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EFFECTS OF A SPRAY-ON SUCKERCIDE AND A COMPLETE FERTILIZER ON SOME CHARACTERISTICS OF FLUE-CURED TOBACCO IN SOUTH-EASTERN QUEENSLAND

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SUMMARY

Two similar experiments were conducted at Bundaberg and Beerwah in south-eastern Queensland to ascertain the relationship between fertilizer rates and the use of dimethyldodecylamine acetate ("Penar") for sucker control.

There were substantial advantages for Penar in terms of sucker control and saleable yield. Fertilizer was found to have no adverse effects on sucker numbers and also produced a saleable yield increase.

Two applications of Penar were found to be necessary unless regular hand-suckering was used in conjunction with a single application.

Data on comparative treatment costs are included.

I. INTRODUCTION

The study of different aspects of sucker control has been important in recent years at both Bundaberg and Beerwah in south-eastern Queensland. In a survey conducted at the time these trials were conducted, growers estimated that intensive hand-suckering cost $100-120/ac. Previous investigations carried out in Beerwah and Bundaberg (unpublished data) had revealed that the application of the suckercide "Penar" (dimethyldodecylamine acetate) reduced production costs and increased yields without loss of quality. With the introduction of Penar on a commercial scale, the industry sought information on the relationship between Penar usage and fertilizer usage to understand better the change in agronomic practice.

Two similar experiments were conducted at Bundaberg and Beerwah in 1968-69 to establish the relationship between fertilizer rate and the use of Penar.

II. METHODS AND MATERIALS

(a) Bundaberg Experiment

Design and treatments.—Four rates of the commercially available tobacco fertilizer "315" (3·0% N, 5·7% P, 15·0% K) were combined with three sucker control treatments using "Penar" (dimethyldodecylamine acetate 56·5% w/w), as the spray-on suckercide. The 12 treatment combinations were arranged in a randomized block design using three replications. Each 2-row plot of 1/200 ac contained a total of 34 plants to give a plant population of 6,800/ac.

The 12 treatments were the combinations of the following fertilizer levels and methods of sucker control—

Fertilizer levels

(1) 672 lb/ac 315 applied at planting time with no side-dressing.

(2) 672 lb/ac 315 applied a planting time plus 224 lb/ac 315 applied 3 weeks after planting.

(3) 672 lb/ac 315 applied at planting time plus 448 lb/ac 315 applied 3 weeks after planting.

(4) 672 lb/ac 315 applied at planting time plus 672 lb/ac 315 applied 3 weeks after planting.

The planting fertilizer, which included 10 lb/ac bluestone, was applied into the wet open drill immediately after back-watering the hand-planted crop. The side-dressings were placed by hand into two specially prepared drills on each side of the row of plants.

Sucker control treatments

(1) Topping at the early to mid flowering stage. No Penar applied. Suckered four times at approximately 10-day intervals.

(2) Topping at the early to mid flowering stage. Penar applied once, the day after topping, using 1 fl oz/gal with 20 gal/ac applied. Suckered three times at approximately 14-day intervals.

(3) Topping at the early to mid flowering stage. Penar applied twice, first on the day after topping, again 10 days after topping using 1½ fl oz/gal with 30 gal/ac for each application. Suckered three times at approximately 14-day intervals.

The Penar was applied to the top two leaf axils using a Rega pneumatic sprayer with a coarse nozzle and low pressure about 15 p.s.i.

Site.—The experiment was conducted on a grey loamy sand at South Kalkie typical of about one-third of the soils used for tobacco production in the area. The surface soil from 0 to 8 in. is a grey loamy sand. The subsoil is a deep yellow-grey sand. The freely draining profile is subject to rapid leaching. The soil analysis (Morgan tests) of the 0-8 in. layer was:—

pH	5·6	Cl (p.p.m.)	10
P (p.p.m.)	63	K (m-equiv. %)	0·17
NO_3 nitrogen	L	Ca (m-equiv. %)	1·6
NH_4 nitrogen	VL	Mg (m-equiv. %)	0·3

Rows ran north-south following the slight slope to the south. The site had grown tobacco in each of the previous 3 years.

General information.—The crop in the field mainly experienced favourable but dry conditions. Rainfall of 11¼ in. received during the life of the crop in the field was low, necessitating the application of 10 in. of irrigation water. The variety grown was Q46, equivalent to American Hicks. Cultural practices produced a crop virtually free of weeds, pests and diseases.

Quality, with a maximum of 100 points, was measured as the weighted average of the sum of four subjective ratings for colour (50), pliability (10), grain (10) and maturity (30). Leaf analyses were carried out on a weighted sample representing all saleable grades. All analytical results are from ground whole-leaf samples expressed on an oven-dry basis.

(b) Beerwah Experiment

Design and treatment.—The 12 treatments were arranged in a randomized block design using three replications. Each plot of 1/100 ac consisted of one row containing a total of 60 plants to give a plant population of 6,000/ac. The 12 treatments in this experiment were the combinations of the following fertilizer levels and methods of sucker control. These were slightly different from those applied in the Bundaberg trial.

Fertilizer levels

(1) 610 lb/ac 315 (2·8% N, 5·4% P, 14·3% K) with 0·2% Cu, 0·2% Zn, 0·03% Mo, 0·45% Mg, 0·15% Mn, 0·07% B applied at planting time with no side-dressing.

(2) 610 lb/ac 315 with trace elements at planting time plus 260 lb/ac 315 with trace elements 8 days after planting.

(3) 610 lb/ac 315 with trace elements at planting time plus 520 lb/ac 315 with trace elements 8 days after planting.

(4) 610 lb/ac 315 with trace elements at planting time plus 780 lb/ac 315 with trace elements 8 days after planting.

The planting application of fertilizer was made mechanically as part of the machine-planting operation. The balance of the fertilizer was mechanically applied 8 days after planting.

Sucker control treatments

(1) Topping progressively "at the early flowering stage" (2 open flowers). No Penar applied. Suckered seven times at weekly intervals.

(2) Topping progressively "at the early flowering stage" (2 open flowers). Penar applied once at topping using ¾ fl oz/gal with 20 gal/ac applied. Suckered seven times at weekly intervals.

(3) Topping progressively "at the early flowering stage" (2 open flowers). Penar applied twice, first at topping, again 9 days after topping using ¾ fl oz/gal with 20 gal/ac for each application. Suckered seven times at weekly intervals.

These three sucker control treatments were considered to be of increasing efficiency for sucker control. The efficiency of sucker control in the Beerwah experiment covered a narrower range than the Bundaberg trial. Penar was applied to the top of the plant using a Rega pneumatic sprayer with a coarse nozzle and low pressure about 15 p.s.i.

Site.—This experiment was conducted on a brown sandy loam typical of the soils used for tobacco production in the area. The surface soil from 0 to 2 in. was a brown sandy loam. The subsoil was a sandy clay loam varying from red to yellow in colour. The soil analysis (Morgan tests) was:—

pH	4·3–4·9	NH_4 nitrogen	VL
P (p.p.m.)	24–74	K (m-equiv. %)	0·09–0·27
NO_3 nitrogen	L	Cl (p.p.m.)	2·5–17

To overcome the highly acid soil conditions, 1,260 lb/ac dolomite was applied.

General information.—The crop in the field mainly experienced dry weather conditions. Rainfall of 12·53 in. received during the life of the crop in the field was low, necessitating the application of 7·20 in. of irrigation water. The variety grown was NC95. Cultural practices produced a crop virtually free of weeds, pests and diseases.

Quality, with a maximum of 100 points, was measured as the weighted average of four major subjective ratings: colour and associated factors including maturity (70), body and pliability (20), grain (10). The rating technique differs slightly from that used in Bundaberg, but the end result is comparable.

Leaf analyses were carried out on weighted samples selected from the 5th pick representing the middle portion of the plant. Analytical results are from leaf lamina samples and are expressed on an oven-dry weight basis. The method of sampling and the sample used for analysis were different from the Bundaberg trial. Leaf ripening data are presented for both trials as "Earliness Indexes" devised by Steffens and Miles (1964).

The productivity index, which is a relative measurement of the commercial value of a crop, was measured for both trials and is defined as follows:—

$$PI = \frac{\text{Quality (max. 100 points) x Saleable Yield (lb/ac).}}{1{,}000}$$

III. RESULTS

The overall pattern for sucker numbers, shown in Tables 1 and 2, was similar for both trials. There was a non-significant general tendency for sucker numbers to increase with fertilizer usage as well as a highly significant reduction of sucker numbers in both trials with increasing use of Penar.

TABLE 1

TOTAL NUMBER OF SUCKERS REMOVED PER ACRE AT BUNDABERG BEFORE END OF LEAF HARVEST

Treatment	672 lb/ac 315 + Cu	672 + 224 lb/ac 315 + Cu	672 + 448 lb/ac 315 + Cu	672 + 672 lb/ac 315 + Cu	Penar Averages
No Penar	178,060	204,340	192,400	207,460	195,560
Penar once	74,800	68,060	74,940	86,600	76,100
Penar twice	45,200	46,800	50,460	39,400	45,400
Fertilizer averages	99,360	106,400	105,940	111,160	105,710
		Necessary Differences for Significance			
Means	S.E.	5%	1%		
Penar	±5,560	16,340	22,200	..	..
Fertilizer	±6,420	N.S.	N.S.	..	..
Individual	±11,140	32,660	44,400	..	..

The marked difference in actual sucker numbers in the two trials has a number of explanations, the most important of which is the habit of Q46 of suckering more profusely than NC95. The Beerwah trial, where NC95 was used, showed an average of 38% fewer suckers compared with the Bundaberg trial for the hand-suckering treatment. This was in spite of an increase in the number of suckerings at Beerwah compared with Bundaberg. A further factor in explaining the fewer suckers is that the Beerwah trial had 9·5% fewer plants. Seltmann and Kim (1964), in an anatomical study of the upper nodes, showed that tobacco has the potential to produce three suckers in each leaf axil, so the lesser number of plants could influence sucker numbers substantially.

TABLE 2

TOTAL NUMBER OF SUCKERS REMOVED PER ACRE AT BEERWAH BEFORE END OF LEAF HARVEST

Treatment	610 lb/ac 315 + T.E.	610 + 260 lb/ac 315 + T.E.	610 + 520 lb/ac 315 + T.E.	610 + 780 lb/ac 315 + T.E.	Penar Averages
No Penar	122,730	108,430	120,830	132,500	121,120
Penar once	73,900	70,770	84,330	88,700	79,420
Penar twice	55,630	61,330	57,170	64,930	59,770
Fertilizer averages	84,090	80,180	87,440	95,380	86,770
		Necessary Differences for Significance			
Means	S.E.	5%	1%	..	..
Penar	±3,600	10,570	14,370	..	..
Fertilizer	±4,160	N.S.	N.S.	..	..
Individual	±7,210	21,140	28,740	..	..

On the other hand, the Beerwah trial with its lower usage of Penar in the Penar-twice treatment had 31% more suckers than the Bundaberg trial. Two applications of Penar in the Bundaberg trial gave an average reduction in sucker numbers of 77% compared with 42% in the Beerwah trial, where the lower volume and concentration of Penar was used.

The overall pattern for total leaf quality shown in Tables 3 and 4 showed both similarities and differences for the two trials. Both trials showed improved quality with increasing fertilizer usage, with the major response at the second lowest level of fertilizer in each case. The response to additional fertilizer was relatively smaller than for the initial increase in both trials. The response was significant in the Beerwah trial but not in the Bundaberg trial. The quality range in both trials was narrow, making it a minor factor in these two trials.

TABLE 3

TOTAL LEAF QUALITY—BUNDABERG TRIAL

Treatment	672 lb/ac 315 + Cu	672 + 224 lb/ac 315 + Cu	672 + 448 lb/ac 315 + Cu	672 + 672 lb/ac 315 + Cu	Penar Averages
No Penar	64·81	69·04	70·57	69·22	68·41
Penar once	67·26	65·79	68·33	70·23	67·90
Penar twice	68·53	72·19	70·47	70·65	70·46
Fertilizer averages	66·87	69·01	69·79	70·03	68·92
		Necessary Differences for Significance			
Means	S.E.	5%	1%	..	..
Penar	±1·02	N.S.	N.S.	..	..
Fertilizer	±1·18	N.S.	N.S.	..	..
Individual	±2·04	6·08	8·15	..	..

TABLE 4

TOTAL LEAF QUALITY—BEERWAH TRIAL

Treatment	610 lb/ac 315 + T.E.	610 + 260 lb/ac 315 + T.E.	610 + 520 lb/ac 315 + T.E.	610 + 780 lb/ac 315 + T.E.	Penar Averages
No Penar	48·1	49·4	51·8	51·6	50·2
Penar once	45·5	50·4	52·8	52·3	50·3
Penar twice	47·6	50·6	50·0	51·4	49·9
Fertilizer averages ..	47·1	50·1	51·5	51·7	50·1
		Necessary Differences for Significance			
Means	S.E.	5%	1%	..	..
Penar	±0·7	N.S.	N.S.	..	..
Fertilizer	±0·8	2·3	3·1	..	..
Individual	±1·4	4·0	5·4	..	..

Saleable yields are given in Tables 5 and 6. The main effects of treatment in both trials were similar except in the Penar-once treatment. The general trend was for yields to increase with increasing fertilizer usage; the increase was significant in Beerwah, while in Bundaberg significance was achieved only with the "t" test.

TABLE 5

SALEABLE YIELD (lb/ac)—BUNDABERG TRIAL

Treatment	672 lb/ac 315 + Cu	672 + 224 lb/ac 315 + Cu	672 + 448 lb/ac 315 + Cu	672 + 672 lb/ac 315 + Cu	Penar Averages
No Penar	2,268·5	2,527·2	2,576·7	2,549·5	2,480·5
Penar once	2,530·5	2,285·7	2,376·2	2,597·7	2,447·5
Penar twice	2,814·9	2,956·2	3,009·0	3,070·8	2,962·7
Fertilizer averages ..	2,538·0	2,589·7	2,654·0	2,739·3	2,630·2
		Necessary Differences for Significance			
Means	S.E.	5%	1%	..	..
Penar	±57·9	169·7	230·7	..	..
Fertilizer	±66·8	N.S.	N.S.	..	..
Individual	±115·8	339·5	461·4	..	..

In the Bundaberg trial the erratic pattern in the saleable yield of the Penar-once treatment was caused by leaf losses as the result of large suckers pushing leaves off the stem. This represents a problem with the Penar-once treatment and emphasizes the need for the more frequent use of hand-suckering as in Beerwah, where a predictable but not significant increase in yield was achieved.

The second factor involved in reducing the difference between the two treatments in Beerwah was the more frequent hand-suckering, compared with the Bundaberg trial, in the Penar-once treatment.

TABLE 6

SALEABLE YIELD (lb/ac)—BEERWAH TRIALS

Treatment	610 lb/ac 315 + T.E.	610 + 260 lb/ac 315 + T.E.	610 + 520 lb/ac 315 + T.E.	610 + 780 lb/ac 315 + T.E.	Penar Averages
No Penar	2,531·6	2,539·7	2,790·2	2,897·5	2,689·7
Penar once	2,640·5	2,732·8	2,923·3	3,027·8	2,831·1
Penar twice	2,755·4	2,894·2	2,926·8	3,001·3	2,894·4
Fertilizer averages	2,642·5	2,722·2	2,880·1	2,975·5	2,805·1
		Necessary Differences for Significance			
Means	S.E.	5%	1%	..	..
Penar	±50·8	148·8	202·3	..	..
Fertilizer	±58·6	171·9	233·6	..	..
Individual	±101·5	297·7	404·6	..	..

The effect of Penar-twice in Bundaberg was much more apparent due in part to the greater relative sucker control achieved when compared with the Beerwah trial. The greater degree of sucker control is most likely due to the larger amount of Penar applied in the Bundaberg trial. The average saleable yield increase from Penar-twice was almost 500 lb/ac in Bundaberg and 200 lb/ac in Beerwah. Both of these increases were highly significant.

The trends in the productivity index results shown in Tables 7 and 8 for the two trials summarize the results shown in the saleable yield and quality tables. Both trials showed a similar average increase in productivity index in response to fertilizer. The increase in the Beerwah trial was highly significant while the increase in the Bundaberg trial was significant only on the "t" test.

Both trials showed a highly significant increase in the average productivity index for the Penar-twice treatment. The explanation for the smaller response in the Beerwah trial has been discussed under saleable yield. The importance of hand-suckering to complement the Penar-once treatment is again emphasized from a comparison of the results obtained in the two trials.

TABLE 7

PRODUCTIVITY INDEX—BUNDABERG TRIAL

Treatment	672 lb/ac 315 + Cu	672 + 224 lb/ac 315 + Cu	672 + 448 lb/ac 315 + Cu	672 + 672 lb/ac 315 + Cu	Penar Averages
No Penar	147·98	174·42	181·85	177·33	170·39
Penar once	170·25	150·05	162·56	182·79	166·42
Penar twice	192·98	213·67	212·09	216·77	208·88
Fertilizer averages	170·41	179·38	185·50	192·30	181·90
		Necessary Differences for Significance			
Means	S.E.	5%	1%	..	..
Penar	±2·22	15·30	20·79	..	..
Fertilizer	±6·02	N.S.	N.S.	..	..
Individual	±10·43	30·60	41·59	..	..

TABLE 8

PRODUCTIVITY INDEX—BEERWAH TRIAL

Treatment	610 lb/ac 315 + T.E.	610 + 260 lb/ac 315 + T.E.	610 + 520 lb/ac 315 + T.E.	610 + 780 lb/ac 315 + T.E.	Penar Averages
No Penar	121·3	125·5	144·4	149·4	135·2
Penar once	120·2	137·8	154·4	157·8	142·6
Penar twice	130·8	146·4	146·2	154·2	144·4
Fertilizer averages	124·1	136·6	148·3	153·8	140·7
		Necessary Differences for Significance			
Means	S.E.	5%	1%	..	..
Penar	±2·3	6·8	9·2	..	..
Fertilizer	±2·7	7·8	10·6	..	..
Individual	±4·6	13·5	18·4	..	..

Total alkaloids percentages are given in Tables 9 and 10. The increase in total alkaloids with increasing rate of fertilizer was evident in both trials and was a predictable type of result. The increase in alkaloid level was highly significant in both trials. The only exception to the general pattern was the fall in total alkaloids at the highest fertilizer rate in the Bundaberg trial. No explanation is offered for this unexpected result.

TABLE 9

PERCENTAGE TOTAL ALKALOIDS AT BUNDABERG

Whole plant sample

Treatment	672 lb/ac 315 + Cu	672 + 224 lb/ac 315 + Cu	672 + 448 lb/ac 315 + Cu	672 + 672 lb/ac 315 + Cu	Penar Averages
No Penar	1·577	2·067	2·350	1·893	1·972
Penar once	1·707	1·740	2·023	1·753	1·806
Penar twice	1·670	1·957	1·910	2·037	1·893
Fertilizer averages	1·651	1·921	2·094	1·894	1·890
		Necessary Differences for Significance			
Means	S.E.	5%	1%	..	..
Penar	±0·068	N.S.	N.S.	..	..
Fertilizer	±0·079	0·231	0·313	..	..
Individual	±0·136	0·399	0·543	..	..

Increasing Penar usage in the Beerwah trial caused the total alkaloids to fall, but this fall was significant only at the 5% level (necessary difference 0·275). In contrast to the Beerwah trial, Penar-once in the Bundaberg trial gave the lowest total alkaloid level. This Bundaberg result can be explained by the sucker problem with this treatment, the presence of suckers in the Penar-once treatment apparently causing the lower result.

TABLE 10

PERCENTAGE TOTAL ALKALOIDS AT BEERWAH

Leaf 5th pick

Treatment	610 lb/ac 315 + T.E.	610 + 260 lb/ac 315 + T.E.	610 + 520 lb/ac 315 + T.E.	610 + 780 lb/ac 315 + T.E.	Penar Averages
No Penar	1·213	1·320	1·423	2·040	1·499
Penar once	1·063	1·330	1·447	1·587	1·357
Penar twice	0·947	1·120	1·183	1·400	1·162
Fertilizer averages	1·074	1·257	1·351	1·676	1·339
		Necessary Differences for Significance			
Means	S.E.	5%	1%		
Penar	±0·094	N.S.	N.S.		
Fertilizer	±0·108	0·318	0·432		
Individual	±0·188	0·550	0·748		

IV. DISCUSSION

(a) Effects of Treatments on Sucker Numbers

Tables 1 and 2 show that fertilizer caused a small non-significant increase in sucker numbers. With the wide range of fertilizer rates tested in the two trials, sucker numbers are clearly not a point for consideration when choosing the rate of fertilizer. Appendix Tables 1 and 2 show that increasing fertilizer usage increased treatment costs but this was mainly due to the cost of the fertilizer.

The effect of Penar on sucker numbers was greater for the Penar-twice treatment than the Penar-once treatment when compared with the no-Penar treatment in both trials, particularly in the Bundaberg trial. The reduction in sucker numbers for the Bundaberg trial was 77%, compared with 42% in the Beerwah trial.

The Penar-once treatment in the Bundaberg trial was more effective in reducing sucker numbers than in the Beerwah trial (61% reduction compared with 34%). The advantage was lost because the remaining suckers grew very large, causing leaf loss. The effect of the leaf loss is discussed later.

The estimated cost of the treatments in the two trials is shown in Appendix Tables 1 and 2. Both experiments show that the reduction in sucker numbers led to a saving in production costs. The estimated savings were greater in the Bundaberg trial because of the substantially higher number of suckers produced by the Q46 variety. The savings applied in both districts and for the markedly different varieties Q46 and NC95.

(b) Effects of Treatments on Yield and Quality

Saleable yield.—The effect of increasing fertilizer in both trials was for the saleable yield to increase (Tables 5 and 6). The increase was hightly significant in the Beerwah trial, but in the Bundaberg trial significance was achieved only with the "t" test. By arbitrarily valuing the increased yield at a conservative figure of $1/lb, the increased return per acre easily offsets the additional cost of the fertilizer shown in Appendix Tables 1 and 2. The only

measured disadvantage of increasing fertilizer usage is shown in Appendix Tables 3 and 4, where increasing fertilizer reduced rate of ripening. This result was more important in the Beerwah trial, where the regular hand-suckering allowed the fertilizer to exert its full effect on rate of ripening. The result in Bundaberg was similar for the Penar-twice treatment but with the other suckering treatments in Bundaberg the presence of suckers tended to change the pattern.

The effect of Penar-twice was to give a highly significant yield increase in both trials. These results emphasize the advantage of two applications of Penar over only one application. The Penar-twice average yield in the Bundaberg trial was over 300 lb/ac higher than the grand mean, while in the Beerwah trial it was less than 100 lb/ac higher. This emphasizes two things: firstly the benefit from hand-suckering in the Beerwah trial, and secondly the greater effectiveness of the two applications of Penar at the higher usage rate in the Bundaberg trial.

The response to the Penar-once treatment in the two trials shows the importance of hand sucker control if a satisfactory result is to be achieved. The alternative is to apply Penar twice.

The only disadvantage with the Penar-twice treatment is evident in the Bundaberg trial's earliness index (Appendix Table 3), which showed that Penar-twice slowed ripening. This effect is probably not an intrinsic effect of Penar, because in the Beerwah trial, where all treatments were hand-suckered weekly, the effect on ripening was barely apparent. The mechanism is most likely one of degree of sucker control.

Quality.—The most important effect of the treatments in both trials was for quality to increase with increasing fertilizer (Tables 3 and 4). This was significant in the Beerwah trial. The Bundaberg trial tended to be inconsistent in response to Penar applications at the different fertilizer levels. Quality in the Penar-once treatment appeared to be affected in the Bundaberg trial by the presence of large suckers; in the Beerwah trial the additional hand-suckering carried out overcame this problem.

It appears that if a decision is made to use one application of Penar, hand-suckering is essential to overcome the problem of the small number of large suckers which can be produced.

Overall, Penar had no adverse effect on quality even at the highest rate, as in the Penar-twice treatment used in the Bundaberg trial, where quality tended to be improved.

(c) Effects of Treatments on Total Alkaloids

The samples and the material used for analysis in the two trials were different; nevertheless consistency exists and comparisons can be made.

Both experiments show (Tables 9 and 10) that percentage of total alkaloids increased significantly with increasing fertilizer rate. Many other workers, including Steffens and Miles (1964), have found this result. The pattern of response in the two trials for other constituents such as reducing sugars and nitrogen confirmed data already published.

The effect of Penar on total alkaloids was not significant in either trial. The non-significant trend in the Beerwah trial appears to be one of reduction of total alkaloids with Penar. The trend in the Bundaberg trial, though less evident, is also for Penar to reduce total alkaloids. The complications caused by the large suckers on the Penar-once treatment undoubtedly helped keep the average of this treatment low in spite of any effect the Penar itself might have had.

(d) General

The following general conclusions may be drawn:

(1) Penar is a highly effective spray-on suckercide which can substantially increase yield and reduce sucker numbers.

(2) Penar should be applied twice unless it is combined with regular hand-suckering.

(3) Penar reduced production costs with either one or two applications.

(4) The choice of Penar concentrations will affect efficiency of sucker control.

(5) Some hand-suckering in conjunction with Penar is necessary to prevent the development of large suckers capable of pushing off leaves.

(6) Increasing the rate of fertilizer in combination with two Penar applications did not adversely affect sucker control or quality.

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APPENDIX

The treatment costs for the two trials shown in Appendix Tables 1 and 2 are helpful guides which confirm the value of the Penar treatment. The cost component for removing suckers in the Bundaberg trial is based on the recorded average time of sucker removal in the Beerwah trial, i.e. 1·8 sec per sucker. Labour costs were $1.20/hr. The cost saving advantage is more apparent in the Bundaberg trial because of the much greater reduction in sucker numbers with the Penar-twice treatment. This is explained in the Results section on sucker numbers.

APPENDIX TABLE 1

TREATMENT COSTS ($/ac)—BUNDABERG

Treatment	672 lb/ac 315 + Cu	672 + 224 lb/ac 315 + Cu	672 + 448 lb/ac 315 + Cu	672 + 672 lb/ac 315 + Cu	Penar Averages
No Penar	134	160	161	179	158
Penar once	79	86	98	113	94
Penar twice	77	87	99	101	91
Fertilizer averages ..	97	111	119	131	114

APPENDIX TABLE 2

TREATMENT COSTS ($/ac)—BEERWAH

Treatment	610 lb/ac 315 + T.E.	610 + 260 lb/ac 315 + T.E.	610 + 520 lb/ac 315 + T.E.	610 + 780 lb/ac 315 + T.E.	Penar Averages
No Penar	98	100	118	136	113
Penar once	69	80	96	109	89
Penar twice	58	72	80	95	76
Fertilizer averages ..	75	84	98	113	93

The "earliness index" data in Appendix Tables 3 and 4 summarize the harvesting pattern in the two trials. One major difference between the two tables is that the Beerwah trial ripened more quickly than the Bundaberg trial.

APPENDIX TABLE 3

EARLINESS INDEX—BUNDABERG

Treatment	672 lb/ac 315 + Cu	672 + 224 lb/ac 315 + Cu	672 + 448 lb/ac 315 + Cu	672 + 672 lb/ac 315 + Cu	Penar Averages
No Penar	34·1	22·9	20·6	28·4	26·5
Penar once	28·5	25·6	25·8	25·2	26·3
Penar twice	24·9	18·9	18·4	15·0	19·3
Fertilizer averages ..	29·2	22·5	21·6	22·9	24·0

APPENDIX TABLE 4

EARLINESS INDEX—BEERWAH

Treatment	610 lb/ac 315 + T.E.	610 + 260 lb/ac 315 + T.E.	610 + 520 lb/ac 315 + T.E.	610 + 780 lb/ac 315 + T.E.	Penar Averages
No Penar	48·1	45·3	39·8	34·6	42·0
Penar once	49·2	41·7	37·8	33·6	40·6
Penar twice	43·3	42·9	39·3	35·3	40·2
Fertilizer averages ..	46·9	43·3	38·9	34·5	40·9