development and, at the same time, to provide a demonstration of the efficiency of fungicides for the control of blue mould.

The experiments conducted from 1962-63 to 1964-65 were located at the Parada Research Station. The results of previous trials at this Station had demonstrated that the conventional experimental design for a fungicide spray trial, consisting of a large number of sprayed plots grouped together with unsprayed plots in a small compact block, was unsuitable for testing the efficiency of blue mould fungicides. In the 1962-63 trials and in all subsequent trials, randomized block designs were used but an attempt was made to overcome the problem of drift from sprayed onto unsprayed rows and to ensure an adequate amount of inoculum by interspersing unsprayed guard rows (usually three) between plots. A standard plot size of 3 chain x 1 chain rows (approximately 120 plants) was adopted.

(b) Results

1961-62 trials.—Satisfactory levels of infection were obtained in only two of the five trials. Since trends were similar in the four blocks within the two experimental areas concerned, the figures have been combined and the results are presented in Table 2.

TABLE 2

1961–62 Field Spray Trials: Leaf and Stem Mould Figures

Treatment	Whole Plant Infection Index	No. of Leaves Lost per Plant (%)	Stem Mould (%)
Zineb (0·24% a.i.) + benzyl salicylate (0·1%)	1·0*	0·1*	0·75*
Maneb (0·16% a.i.) ..	1·1	0	2·0
Maneb (0·3% a.i.)	0·7	0	0·5
Unsprayed	12·0	3·1	48·0

* Mean figures derived from four replicates of each treatment.

These results indicate that the three mixtures were efficient. The figures showing the number of leaves lost indicate the proportion of wasted leaf in the unsprayed control plots. Benzyl salicylate was found to impart an undesirable aroma to the cured leaf.

1962-63 trials.—Two trials were carried out. The main trial (Trial 1) was devoted to a comparison of the relative efficacy of maneb (0·16% a.i.) and zineb (0·24% a.i.). In a subsidiary trial the bisdithiocarbamates mancozeb (0·16% a.i.) and Bayer 5078a (0·1% a.i.) were compared with maneb and zineb.

The treatments used are shown in Table 3, where the results are presented.

TABLE 3

TRIALS 1 AND 2, 1962–63: BLUE MOULD FIGURES

Treatment		Whole Plant Infection Index		No. of Sound Leaves		Stem Mould (%)	
Trial 1	Trial 2	Trial 1	Trial 2	Trial 1	Trial 2	Trial 1	Trial 2
A. Zineb (0·24% a.i.)	A. Zineb (0·24% a.i.)	2·91	11·75	23·72	21·00	1·25	17·50
B. Maneb (0.16% a.i.)	B. Maneb (0·16% a.i.)	1·58	9·52	23·98	21·58	1·25	18·75
C. Unsprayed	C. Unsprayed	8·45	11·19	19·38	20·88	66·25	83·75*
	D. Maneb (0·3% a.i.)	..	7·76	..	21·78	..	15·00
	E. Bayer 5078a (0·1% a.i.)	..	12·76	..	19·98	..	12·50
	F. Mancozeb (0·16% a.i.)	..	8·27	..	22·35	..	13·75
S.e.		± 0·449	± 2·305	± 0·478	± 0·775	†	± 5·956
Necessary differences for significance	5%	1·36	..	1·45	..	..	..
	1%	1·89	..	2·01	..	..	..
		A, B ≪ C	No sig. diff.	A, B ≫ C	No sig. diff.		No sig. diff.

* Treatment C (unsprayed) was not included in the analysis for percentage stem mould, its mean value of 83·75 being obviously different from any of the spray treatments.

† No analysis was carried out for percentage stem mould, the differences being obvious.

In trial 1 both fungicides depressed leaf and stem mould and increased the number of sound leaves, whereas in trial 2 the beneficial effects of spray treatment were shown only in the reduction in the amount of stem mould recorded. Almost without exception the lugs and cutters on sprayed plants remained free from mould—hence the low figures for basal stem mould. However, leaves further up the plant were badly affected. On unsprayed plants, lugs and cutters were destroyed but leaves higher up suffered little damage due to the acquired resistance effect (Pont 1959).

The following facts are thought to have some bearing on the differences apparent in the results of these two trials:—

Trial 1 was located on a freely drained sandy loam; trial 2 was on a heavier soil type—a sandy clay loam with drainage problems.

While blue mould was uniformly distributed through the trial 1 area prior to storm rains in November, the incidence was slight up to this time—spot mould only—and sporulation was sparse. On the other hand, the disease was present in serious proportions at an early date on a badly drained area immediately adjacent to trial 2 and had commenced to move on a broad front into the trial area prior to the November rains.

1964–65 trial.—Bayer 5078b (Antracol), which superseded Bayer 5078a, was included in this experiment and the three bisdithiocarbamates tested in the previous season were used also. As the influence of rain on the development of blue mould epiphytotics in North Queensland is considerable (Pont and Hughes 1961), a maneb after-rain treatment, which was to involve fortnightly treatment with this fungicide or application immediately after rain, was tested.

Eight weekly applications of all treatments except maneb after rain were made. The after-rain sprays were applied at irregular intervals due to showery weather but the plots received eight applications.

The results are given in Table 4.

TABLE 4

1964–65 FIELD SPRAY TRIAL: BLUE MOULD FIGURES

Treatment	Whole Plant Infection Index	No. of Leaves Lost per Plant*
A. Zineb (0·24% a.i.)	2·04	0·15
D. Antracol (0·14% a.i.)	1·82	0·07
E. Mancozeb (0·16% a.i.)	1·58	0·1
B. Maneb (0·16% a.i.)	1·58	0·03
C. Maneb (0·16% a.i.) fortnightly and after rain	1·57	0
F. Unsprayed	17·63†	3·4
G.M.	1·72	..
S.E. treatment means	0·21	..
Necessary differences for significance 5%	0·63	..
Necessary differences for significance 1%	0·86	..

* These data were examined by the Biometrician and analysis was not considered necessary.
† Not included in the analysis as obviously significantly greater than other treatments.

Some 7 weeks after planting out, blue mould had reached epiphytotic proportions in the trial area due to the occurrence of a sustained wet period, but there was no large-scale development of mould in the sprayed plots. All fungicides were equally efficient.

IV. METHOD-OF-APPLICATION TRIALS

Control of tobacco blue mould, particularly when conditions are conducive to its development and inoculum potential is high, calls for quick and thorough coverage of the foliage. Low-volume treatment with mist blowers, and dusting, were accordingly investigated.

In preliminary experimental work, misting and dusting were compared with the standard high-volume spray method in observation trials and replicated field trials. Both techniques showed promise in these early tests but an opportunity to evaluate their efficiency under conditions suitable for the development of an epiphytotic did not occur until the 1964-65 season. This trial, which was conducted at Parada Research Station, is decribed below.

(a) Materials and Methods

A total of eight weekly applications of maneb was made by each of the following methods:

(A) *Misting.*—Each application was made with a "Moto-blo" knapsack mister calibrated to deliver approximately 8 gal/ac. The amount of fungicide used was varied to keep pace with the growing crop and an attempt was made to keep the actual dosage applied each week close to that applied with the high volume method. A 2-row misting head designed and supplied by H. R. Mapother (Long Ashton Research Station, England) was fitted to the mister. The coverage obtained was tested by fluorescent tracer and found to be very satisfactory.

(B) *Dusting.*—Dusts were applied with a "Moto-blo" knapsack mister fitted with a dusting attachment. In the early stages (first 3 applications), a 4% dust (maneb-pyrophyllite) was used. This was then increased to 10% fungicide content. Here again an attempt was made to apply a dosage equal to that applied with the high-volume method.

(C) *High-volume spraying.*—Hand lances supplied from a small inter-row, self-propelled spray plant were used in the early stages and a boom with droppers was fitted to the machine when the crop had grown to approximately 18 in. in height. The spray volume used varied from 40 gal/ac initially to 180 gal/ac.

(D) *Medium-volume spraying.*—A "Tricrop" spray unit with fixed boom and flexible droppers was used for this treatment. By altering the number of nozzles as the crop progressed, it was possible to apply approximately half the spray volume used in the high-volume treatment. The concentration of fungicide was equivalent to that used in the high-volume treatment, thus halving the dosage rate. This treatment was designed to test the efficiency of spray volumes and dosages which are commonly used by tobacco growers.

(E) Unsprayed.

In both the spray treatments maneb was used as a 0·16% a.i. suspension.

Despite the attempt to standardize the dosage rates, the total amount of maneb applied varied. The actual dosages in pounds per acre (total of eight applications) for misting, dusting, medium-volume and high-volume spraying were 21·6, 20, 8·8 and 17·6 respectively.

The experimental layout consisted of a 5 x 5 randomized block design. Each treatment plot comprised 3 chains x 1 chain rows and was separated from neighbouring plots by four guard rows.

(b) Results

Results are given in Table 5. They show that weekly applications of maneb were beneficial with all methods. Misting and high-volume spraying were superior to dusting and medium-volume spraying. The data also indicate that under the

conditions of this experiment spraying was a more efficient method of application than was dusting. Control comparable to that obtained with the dusting treatment was gained when the dosage rate was halved and the fungicide applied as a medium-volume spray.

TABLE 5

1964–65 METHOD-OF-APPLICATION TRIAL: BLUE MOULD FIGURES

Treatment	Whole Plant Infection Index	No. of Leaves Lost per Plant
A. Misting	0·79	0·02
B. Dusting	5·14	1·06
C. Medium-volume spraying	6·74	1·28
D. High-volume spraying	1·27	0·18
G.M.	3·48	0·64
S.E. treatment means	1·37	0·32
Necessary differences for significance 5%	4·22	0·98
Necessary differences for significance 1%	5·92	1·37
	C ⩾ A C > D B > A	C > D B > A C > A
Unsprayed treatment means	17·22	3·58

The disease was not uniformly severe throughout all five blocks of the experimental area and it was noticeable that the protection afforded by dusting and medium-volume spraying was less efficient in those blocks with a higher local inoculum potential.

V. TAINT TRIALS

(a) Materials and Methods

A standardized technique for tobacco insecticide taint trials has been used by the Entomology Section of this Department for some years (Saunders and Bengston 1961). Briefly, the technique involves the application of the test materials at commercial strengths to complete cover within 7 days of harvesting.

In 1962 and 1963 the promising tobacco fungicides zineb, maneb, mancozeb and Bayer 5078a were included in combined insecticide-fungicide taint trials.

Fungicidal treatment for blue mould control ceases before the first harvest, whereas harvesting and spraying to control pests may be, and generally are, concurrent. Therefore, in the 1963-64 and 1964-65 trials it was decided that a fairer assessment of taints induced by residues of fungicidal materials might ensue if the samples were harvested from spray trials and method-of-application trials in which fungicidal treatment had ceased 7-10 days before the first pick.

(b) Results

The results of the taint tests are given in Tables 6 and 7.

TABLE 6

1962–63 TAINT TRIALS OF TOBACCO FUNGICIDES

Treatment	No. of Trials	No. of Samples Tested	No. of Samples with			
			No Taint	Suspected Slight Taint	Slight Taint	Distinct Taint
Maneb (0·16% a.i.)	2	18	10	1	5	2
Zineb (0·24% a.i.)	2	18	17	0	1	0
Mancozeb (0·16% a.i.)	1	6	2	1	3	0
Bayer 5078a (0·14% a.i.) ..	1	6	2	3	1	0
Unsprayed	3	24	23	0	1	0

TABLE 7

1963–1965 TAINT TRIALS OF TOBACCO FUNGICIDES

Treatment	No. of Trials	No. of Samples Tested	No. of Samples with			
			No Taint	Suspected Slight Taint	Slight Taint	Distinct Taint
Maneb (0·16% a.i.) high-volume ..	4	30	29	0	1	0
Maneb (0·16% a.i.) medium-volume ..	2	6	6	0	0	0
Maneb Misting	2	6	5	0	1	0
Maneb Dusting	2	6	6	0	0	0
Maneb (early) + Zineb (late)	1	6	5	0	1	0
Zineb (0·24% a.i.) high-volume ..	2	12	8	0	2	2*
Mancozeb (0·16% a.i.) high-volume ..	2	12	11	0	1	0
Antracol (0·14% a.i.) high-volume ..	2	12	10	0	1	1*
Unsprayed	4	18	16	0	2*	0

* These samples came from one trial, were included in the one package and were apparently tainted during transit.

While maneb (high-volume) produced two ratings of distinct taint in 1962 (Table 6), tests in subsequent seasons (Table 7) showed that it induced only slight taint in 1 out of 30 samples when its use was terminated 7-10 days before harvesting commenced. Maneb (misting) was responsible for one slight taint among six samples tested. When this fungicide was used as a medium-volume spray or as a dust it gave no evidence of taint. The other dithiocarbamates appeared to be similarily innocuous when used as high-volume sprays if the taints indicated by asterisks in Table 7 are disregarded.

VI. EFFECT OF FUNGICIDES ON LEAF QUALITY AND ON CHEMICAL COMPOSITION

In Europe, zineb and maneb have been found to have very little unfavourable influence on the organoleptic properties of cured tobacco leaf (De Baets 1962). In Victoria, Paddick (1964) found that zineb and maneb gave consistently good blue mould control without adversely affecting leaf quality.

De Baets (1963) reported that the application of maneb or zineb to tobacco once or twice per week resulted in small reductions in the contents of protein, nicotine, soluble carbohydrates and polyphenols. Mickovski (1963), however, found that maneb and zineb produced positive changes in chemical composition which included an increase in soluble sugars and polyphenols.

In North Queensland, cursory appraisals of leaf from spray trials have shown no quality differences due to dithiocarbamate fungicides. However, a much more critical appraisal was carried out on leaf harvested from the method-of-application trial conducted at Parada Research Station in the 1965-66 season. Mancozeb was the fungicide applied.

In this trial blue mould damage was very slight due to dry weather. This allowed a comparison of leaf from similar positions on sprayed and unsprayed plants and ensured that any quality differences among treatments could reasonably be attributed to the effect of the fungicide. The appraisal schedule employed was a centigrade points system taking into account colour, pliability, grain and maturity.

The results are presented in Table 8. It is apparent that the quality of leaf treated with mancozeb did not differ from that of untreated leaf.

TABLE 8

1965–66 METHOD–OF–APPLICATION TRIAL: APPRAISAL VALUES OF LEAF TREATED WITH MANCOZEB

Treatment	Total Dosage (lb/ac a.i.)	Average Points Score
Misting	14·4	42·58
Dusting	14·4	42·64
Medium-volume spray	14·4	43·07
High-volume spray	14·4	41·48
High-volume spray (after rain) ..	5·6	43·12
Unsprayed	0	42·67

Points were allocated for physical characteristics according to the following scale:—

Colour ..	0–50
Pliability ..	0–10
Grain ..	0–10
Maturity ..	0–30
Total ..	100

TABLE 9

1962–63 AND 1964–65 SPRAY TRIALS: LEAF ANALYSIS

Treatment		Total Alkaloids (%)			Reducing Sugars (%)			N (%)		
Trial 2, 1962–63	1964–65	1962–63	1964–65		1962–63	1964–65		1962–63	1964–65	
		SCL	RSL	SCL	SCL	RSL	SCL	SCL	RSL	SCL
A. Zineb (0·24% a.i.) ..	A. Zineb (0·24% a.i.)	2·5250	1·18	1·89	12·725	19·0	11·9	1·8900	1·18	1·47
B. Maneb (0·16% a.i.) ..	B. Maneb (0·16% a.i.)	2·1975	1·31	1·82	17·525	18·5	12·9	1·7025	1·23	1·41
C. Unsprayed	C. Unsprayed	2·2325	1·43	1·90	15·850	16·7	14·2	1·8050	1·37	1·60
D. Maneb (0·3% a.i.) ..	D. Maneb (0.16% a.i.) fortnightly and after rain	2·5725	1·04	2·07	13·275	19·2	12·5	1·9750	1·07	1·58
E. Bayer 5078a (0.15% a.i.)	E. Antracol (0·14% a.i.)	2·3250	1·19	2·11	15·175	17·7	12·4	1·8900	1·22	1·56
F. Mancozeb (0·16% a.i.)	F. Mancozeb (0·16% a.i.) ..	2·6775	1·39	1·91	14·625	16·9	12·6	1·8850	1·21	1·41

RSL = Red sandy loam
SCL = Sandy clay loam

Chemical analyses on leaf from certain North Queensland blue mould control trials are shown in Table 9.

The soil type in the case of the 1962-63 trial was so-called marginal tobacco soil—a levee type or sandy clay loam. Replicates in the 1964-65 trial were located on this soil and also on a typical North Queensland tobacco soil—a red sandy loam. Figures are listed in Table 9 for leaf harvested from plots on both soil types. It is usual for tobacco leaf grown in levee soil to have a lower reducing sugars content and to be higher in total alkaloids and nitrogen than leaf from good tobacco soil.

The Chemist's comments on the results of the most recent analyses (1964-65) were that "treatments do not appear to have had any consistent effect on leaf constituents".

VII. GENERAL DISCUSSION

In screening trials on tobacco seedlings when the test fungicides were applied twice a week the bisdithiocarbamates were superior to all other fungicides tested to date for blue mould control.

When applied as weekly sprays in the field from a week after planting out to within 7-10 days of the beginning of harvest, maneb (0·16% a.i.), mancozeb (0·16% a.i.), Antracol (0·14% a.i.) and zineb (0·24% a.i.), used as high-volume sprays, all gave satisfactory control of blue mould during wet periods when the disease built up to epiphytotic proportions in unsprayed plots. Misting also gave good control under similar conditions. Dusting and medium-volume spraying were less efficient.

The results of the 1962-63 spray trials indicate that the efficacy of blue mould fungicides is governed to a large extent by the local inoculum potential. An adequate inoculum potential is essential for the successful assessment of fungicides under field conditions, and in the majority of the trials discussed here the expermental layout was designed to ensure an adequate build-up of the disease within the experimental area. It appears, however, that an over-abundant supply of inoculum may prejudice the performance of an otherwise effective fungicide.

The effect of inoculum potential on fungicidal efficiency should not be of practical concern to a grower provided he plants out healthy seedlings and commences regular fungicidal treatment before blue mould appears. A possibility does exist, however, that a control programme could be jeopardized if inoculum was allowed to build up in a nearby field.

Taint testing has shown that leaf sprayed with any of the dithiocarbamates referred to should be quite acceptable provided spraying is terminated 7-10 days before harvesting commences.

Chemical analyses of cured leaf from sprayed and unsprayed plots have revealed no appreciable differences in levels of total alkaloids, reducing sugars and total nitrogen.

No evidence was found to indicate that the organoleptic properties of cured leaf are adversely affected by fungicidal spraying.

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