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SOME AGRONOMIC ASPECTS OF THE USE OF MANEB FOR BLUE MOULD CONTROL IN FLUE-CURED TOBACCO

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SUMMARY

Three related experiments were conducted in south-eastern Queensland to determine the effect of manganese ethylene-1, 2-bisdithiocarbamate (maneb) on flue-cured tobacco leaf quality and saleable yield when used for blue mould control.

Maneb was associated with an accelerated fall in leaf quality under conditions of nutrient stress such as exist following leaching rains. One experiment showed that nutrient stresses can be prevented by the application of adequate planting fertilizer and timely side-dressings.

Maneb supplied from transplanting until topping mantained blue mould control. Maneb used for no longer than 6 weeks after transplanting (hilling time) was unable to maintain blue mould control and saleable yields were less than the no-maneb treatment. Control of blue mould during wet weather, especially when the disease occurred during the period of rapid growth prior to flowering, was better with higher frequency of maneb application.

I. INTRODUCTION

Blue mould (*Peronospora tabacina* Adam) has always been a major disease of tobacco in the Bundaberg area of south-eastern Queensland. Zineb was the first fungicide used successfully for the control of the disease in the district. Zineb was followed by maneb (manganese ethylene-1, 2-bisdithiocarbamate) and later by other dithiocarbamate fungicides.

Reports that fungicides, particularly maneb, lowered leaf quality were received soon after farmers commenced spraying for blue mould control. Tobacco growers changed their spray programme in response to these reports in one of three ways: (a) used no fungicide, (b) used the fungicide irregularly, (c) used the fungicide for only 3-6 weeks after transplanting. As a consequence of these actions, blue mould developed and yields continued to be low (600-800 lb/ac), about the same as before any dithiocarbamates were used.

A series of three experiments was conducted on commercial farms to determine whether fungicides, particularly maneb, were directly or indirectly responsible for the reported fall in leaf quality.

II. MATERIALS AND METHODS

Experiment I, 1964-65: *Effect of length of spray period on yield and quality.* —To determine the effect of length of maneb spray period on yield and quality, four periods, each starting with transplanting, were chosen as follows:—(1) nil application; (2) application during establishment (3 lb maneb in 4 applications); (3) application until topping (18 lb maneb in 11 applications); and (4) application until end of harvest (27 lb maneb in 17 applications). Once harvesting commenced, the fungicide was applied immediately after each pick to minimize residue.

The experimental design was a randomized block with five replications. Each plot of 1/200 ac was surrounded by similarly treated tobacco. A complete fertilizer was applied at planting time and no side-dressings were applied.

Maneb 80 was applied at 2 lb/100 gal, using 5 to 7-day intervals depending on weather conditions. The fungicide was applied as a high-volume spray sufficient to wet all leaf surfaces. This procedure was based on the recommendations of Pont (1963).

The blue mould severity index was measured immediately before harvesting the lowest leaves, using the following formula—

$$\text{Severity Index} = \frac{\text{No. of plants infected}}{\text{No. of plants inspected}} \times \begin{matrix}\text{Severity rating} \\ (0\text{–}7)\end{matrix} \times \begin{matrix}\text{Infected portion} \\ \text{rating } (0\text{–}5)\end{matrix}$$

Quality was the sum of five quality components assessed subjectively to give a maximum quality rating of 40.

Rainfall was generally below average with 10·75 in. rain received from transplanting till the end of harvest. A further 7·50 in. was applied, using spray irrigation till topping, followed by furrow irrigation.

Experiment II, 1965-66: *Effect of period of use and fungicide used for blue mould control on yield and quality.*—Four zinc and/or manganese dithiocarbamates recommended for blue mould control in Queensland by Pont and O'Brien (1965) were selected to determine whether leaf quality was influenced by the composition of the fungicide. Two spray periods were compared to determine the effect of the length of spray period after transplanting on yield and quantity: (1) transplanting until topping (normal practice, giving a total of 665 gal/ac in 12 applications) and (2) transplanting until hilling (common farm practice at the time, giving a total of 280 gal/ac in 7 applications).

The four fungicides were applied at the following concentrations:—zineb 65%, 3¾ lb/100 gal; maneb 80%, 2 lb/100 gal; "Mancozeb" 80%, 2 lb/100 gal; and "Mezineb" 70%, 2 lb/100 gal, as recommended by Pont and O'Brien (1965). All fungicides were applied at 5 to 7-day intervals, using a high-volume spray sufficient to wet all leaf surfaces.

Each plot of 1/200 ac was surrounded by tobacco unprotected by a fungicide, to enable blue mould to develop and thus ensure that the inoculum would spread evenly throughout the experiment. This change in practice compared with experiment 1 was introduced to ensure that the control plots would not be differentially infected depending on the nature of the treatment in the adjacent plot. The nine treatments were arranged in a randomized block with duplicate plots of the control in each replicate. The purpose of the duplicate control plots was to increase the sensitivity of comparison of the individual treatments with the control.

In experiment 2, blue mould incidence was assessed on 10 random plants within each plot with the aid of the following formula:

$$\%\ \text{Blue Mould Infection} = \frac{\Sigma\ 10\left(\dfrac{(\Sigma\ \%\ \text{blue mould infection on each leaf})}{\text{no. of leaves on that plant}}\right)}{10}$$

The assessment of percentage blue mould infection was made after the last fungicidal spray was applied in the until-topping group. This assessment was made soon after a massive blue mould infection, which occurred in the experiment as the plants reached the late bud to early flowering stage. Rainfall was below average, as in the previous season.

Quality was assessed using the same method as in the previous season. A productivity index was calculated as follows:

$$\text{Productivity Index} = \frac{\text{Saleable yield (lb/ac) x Quality rating (Max. 40)}}{1{,}000}$$

The samples collected for chemical analyses represented all saleable grades; analyses were made on lamina only.

Experiment III, 1967-68: *Relationship between nutrition and blue mould control using maneb.*—In this experiment the relationship between nutrition and the use of maneb for blue mould control was studied. The object was to determine whether quality was reduced directly by maneb or indirectly as the result of nutritional stresses caused by the feeding of leaves previously lost to blue mould.

To ascertain whether the effect of maneb was direct, three frequencies of maneb application were chosen as follows: (1) nil application; (2) applied every 5 days from transplanting until topping time, using maneb 80% at 2 lb/100 gal to give 11·2 lb/ac of material in 12 applications (normal frequency); and (3) applied every second and third day alternately to give an average interval between sprays of 2½ days from transplanting until topping and using maneb 80% at 2 lb/100 gal to give 23·2 lb/ac of material in 24 applications, or twice normal frequency.

The fungicide was applied using a high-volume spray sufficient to cover all leaf surfaces at the time of application. The comparatively lower spray volumes used were due to the dwarfed nature of the crop.

To ascertain whether the effect of maneb was indirect, three rates of planting fertilizer using tobacco mixture 315 (3.0N: 5.7P: 15.0K) were selected, each rate being combined with either (1) no side-dressing or (2) side-dressing (combination of nitrogen and potassium), to give six fertilizer treatments. The nitrogen side-dressing was applied at a rate equal to the nitrogen in the planting fertilizer. The potassium side-dressing was applied at the rate of 2½ times the weight of nitrogen in the planting fertilizer. Details of the six nutrient levels are shown as part of Table 5.

The crop had received only 4·40 in. of well spread rain plus two irrigations when the side-dressing was applied 69 days after transplanting. The crop at the time was pale and lacked development, apparently due to the tie-up of nitrogen by the residues of the previous sugar-cane crop. From the time of application of the side-dressing until the end of harvest 40 days later, the experiment received approximately 30 in. of rain plus one irrigation. The excessive rain during the period reduced what was likely to have been an excessive side-dressing at the highest rate applied to a level approximating the crop's requirements.

The scale for the subjective assessment of quality was changed in experiment III to give a maximum total rating of 100. Aroma was deleted from the list of indices which made up total quality and was considered separately.

The degree of blue mould infection was not measured in detail in experiment III. Observations on a random sample of plots at budding time showed the 2½-day frequency maneb plots to be mould-free except for an occasional spot, while the control and 5-day interval treatments had heavy lower leaf infection. The effect of the blue mould attack is reflected in the saleable yield figures presented in Table 5.

Each of the three maneb frequency treatments was arranged at random in a split plot design within each of the six randomized fertilizer treatments. Each plot of 1/200 ac was surrounded by tobacco unprotected by a fungicide, to enable blue mould spores to spread evenly throughout the experiment.

The sample collected for chemical analyses represented all saleable grades, and the chemical analyses were made on lamina plus midrib.

III. RESULTS

The results of the various experiments are presented in Tables 1–6.

TABLE 1

EXPERIMENT 1, 1964–65: EFFECT OF PERIOD OF MANEB USE ON BLUE MOULD INCIDENCE, SALEABLE YIELD AND QUALITY

Treatment	Blue Mould Severity Index (Max. 35)	Saleable Yield (lb/ac)	Aroma Rating (Max. 10)	Quality Rating (Max. 40)
No maneb	12·0	1,243	6·04	23·71
Maneb during establishment	12·0	1,123	5·52	23·54
Maneb till topping	1·0	1,568	3·02	20·11
Maneb till end of harvest	1·0	1,459	2·24	18·99
Necessary differences for significance 5%	..	171	1·22	2·47
Necessary differences for significance 1%	..	239	1·71	3·47
S.E. treatment means	..	55	0·40	0·80

TABLE 2

EXPERIMENT 1, 1964–65: EFFECT OF PERIOD OF MANEB USE ON SOME CHEMICAL CONSTITUENTS*

Treatment	Calcium (%)	Magnesium (%)	Potassium (%)	Nitrogen (%)	Total Alkaloids (%)	Manganese (p.p.m.)
No maneb	1·59	0·55	2·05	1·86	3·04	94·4
Maneb during establishment	1·60	0·57	2·23	1·90	3·06	102·6
Maneb till topping	1·72	0·57	2·33	1·63	2·73	290·8
Maneb till end of harvest	1·81	0·66	2·39	1·71	2·73	598·8
Necessary differences for significance 5%	0·14	0·08	0·19	0·16	0·28	47·5
Necessary differences for significance 1%	0·20	0·11	0·26	0·22	0·40	66·5
S.E. treatment means	0·05	0·03	0·06	0·05	0·09	15·4

* Analyses calculated from moisture-free lamina only, using leaf representing all saleable grades.

TABLE 3

EXPERIMENT II, 1965–66: EFFECT OF PERIOD OF USE AND TYPE OF FUNGICIDE ON SELECTED FACTORS

No. of Replications	Treatment	Average Blue Mould Infection (%)	Saleable Yield (lb/ac)	Quality Rating (Max. 40)	Productivity Index	Cured Leaf Lamina Analysis		
						Chlorine (%)	Potassium (%)	Manganese (p.p.m.)
8	Control	38·97	1,662·62	23·02	38·23	1·52	1·66	90·3
4	Zineb to hilling	36·67	1,527·75	23·92	36·51	1·63	1·73	81·4
4	Maneb to hilling	33·50	1,416·75	22·51	32·13	1·56	1·56	104·6
4	Mancozeb to hilling	40·92	1,368·25	22·85	31·31	1·47	1·42	89·2
4	Mezineb to hilling	44·00	1,364·50	22·99	31·27	1·51	1·65	87·9
4	Zineb to topping	20·77	1,817·00	21·92	39·79	1·91	1·76	123·3
4	Maneb to topping	10·37	2,139·25	21·31	45·65	1·84	1·81	207·1
4	Mancozeb to topping	14·45	1,924·00	22·66	43·61	1·67	1·91	192·9
4	Mezineb to topping	20·62	1,649·50	21·87	36·25	1·76	1·84	105·9
	Mean of 4 *v.* mean of 4.S.E. of difference	5·27	184·31	0·89	4·51	0·14	0·15	16·6
	Necessary differences for significance 5%	10·79	377·55	1·83	9·24	0·28	0·30	34·1
	Necessary differences for significance 1%	14·55	509·31	2·47	12·47	0·38	0·41	46·0
	Mean of 8 *v.* mean of 4.S.E. of difference	4·56	159·62	0·77	3·91	0·12	0·13	14·4
	Necessary differences for significance 5%	9·34	326·97	1·59	8·01	0·24	0·26	29·5
	Necessary differences for significance 1%	12·60	441·08	2·14	10·80	0·33	0·35	39·8

TABLE 4

EXPERIMENT II, 1965–66: AVERAGE EFFECTS OF PERIOD OF USE AND TYPE OF FUNGICIDE ON SELECTED FACTORS

Treatment	Average Blue Mold Infection (%)	Saleable Yield (lb/ac)	Quality Rating (Max. 40)	Productivity Index	Cured Leaf Lamina Analysis		
					Chlorine (%)	Potassium (%)	Manganese (p.p.m.)
Fungicides to hilling ..	38·77	1,419·3	23·07	32·81	1·54	1·59	90·8
Fungicides to topping	16·56	1,882·4	21·94	41·33	1·79	1·83	157·3
S.E.	1·86	65·2	0·32	1·60	0·05	0·05	5·9
Necessary differences for significance 5%	5·39	188·8	0·92	4·62	0·14	0·15	17·0
Necessary differences for significance 1%	7·28	254·7	1·24	6·24	0·19	0·21	23·0
Zineb	28·72	1,672·4	22·92	38·15	1·77	1·75	102·3
Maneb	21·94	1,778·0	21·91	38·89	1·70	1·68	155·8
Mancozeb	27·69	1,646·1	22·75	37·46	1·57	1·67	141·0
Mezineb	32·31	1,507·0	22·43	33·76	1·64	1·74	96·9
S.E.	2·63	92·2	0·45	2·26	0·07	0·07	8·3
Necessary differences for significance 5%	7·63	267·0	1·30	6·54	0·20	0·22	24·1
Necessary differences for significance 1%	10·29	360·1	1·75	8·82	0·27	0·29	32·5

TABLE 5

EXPERIMENT III, 1967–68: EFFECT OF NUTRITION AND MANEB ON YIELD AND QUALITY FACTORS

Treatment No.*	Fertilizer Treatment			Colour (Max. 50)	Quality (Max. 100)	Saleable Yield (lb/ac)	Productivity Index	Aroma (Max. 10)
	Planting (lb N/ac)	Side-dressing (lb/ac)						
		N	K					
1	20	..	..	24·99	52·26	1,062·6	55·46	6·05
2	20	20	50	27·18	57·63	1,274·7	73·14	6·44
3	25	..	..	22·68	50·74	1,087·3	54·98	6·07
4	25	25	62½	29·20	61·19	1,258·0	77·54	5·74
5	30	..	..	27·24	55·81	1,301·8	72·79	6·37
6	30	30	75	31·29	61·97	1,307·0	80·95	6·18
7	20	..	..	26·59	56·27	1,147·9	64·43	5·51
8	20	20	50	29·79	60·73	1,366·1	83·26	6·26
9	25	..	..	22·00	52·37	1,115·5	58·47	5·80
10	25	25	62½	29·61	60·28	1,457·7	87·93	6·23
11	30	..	..	25·09	53·97	1,363·6	73·82	6·46
12	30	30	75	30·34	60·24	1,481·8	88·99	6·86
13	20	..	..	22·63	50·69	1,385·2	69·92	5·61
14	20	20	50	24·11	52·29	1,621·4	85·11	6·42
15	25	..	..	24·50	54·24	1,376·7	75·34	6·23
16	25	25	62½	27·31	56·33	1,758·4	99·05	7·26
17	30	..	..	22·80	52·29	1,373·6	71·72	5·57
18	30	30	75	30·86	61·32	1,825·7	111·93	7·17
Necessary differences for significance 5%				4·32	5·61	289·0	19·32	1·03
Necessary differences for significance 1%				5·80	7·53	391·7	25·93	1·40
S.E.				1·50	1·95	99·0	6·72	0·35

* Maneb treatments—
1–6 Nil.
7–12 Applied at 5-day intervals; total application 11·2 lb/ac.
13–18 Applied at 2½-day intervals; total application 23·2 lb/ac.

TABLE 6

EXPERIMENT III, 1967–68: MAJOR TREATMENT EFFECTS ON QUALITY, YIELD AND LEAF CONSTITUENTS

Treatment Average		Colour (Max. 50)	Quality (Max. 100)	Saleable Yield (lb/ac)	Productivity Index	Aroma (Max. 10)	Total Alkaloids (%)	Reducing Sugars (%)	Nitrogen (%)	Manganese (p.p.m.)
Planting fertilizer—										
20 lb N		25·88	54·98	1,309·7	71·89	6·05	1·22	22·33	1·38	85·56
25 lb N		25·89	55·86	1,342·3	75·55	6·22	1·37	21·43	1·45	92·28
30 lb N		27·94	57·60	1,442·3	83·37	6·44	1·46	20·48	1·49	92·33
Necessary differences for significance	5%	1·76	2·29	132·5	7·89	0·30	0·09	1·48	0·06	N.S.
	1%	2·37	3·07	188·4	10·59	0·43	0·12	2·10	0·09	
S.E.		0·61	0·80	42·0	2·74	0·10	0·03	0·47	0·02	3·38
Side-dressing—										
Nil		24·28	53·18	1,246·0	66·32	5·97	1·19	21·90	1·36	93·37
Av. 25 lb N, 62½ lb K		28·86	59·11	1,483·4	87·54	6·51	1·51	20·92	1·52	86·74
Necessary differences for significance	5%	1·44	1·87	108·1	6·44	0·25	0·07	N.S.	0·05	N.S.
	1%	1·93	2·51	153·8	8·64	0·35	0·10		0·07	
S.E.		0·50	0·65	34·3	2·24	0·08	0·03	0·38	0·02	2·76
Maneb usage—										
Nil		27·10	56·60	1,215·2	69·14	6·14	1·38	21·31	1·49	42·00
11·2 lb/ac		27·24	57·31	1,322·1	76·15	6·19	1·34	21·64	1·44	87·67
23·2 lb/ac		25·37	54·53	1,556·9	85·51	6·38	1·33	21·28	1·39	140·50
Necessary differences for significance	5%	1·76	2·29	118·0	7·89	0·42	N.S.	N.S.	0·05	7·57
	1%	2·37	3·07	159·9	10·59	0·57	N.S.	N.S.	0·06	10·25
S.E.		0·61	0·80	40·4	2·74	0·14	0·03	0·39	0·02	2·59

IV. DISCUSSION

Though the experiments were designed primarily to study the effects of fungicide application on the yield and the quality of tobacco leaf, some comments on the effect of fungicide application on blue mould incidence are made.

(a) Effect of Period and Frequency of Maneb Use on Blue Mould Incidence

In experiments I and II, maneb proved its efficiency as a fungicide for blue mould control when applied from transplanting time until topping time at 5 to 7-day intervals (Tables 1 and 3). Maneb during establishment (experiment I, Table 1) and maneb till hilling (experiment II, Table 3) were ineffective, resulting in a lower yield than the control in each case. It is obvious from these two experiments that where maneb was not used during the grand growth stage prior to flowering its usefulness was lost.

The extension of maneb usage to the end of harvest in experiment I provided no additional blue mould control due to the cessation of the disease's activity once the crop had flowered. This treatment was not evaluated in experiments II and III and no blue mould activity was observed once topping was completed.

Experiment III revealed a weakness in the routine 5-day spray schedule, treated plants being heavily infected by blue mould in the 3 weeks prior to budding. The effect of the blue mould damage is apparent from an examination of the saleable yield figures in Tables 5 and 6. The ineffectiveness of the 5-day interval treatment was probably caused by the removal of the fungicide by rain in the critical 3 weeks prior to budding. During this period, 0·60–0·80 in. of rain fell on three occasions soon after the application of the treatment. The frequent removal of maneb during the period of rapid growth, together with the growth of unprotected new leaves stimulated by the rain, apparently greatly increased the susceptibility of the crop to blue mould. Slawinski (1963) of Poland reached a similar conclusion when he found that fungicides for blue mould control should be applied every 8 days and after heavy falls of rain.

The effectiveness of the 2½-day average spray interval in experiment III shows that blue mould can be controlled during adverse conditions by increasing the frequency of application. Since maneb was effective at 5 to 7–day intervals in experiments I and II, it is likely that control of blue mould would be achieved at the normal 5 to 7–day spray interval provided the interval is reduced during adverse conditions.

(b) Effect of Fertilizer and Fungicides on Leaf Quality

Maneb was associated with a significant fall in leaf quality when it was used until topping in experiments I and II (Tables 1 and 3). This is contrary to the results of other workers such as Pont (1963). This effect appears to be associated with nutrient stresses, the nutrient stresses probably being aggravated by the feeding of leaves which would otherwise be destroyed by blue mould if they were not protected by maneb. Suspected leaching in experiments I and II at the time of the blue mould attack and a nitrogen tie-up by the sugar-cane residues in experiment III are believed to have predisposed the plant to nutrient stresses.

The highest rates of planting fertilizer and side-dressing used in experiment III prevented a fall in quality when blue mould was controlled using maneb (compare treatments 6 and 18, Table 5). Fertilizer, especially the side-dressing, had the greatest effect on quality (Table 6). This indicates that maneb apparently does not affect leaf quality if nutrient stresses are eliminated. Aroma and colour ratings in the three trials support these conclusions (Table 5).

(c) Effect of Fertilizers and Fungicides on Saleable Yields

The saleable yield was significantly increased in each of the three experiments when maneb was used until topping in such a way that blue mould was controlled (Tables 1, 3 and 6), the yield increase being due mainly to the prevention of leaf losses. Stunting caused by systemic blue mould was not a factor in the yield differences recorded in the experiments.

Maneb was the only fungicide which, when applied till topping in experiment II, produced a significant increase in saleable yield compared to the no-fungicide treatment. Maneb, however, only produced a significantly higher saleable yield than Mezineb of the three other fungicides tested (Table 3).

The highest yield in experiment III (1,825·7 lb/ac) was achieved when all three of the factors of planting fertilizer, side-dressing and frequency of maneb application were combined at their maximum rates (treatment 18, Table 5). In contrast, the lowest yield (1,062·6 lb/ac) was recorded when all factors were combined at their minimum levels (treatment 1, Table 5). Each factor at its maximum in turn produced small yield increases, the combination of all three being essential for the best result (Table 5). The factors when ranked for their relative contribution to the saleable yield increase show that frequency of maneb application gave the major effect, followed by side-dressing and planting fertilizer (Table 6). The high rate and late application of the nitrogen side-dressing would normally be regarded as excessive, but the heavy rain greatly reduced its influence.

Comparison of the treatments within experiment II shows (1) that maneb used until topping produced yields highly significantly better than those of all other fungicides used for periods from transplanting until hilling (Table 3), and (2) that tobacco untreated with fungicides produced a significantly higher yield than the average of the fungicides used until hilling in experiment II (Table 3). It was better from a saleable yield point of view to use no fungicides at all than to use fungicides to hilling only.

(d) Effect of Fertilizers and Fungicides on Productivity Index

The increase in productivity index due to the control of blue mould with maneb was non-significant in experiment II only (Table 4). This was because the advantage of the saleable yield increase was offset by the loss of quality caused by nutrient stresses. Where nutrition was not limiting in experiment III, the productivity index increase was highly significant when blue mould was controlled by using maneb (treatment 18, Table 5).

Planting fertilizer, side-dressing and frequency of maneb application, the major treatment effects evaluated in experiment III, each made a highly significant contribution to the productivity index (Table 6). The elimination of the side-dressing when blue mould was controlled at the highest rate of planting fertilizer significantly reduced the productivity index. The reduction in productivity index from 111·93 to 71·72 was clear evidence that nutrition is very important when blue mould is controlled (treatments 18 and 17, Table 5).

Equally important was the highly significant reduction in productivity index when planting fertilizer and side-dressings were maintained and maneb was eliminated. The reduction in productivity index from 111·93 to 80·95 shows the value of blue mould control when nutrition is adequate (treatments 18 and 6, Table 5).

(e) Effect of Fertilizers and Fungicides on Leaf Constituents

The differences in the leaf constituent levels between treatments partly reflect the different percentages of the various plant positions within the sample, due to the variation in leaf losses caused by blue mould.

Increasing maneb usage and/or degree of blue mould control had the desirable effect of increasing the percentage potassium in experiments I and II (Tables 2 and 3). Calcium and magnesium both showed a similar trend to potassium in experiment I (Table 2).

Total nitrogen and total alkaloids fell in all trials with increasing maneb usage except in experiment I (Table 3), where continuous maneb was associated with a minor reversal of the trend. The fall in leaf nitrogen levels associated with maneb and blue mould control is indicative of the induced nutrient stresses referred to earlier.

Increasing use of nitrogen in either the planting fertilizer or the side-dressing caused a rise in total alkaloids and total nitrogen (normal response) (Table 6). This contrasts with the effect of blue mould control using maneb, which caused percentage nitrogen levels to fall in experiments I and III (Tables 2 and 6). This result is a strong indication that nitrogen levels became limiting when maneb controlled blue mould.

The following conclusions are reached:

(1) Maneb should normally be an effective fungicide for blue mould control in Bundaberg when used at 2 lb/100 gal at 5 to 7-day intervals and applied as a high-volume spray sufficient to wet all leaf surfaces. During periods of wet weather, the fungicide may become ineffective unless the intervals between sprays are reduced to enable the maintenance of the protective fungicidal cover.

(2) Saleable yield increases as the result of blue mould control can be achieved without a reduction in leaf quality provided nutrient stresses are prevented.

(3) Maneb must be applied regularly from the time of transplanting until topping; otherwise saleable yields are likely to be lower than if no maneb was used at all.

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