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CONTROL OF WHITE WAX SCALE (GASCARDIA DESTRUCTOR (NEWSTEAD)) ON CITRUS IN SOUTH EASTERN QUEENSLAND

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SUMMARY

In field trials using 14 pesticides against *Gascardia destructor* (Newstead) on citrus between 1964 and 1972, the most effective control was obtained by sprays of 0·075% methidathion.

Control was best achieved with a double spray schedule in the summer; the first spray was applied at the first appearance of peak stage scale in late November to mid December and the second spray two months later, at the conclusion of the summer crawler emergence.

I. INTRODUCTION

White wax scale (*Gascardia destructor* (Newstead)) is an important scale pest of citrus in Queensland (Manefield 1956, Smith and Ironside 1974). Its importance stems from its encouragement of the black fungal deposit, sooty mould, which covers leaves and disfigures fruit.

In the 1950s, control of the scale in Queensland was achieved with a spray of 20 g l^{-1} washing soda or 7·5 g l^{-1} soda ash containing 0·85% detergent. This was applied in late December when it was considered most of the adult scales had completed egg laying (Manefield 1956). However, this control was inadequate, and the alkaline materials were apt to cause leaf drop at high temperatures or during periods of tree stress. The present work was conducted during 1964–1972 in conjunction with seasonal history studies on the scale (Smith 1970, Smith and Ironside 1974) to test alternative materials and establish more effective control measures.

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II. MATERIALS

azinphos-ethyl	40% w/v emulsifiable concentrate
azinphos-methyl	50% w/w wettable powder
carbaryl	80% w/w wettable powder
dimethoate	25% w/w wettable powder
maldison	25% w/w wettable powder
methidathion	40% w/v emulsifiable concentrate
mineral oil	84% w/v 'Superior Summer Oil', 80% w/v 'White Oil', 97% 'Volck 70 Supreme Oil', 98% 'Volck Supreme Oil'
omethoate	50% w/v emulsifiable concentrate
parathion	50% w/v emulsifiable concentrate
phenthoate	50% w/v emulsifiable concentrate
promecarb	50% w/w wettable powder
soda ash	anhydrous sodium carbonate
sodium metasilicate	formulations containing 20·6% to 29% sodium metasilicate pentahydrate
vamidothion	40% w/v emulsifiable concentrate

III. METHODS

Thirteen trials were carried out on oranges or mandarins in the Palmwoods, Beerwah and Gayndah citrus growing areas during 1964–1972. The number and type of pesticides varied from trial to trial. Randomized block layouts were used with three or four replications of single tree plots. Sprays were applied to run-off with a hand held lance of a power sprayer operating at 1 000 to 1 400 kPa.

Only one spray was applied in trials 1 to 7, 12 and 13, while two sprays were applied in trials 9 to 11. In trial 8, a single application of 0·075% soda ash + 0·2% wetting agent and of 1·5% sodium metasilicate was compared with two applications of 1·5% sodium metasilicate and of three other pesticides.

The single sprays in trials 1 and 2 were applied during the cooler autumn period of April-May to avoid phytotoxicity. Spray applications in trials 3 to 7 were made in late January to early February. In all 7 trials, the percentages of live scale in the peak stages of development (Smith and Ironside 1974) were determined immediately before and 3 weeks after spraying on a sample of 20 consecutive scales on each of 20 randomly selected twigs per tree.

Single spray applications were also made in trials 8, 12 and 13 in late January, early December and early May respectively. Double applications of spray in trials 8 to 11 were made in the period late November to mid February and were separated by about 2 months. Counts of 1 to 4 month old scales were made on 20 randomly selected 100 mm (one twig section per tree, both before and at 2 to 4 months after spraying).

IV. RESULTS AND DISCUSSION

Pre-treatment counts were not significantly different and are not presented. Post-treatment results for trials 1 to 7 are given in table 1 and for trials 8 to 13 in table 2. In trials 1 to 7, the pre-treatment percentages of live scale in the peak stage of development ranged from 94·5 to 100·00%. In trials 8 to 13, the pre-treatment counts ranged from 22 to 226 scales on 20 twig sections per tree.

TABLE 1

CONTROL OF *G. destructor* IN TRIALS 1 TO 7 EXPRESSED AS PERCENTAGE OF LIVE SCALES IN THE PEAK STAGE OF DEVELOPMENT THREE WEEKS AFTER A SINGLE SPRAY APPLICATION

Treatment	Trial Number						
	1	2	3	4	5	6	7
azinphos-ethyl (0·05%) + mineral oil (1·0%)	57·1 b	..	..	..	..	..	..
azinphos-methyl (0·05%) + mineral oil (1·0%)	82·8 c	..	42·7 d	..	..	43·9 b	..
carbaryl (0·05%) + mineral oil (1·0%)	..	..	2·1 a	..	13·9 c	19·2 a	13·9 ab
carbaryl (0·1%) + mineral oil (1·0%)	..	..	..	..	..	11·8 a	..
dimethoate (0·05%) + mineral oil (1·0%)	..	..	33·1 cd	..	..	..	..
phenthoate (0·05%) + mineral oil (1·0%)	..	93·5 e	..	..	..	..	..
promecarb (0·05%) + mineral oil (1·0%)	..	..	..	..	..	..	11·8 a
soda ash (0·75% w/v) + wetting agent (0·2%)	20·0 a	75·4 d	22·9 bc	3·2 b	2·1 ab	79·1 c	26·0 b
sodium metasilicate (1·0% w/v)	26·8 a	60·4 c	..	..	..	..	..
sodium metasilicate (1·5% w/v)	11·9 a	44·7 b	..	3·6 b	0·7 a	47·6 b	..
sodium metasilicate (2·0% w/v)	6·7 a	24·6 a	..	0·3 a	..	..	..
sodium metasilicate (1·5%) + mineral oil (1·0%)	..	..	15·2 b	..	0·9 a	55·0 b	21·8 ab
sodium metasilicate (2·0% w/v) + mineral oil (1·0%)	..	..	..	..	..	..	19·8 ab
sodium metasilicate (1·5% w/v) + wetting agent (0·2%)	..	..	..	2·5 ab	..	..	..
vamidothion (0·05%) + mineral oil (1·0%)	..	93·2 e	..	..	..	..	..
No treatment	80·6 c	94·6 e	95·1 e	84·2 c	97·3 d	88·8 c	96·1 d

Treatments followed by the same letter within a trial do not differ significantly at the 5% level.

TABLE 2

CONTROL OF *G. destructor* IN TRIALS 8 TO 13 EXPRESSED AS MEAN NUMBER OF LIVE SCALES ON 20 TWIG SECTIONS TWO TO FOUR MONTHS AFTER THE FINAL SPRAY APPLICATION

Treatment	Trial Number* and Number of Sprays Applied						
	8*		9*	10*	11*	12*	13*
	1	2	2	2	2	1	1
azinphos-methyl (0·05%) + mineral oil (1·0%) ..	..	3·3 ab	..	..	..	..	43·4 b
azinphos-methyl (0·075%)	..	..	23·7 c	8·8 cd	0·4 a	10·7 bc	..
carbaryl (0·05%) + mineral oil (1·0%)	..	..	..	..	..	..	19·9 ab
carbaryl (0·075%)	..	..	24·3 c	49·1 ef	..	17·8 cd	..
carbaryl (0·075%) + mineral oil (1·0%)	..	0·7 a	..	..	..	0·6 a	..
maldison (0·1%)	..	..	159·8 d	33·6 ef	13·5 b	61·4 d	..
methidathion (0·05%) + mineral oil (1·0%) ..	..	..	..	..	..	..	16·4 ab
methidathion (0·075%)	..	..	0·0 a	0·0 a	..	0·0 a	..
omethoate (0·075%)	..	..	24·7 c	36·1 ef	..	..	..
promecarb (0·05%) + mineral oil (1·0%)	..	1·1 a	..	..	..	0·3 a	20·6 ab
promecarb (0·075%)	..	..	9·5 bc	17·2 de	11·3 b	10·6 bc	..
promecarb (0·075%) + mineral oil (1·0%) ..	..	..	..	2·6 b	0·8 a	..	..
soda ash (0·75% w/v) + wetting agent (0·2%) ..	9·5 b	..	..	..	..	3·1 b	5·9 a
sodium metasilicate (1·5% w/v)	60·8 c	6·1 ab	..	..	..	..	..
sodium metasilicate (1·5% w/v) + mineral oil (1·0%)	..	..	..	..	..	..	9·0 a
mineral oil (1·0%)	..	..	18·5 bc	2·0 b	..	31·3 cd	..
mineral oil (1·67%)	..	..	..	3·3 bc	..	17·0 c	..
mineral oil (2·5%)	..	..	6·1 b	..	..	..	..
No treatment	359·1 d	..	401·0 d	80·0 f	225·4 c	421·2 e	308·4 c

Treatments followed by the same letter within a trial do not differ significantly at the 5% level.

Efficacy of Materials

In assessing the efficacy of materials in trials 1 to 7, survival in the peak stage of development of more than 5% was considered unsatisfactory (table 1). Similarly in trials 8 to 13 at the post-treatment assessment, the presence of two or more live scales aged 1 to 4 months on 20 twig sections was considered an unsatisfactory level of control (table 2).

The most effective material was 0·075% methidathion which reduced the scale population to zero where double applications were made in trials 9 and 10, and where a single application was made in trial 12. Methidathion caused 100% mortality of scales in the peak stage of development in trial 12. A single application of 0·05% methidathion + 1·0% mineral oil was unsatisfactory in trial 13.

Less consistent results were given by promecarb and carbaryl each in combination with 1·0% mineral oil and by sodium metasilicate and soda ash. Promecarb at 0·05% + 1·0% mineral oil was effective in trials 8 and 12 but not in 7 and 13. Promecarb at 0·075% + 1·0% mineral oil was effective in trials 10 and 11. However, when used at this rate without the addition of mineral oil, promecarb was significantly inferior.

Carbaryl at 0·05% + 1·0% mineral oil was effective only in trial 3. Carbaryl at 0·075% + 1·0% mineral oil was effective in trials 8 and 12 but was ineffective when used without oil in trials 9, 10 and 12.

Soda ash at 0·75% w/v with wetting agent, and 1·5 or 2·0% w/v sodium metasilicate alone, or combined with 1·0% mineral oil, were effective only in trials 4 and 5. Sodium metasilicate at 2·0% caused leaf drop in trial 1. Severe leaf drop and reduction in fruit size followed the use of both alkaline materials in trial 8. In trial 6, storm rain a few hours after spraying rendered the alkaline treatments ineffective.

Timing of spray application

Results from trials 1 and 2 emphasize the importance of applying sprays before the scales advance beyond the peak stage of development. As discussed by Smith and Ironside (1974), summer oviposition by *G. destructor* commences in mid September and concludes in late January. Young scales from this oviposition begin to reach the peak stage of development from late November. A spray is normally required shortly after late November to control scales emerged since September. A further application is usually needed shortly after late January to control the remainder of the summer emergence. Results demonstrate that it is not possible to obtain consistently good control with a single spray application. In the present work, such sprays were satisfactory in only three out of 10 trials—4, 5 and 12.

Effective control was obtained in the four trials (8 to 11), in which two sprays were applied. In these the first spray was applied during late November to early December and the second 2 months later. It was concluded that two applications of methidathion, using this timing, were the best control measure for *G. destructor* in south-eastern Queensland.

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