QUEENSLAND DEPARTMENT OF PRIMARY INDUSTRIES
DIVISION OF PLANT INDUSTRY BULLETIN No. 458

INSECTICIDAL CONTROL OF CITRUS PESTS IN COASTAL CENTRAL QUEENSLAND

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SUMMARY

Two insecticide spraying programmes for coastal Central Queensland were compared for the control of citrus pests in the Byfield district during 1961-62. Major pests were wax scales (*Ceroplastes rubens* Mask. and *Ceroplastes destructor* Newst.), hard scales (*Aonidiella aurantii* (Mask.) and *Lepidosaphes beckii* (Newn.)), Maori mite (*Phyllocoptruta oleivora* (Ashm.)), and white louse (*Unaspis citri* (Comst.)).

The standard schedule based on a winter lime sulphur, an early summer wettable sulphur, and summer white oil-soap-washing soda, gave good control of white louse and fair control of wax and hard scales.

An additional application of white oil-soap-washing soda in March resulted in a much more satisfactory control of scale insects and a high percentage of fruit free from sooty mould. Differences in Maori mite control between the two schedules were not significant.

I. INTRODUCTION

The major pests of citrus in the humid coastal areas of Central Queensland are pink wax scale (*Ceroplastes rubens* Mask.), white wax scale (*Ceroplastes destructor* Newst.), Maori mite (*Phyllocoptruta oleivora* (Ashm.)) and white louse (*Unaspis citri* (Comst.)). Other pests of common occurrence are red scale (*Aonidiella aurantii* (Mask.)) and mussel scale (*Lepidosaphes beckii* (Newn.)).

Under the humid conditions and the activity of natural enemies, the populations of these pests normally do not exert much effect on tree vigor nor do they seriously influence fruit size or fruit contents; the chief concern lies in fruit appearance. The presence of wax scales results in sooty mould development on the fruit and the mite causes a dark rind blemish. Red scale progeny satisfying a microclimate stimulus move into the region of and settle on the fruit. Mussel scale can also react in this way.

For many years citrus crops were grown in the Byfield district of coastal Central Queensland largely without general use of insecticides and the fruit were accepted on the local Rockhampton market. Although pest control schedules had been devised to suit local conditions (Manefield and Passlow 1954), many growers were not convinced of the value of insecticide applications. With the introduction onto the Rockhampton market of relatively unblemished fruit from other centres, Byfield growers became increasingly aware of the need for pest control. Consequently a field trial was carried out during the 1961-62 season in the Byfield district to determine the efficacy of insecticide schedules in controlling citrus pests in that area.

II. MATERIALS AND METHODS

The insecticidal materials used in the trial were as follows:—

Lime sulphur: A solution containing 20% w/v sulphur as polysulphides.
Liquid soap: A liquid formulation prepared by a Rockhampton firm.
Microtomic sulphur: A wettable powder containing 95% w/w sulphur.
Washing soda: A crystalline product prepared by a Rockhampton firm.
White oil: An emulsion containing 80% w/v mineral oil.

An area of Emperor mandarin trees, 6-8 years old and with an upright habit of growth, was used for the trial. The layout comprised a 3 x 7 randomized block with single tree plots. The three insecticide treatments were as follows:—

1. Untreated.
2. Schedule A: Standard Central Queensland citrus pest control schedule: July, lime sulphur; November, sulphur; early December, white oil-soap-washing soda mixture; followed 2 weeks later by white oil, with sulphur after December as required for Maori mite control.
3. Schedule B: July, lime sulphur; early December, white oil-soap-washing soda mixture; followed 2 weeks later by white oil, with sulphur after December as required for Maori mite control; March, white oil-soap-washing soda mixture.

All plots (including the untreated) received applications of copper spray in the ½-¾ petalfall period on September 28 and October 11 for melanose control, white oil 1 in 160 being used as spreader.

All sprays were applied to give thorough wetting of all surfaces, using a power unit delivering through a twin-nozzle hand-lance at 300 lb/sq in pressure. Details of application rates are listed in Table 1.

Pest species of scale insects infesting the trees at the commencement of the trial were determined by a pretreatment assessment made on fruit of the 1961 crop on July 14. Those noted were pink wax scale, white wax scale and white louse; sooty mould was evident. The incidence of these was recorded in five gradings, namely heavy, medium, light, slight and very slight.

TABLE 1

CITRUS SPRAY PROGRAMMES, BYFIELD, 1961-62

Date of Application	Materials and Concentrations	Treatments	Spray Applied (gal/tree)
July 14, 1961 ..	Lime sulphur (1 : 20)	2, 3	4·3
Sept. 25, 1961 ..	Cuprox (¾ lb) + white oil (2 pt) per 40 gal ..	1, 2, 3	3·6
Oct. 11, 1961 ..	Cuprox (¾ lb) + white oil (2 pt) per 40 gal ..	1, 2, 3	3·3
Nov. 6, 1961 ..	Wettable sulphur (2 lb per 50 gal)	2	3·6
Dec. 4, 1961 ..	White oil (2 gal) + liquid soap (7½ pt) + washing soda (12 lb) per 100 gal	2, 3	3·2
Dec. 21, 1961 ..	White oil (1 : 60)	2, 3	3·0
Feb. 16, 1962 ..	Wettable sulphur (2 lb per 50 gal)	2, 3	4·3
Mar. 21, 1962 ..	White oil (2 gal) + liquid soap (7½ pt) + washing soda (12 lb) per 100 gal	3	4·0

The results of the treatments were assessed at harvesting on June 6 and 22, 1962, on samples of 100 fruit taken at random from each plot and examined separately for the presence of sooty mould, hard scales (*Aonidiella aurantii* and *Lepidosaphes beckii*) and Maori mite.

The extensiveness of sooty mould development on the fruit was taken as an index of the severity of wax scale infestations on the trees. Fruit were allotted to one of four grades depending on the surface area covered by sooty mould. The grades used were as follows:—(a) no mould; (b) mould on up to 25% of fruit surface; (c) mould on 25-50% of surface; (d) mould on more than 50% of surface.

The number of fruit examined was less than 100 in treatment 1 replicate F, treatment 2 replicate B and treatment 3 replicates A and F. Adjustments in analyses were made accordingly.

The unit sample used in assessment of hard scales comprised 50 fruit from each plot except in treatment 2 replicate B and treatment 3 replicate E. The severity of hard scale infestation was designated within a range of six grades based on normally visible scale. The number of fruit in each grade was recorded from each plot. The grades were as follows:—(a) nil scales; (b) 1-25 scales; (c) 26-50 scales; (d) 51-75 scales; (e) 76-100 scales; (f) more than 100 scales.

Maori mite infestation was determined by an examination of the fruit with a X20 hand lens. The number of mites in each of five fields of vision per fruit was recorded on a unit sample of 30 fruit, except in treatment 2 replicate B and treatment 3 replicate E.

Counts were not made for post-treatment incidence of white louse, but observations indicated that the insect was significantly controlled by the winter lime sulphur application, which possibly was assisted by the summer scalicide applications.

III. RESULTS

The pretreatment assessment is detailed in Table 2. The analyses of post-treatment data for sooty mould, hard scales and Maori mite are presented in Tables 3-5.

Analysis of the sooty mould data as an index of wax scale control was confined to the categories of Nil mould and Nil-25% surface mould. Similarly, the categories of Nil scales and Nil-25% scales were the only sections of the hard scale data to be analysed.

TABLE 2

PRETREATMENT ASSESSMENT OF SCALE INSECTS AND SOOTY MOULD

Treatment	Block	Pink Wax	White Wax	White Louse	Mould
1	A	Slight	Slight	Slight	Slight
	B	Light	Slight	Slight	Slight
	C	Light	Slight	Light	Light
	D	Light	Slight	Light	Light
	E	Medium	Light	Very slight	Medium
	F	Heavy	Slight	Light	Medium
	G	Heavy	Medium	Light	Heavy
2	A	Slight	Light	Light	Slight
	B	Light	Light	Slight	Slight
	C	Light	Slight	Slight	Light
	D	Medium	Light	Light	Medium
	E	Medium	Light	Very slight	Medium
	F	Medium	Medium	Slight	Medium
	G	Heavy	Light	(Not noted)	Heavy
3	A	Slight	Slight	Slight	Slight
	B	Slight	Slight	Slight	Slight
	C	Light	Light	Slight	Light
	D	Light	Slight	Light	Light
	E	Medium	Light	Slight	Light
	F	Heavy	Slight	Slight	Medium
	G	Heavy	Heavy	Medium	Medium

IV. DISCUSSION

The two spraying programmes differed in that schedule A (treatment 2) included an additional mite control application of wettable sulphur in November, while schedule B (treatment 3) included an additional scale control application of white oil-soap-washing soda in the following March.

Schedule B was outstanding for the control of wax scales, based on sooty mould development, and of hard scales. The standard control programme (schedule A), while exhibiting an appreciable scalicidal effect when compared with

TABLE 3

POST–TREATMENT ASSESSMENT OF SOOTY MOULD

Treatment	Fruit with Nil Mould		Total Fruit with Not More Than 25% Mould per Fruit	
	Transformed Mean* (%)	Equivalent Mean (%)	Transformed Mean* (%)	Equivalent Mean (%)
1	21·64	13·6	58·99	73·5
2	48·36	55·8	76·45	94·5
3	65·96	83·4	88·11	99·9
S.E.	±2·960	..	±2·415	..
Necessary differences for significance 5%	9·12	..	7·44	..
Necessary differences for significance 1%	12·79	..	10·43	..
	3≫2≫1		3≫2≫1	

* Inverse sine transformation.

TABLE 4

POST–TREATMENT ASSESSMENT OF HARD SCALES†

Treatment	Fruit with Nil Scales		Total Fruit with Not More Than 25 Scales per Fruit	
	Transformed Mean* (%)	Equivalent Mean (%)	Transformed Mean* (%)	Equivalent Mean (%)
1	0·00	0·0	48·74	56·5
2	31·08	26·6	60·55	75·8
3	49·44	57·7	77·05	95·0
S.E.	±2·921	..	±2·929	..
Necessary differences for significance 5%	9·00	..	9·03	..
Necessary differences for significance 1%	12·62	..	12·65	
	3≫2≫1		3≫2≫1	

* Inverse sine transformation.

† *Aonidiella aurantii* and *Lepidosaphes beckii*.

TABLE 5

POST–TREATMENT ASSESSMENT OF MAORI MITE

Treatment	Mean No. per Unit Sample Area	Significantly Less Than	
		5%	1%
1	6·82	..	..
2	2·86	1	..
3	0·60	1	1

the untreated plots, was markedly inferior to schedule B for control of wax scales, based on mould-free fruit, and for control of hard scales. This obvious superiority of schedule B may be ascribed to the extra white oil-soap-washing soda spray that was applied in March. Previously the application of a scalicide spray in March had not been considered necessary for Byfield orchards although it has been an accepted procedure in southern Queensland for a number of years (Manefield 1956). The results of this trial have demonstrated the value of such a spray, and its inclusion in the schedule for coastal Central Queensland is essential for adequate control of scale insects.

Both schedule A and schedule B achieved a measure of control of Maori mite. Although a significant difference was not demonstrated, schedule B effected a greater reduction in mite numbers than schedule A despite the November sulphur application which was included in schedule A specifically for mite control. The March scalicide spray in schedule B must have contributed to the improved control of Maori mite. Mite populations, however, were low throughout the trial period and a general superiority in controlling this pest cannot be claimed for schedule B on the evidence shown. Consequently an application of wettable sulphur in November should still be included in the standard control programme and further sprays may be required in seasons of high mite populations.

The standard lime sulphur spray applied in winter provided good control of white louse scale.

V. ACKNOWLEDGEMENT

Mr. E. Arnold, Byfield, kindly provided orchard facilities for the work. Statistical analyses were carried out by the Biometrics Branch.

REFERENCES

MANEFIELD, T. (1956).—Control of common pests of citrus in coastal areas of southern Queensland. *Qd Agric. J.* 82:687-92.

MANEFIELD, T., and PASSLOW, T. (1954).—The control of common pests of citrus in Central Queensland. *Qd Agric. J.* 78:321-4.

(Received for publication August 21, 1967)

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