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EFFECT OF INSECTICIDES ON *HOMOEOSOMA VAGELLA* ZELLAR DAMAGE TO MACADAMIA FLOWERS

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SUMMARY

Pre-bloom plus full bloom dipping of flower racemes in solutions of 0·05% acephate, 0·01% acephate plus 13 g per 100 L *Bacillus thuringiensis,* 0·01% acephate, and 13 g per 100 L *B. thuringiensis,* in descending order of efficacy, significantly reduced *Homoeosoma vagella* damage to macadamia flowers and increased the set of immature nuts. Similar applications of 0·01% trichlorphon plus 13 g per 100 L *B. thuringiensis* and 0·01% trichlorphon reduced damage but did not significantly increase nut set. The addition of 13 g per 100 L of *B. thuringiensis* to 0·01% acephate and to 0·01% trichlorphon had no significant effect.

A single application of all treatments at full bloom was ineffective because most of the *H. vagella* damage had occurred during the bud stage.

I. INTRODUCTION

The macadamia flower caterpillar (*Homoeosoma vagella* Zellar) is a common and widespread insect pest of macadamia (Ironside 1970). The larvae feed on the flower racemes and, during severe infestations, 90 to 100% of the racemes become infested and few nuts are set. To control the insect, insecticide sprays are applied during the period August to October when honey-bees are foraging the flowers. Because honey-bees are considered important pollinators of macadamia (Urata, 1954) it is necessary to avoid using insecticides hazardous to them.

As a result of previous trials by the senior author (unpublished departmental reports) and by Penelope Sinclair (unpublished CSR Ltd reports), sprays of 0·05% endosulfan or 0·05% trichlorphon are recommended to control *H. vagella.*

Creighton and McFadden (1974) reported that low rates of *Bacillus thuringiensis* var. *alesti* Berliner and chlordimeform hydrochloride had synergistic effects when used in mixed sprays against lepidopteran pests of crucifers. Chlordimeform, however, is no longer available in Australia. Morris (1977) showed that acephate and trichlorphon were compatible with *B. thuringiensis.* The work now reported was undertaken during 1978 to compare low rates of acephate and trichlorphon alone and in combination with *B. thuringiensis* for reducing *H. vagella* damage to macadamia flowers.

II. MATERIALS

The following formulations were used—

acephate—750 g per kg soluble powder;

Bacillus thuringiensis—a wettable powder containing 16 000 international units of potency of *B. thuringiensis* Berliner var. *alesti* per mg;

trichlorphon—625 g per L emulsifiable concentrate.

III. METHODS

EXPERIMENTAL DESIGN. There were seven experimental trees, all 9-year-old specimens of the cultivar Keauhou. The layout was a 7 x 2 factorial array of treatments in a randomized block design. Each tree represented a block of the design and contained four duplicate units of the 14 treatments. A single flower raceme was the experimental unit.

SELECTING AND TAGGING THE FLOWER RACEMES. On 24 August 1978, 56 racemes on each tree were tagged. Racemes in the advanced stage of bud development were selected so that each was infested having five buds showing *H. vagella* larval entry holes.

APPLICATION OF TREATMENTS. The control water dip and the insecticide treatments (table 1) were applied by dipping each raceme for 2 to 3 seconds in water or in the appropriate insecticide solution in a 100 mL graduated cylinder. Half of the racemes were treated at pre-bloom on 25 August and also at full bloom on 8 September, the other half at full bloom only.

TABLE 1

EFFECT OF INSECTICIDE SCHEDULES ON *H. vagella* DAMAGE TO MACADAMIAS

Treatment	Schedule	Mean damage rating per raceme (on 20–21 Sep.)	Mean No. of immature nuts per raceme (on 9–10 Oct.)
Acephate 0·05%	1	4·39	3·39
	2	1·61	10·50
Acephate 0·01% + *Bacillus thuringiensis* 13 g/100 L	1	5·14	4·18
	2	2·04	8·64
Acephate 0·01%	1	4·71	4·11
	2	2·29	7·18
Trichlorphon 0·01% + *B. thuringiensis* 13 g/100 L)	1	4·61	5·96
	2	3·50	5·93
Trichlorphon 0·01%	1	4·96	3·64
	2	3·75	6·14
B. thuringiensis 13 g/100 L	1	5·18	4·21
	2	4·32	6·46
Control-water dip	1	5·61	3·93
	2	5·68	3·39
L.S.D. P = 0·05	..	1·28	2·85
L.S.D. P = 0·01	..	1·69	3·76

Schedule 1 = Application at full bloom only, on 8 September.

Schedule 2 = Applications at pre-bloom and full bloom, on 25 August and 8 September.

ASSESSMENTS. Pre-treatment ratings of *H. vagella* damage on the tagged racemes were made on 25 August and post-treatment ratings of damage were made on 20 and 21 September, 12 and 13 days after full bloom. The ratings used were as follows—

Amount of raceme damaged	Rating
less than $^1/_8$	1
$^1/_8$ to $^1/_4$	2
$^1/_4$ to $^3/_4$	4
$^3/_4$ to $^4/_4$	8

The number of immature nuts set on each tagged raceme was counted on 9 and 10 October.

IV. RESULTS

PRE-TREATMENT DAMAGE RATING. There were no significant treatment differences but there were significant differences between blocks due to the particularly high *H. vagella* damage level on one tree.

POST-TREATMENT ASSESSMENTS. These results are given in table 1. There was significant interaction between insecticides and number of applications ($P < 0{\cdot}01$).

The insecticide treatments at full bloom had no significant effect on the level of *H. vagella* damage or on the number of immature nuts set ($P > 0{\cdot}05$).

Pre-bloom plus full bloom applications of all insecticide treatments significantly reduced damage ($P < 0{\cdot}05$) but only 0·05% acephate, 0·01% acephate + 13 g per 100 L *B. thuringiensis,* 0·01% acephate, and 13 g per 100 L *B. thuringiensis* significantly increased the number of nuts set ($P < 0{\cdot}05$). More nuts were set on the 0·05% acephate than the 0·01% acephate treatment ($P < 0{\cdot}05$). The addition of 13 g per 100 L *B. thuringiensis* to 0·01% acephate and to 0·01% trichlorphon had no significant effect ($P > 0{\cdot}05$).

A covariance analysis of the number of nuts set, adjusted for post-treatment damage rating, exhibited a significant linear regression ($P < 0{\cdot}01$) and no significant treatment differences. This indicates that there were no additional effects of treatments after the post-treatment damage rating was made.

V. DISCUSSION

Lowest damage and highest nut set resulted from 0·05% acephate and even at 0·01% this insecticide resulted in increased nut set. Further studies using rates of acephate lower than 0·05% would therefore be worth while. Mixing 13 g per 100 L *B. thuringiensis* with 0·01% acephate and 0·01% trichlorphon does not warrant further investigation.

Full bloom treatments alone were ineffective because most of the *H. vagella* damage had occurred while the flowers were still in the bud stage. This does not always occur as the timing and severity of attack by this insect varies. Timing of control should therefore be based on the insect's activity and not merely on the stage of flower development.

The highly significant differences in nut set between the successful pre-bloom and full bloom treatments and the control suggests that, under the conditions of the trial, increased production may be obtained by the control of *H. vagella*. However, the number of immature nuts does not necessarily reflect the final yield as many nuts are shed during natural thinning before reaching maturity.

Further trials are needed to investigate the effect of *H. vagella* control on nut yield. In such trials, the yield of mature nuts per tree should be obtained as well as the number of immature nuts set, and commercial spraying methods should be used in applying the treatments.

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