

EFFECT OF FIVE ACARICIDES ON *TETRANYCHUS URTICAE* (KOCH) AND ITS PREDATORS, *STETHORUS* SPP (COLEOPTERA: COCCINELLIDAE) IN AN APPLE ORCHARD

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Abstract

Five acaricides chlordimeform, binapacryl, phenisobromolate, cyclosulfyne and tricyclohexyltin-hydroxide were screened against *Tetranychus urticae* (Koch), two spotted mite, and its coccinellid predators, *Stethorus* spp.

Tricyclohexyltin-hydroxide and cyclosulfyne were the most effective chemicals against *T. urticae*. Cyclosulfyne, phenisobromolate and chlordimeform were the least toxic acaricides to *Stethorus* spp for use in an integrated control program.

Introduction

Cydia pomonella (L), codling moth is the key pest in N.S.W. apple orchards. By endeavouring to control this pest through the use of highly toxic broad spectrum insecticides, other pest species have emerged which require chemical control, e.g., *Tetranychus urticae* (Koch), two spotted mite.

This problem has arisen due to the susceptibility of native predators to the broad spectrum insecticides. From investigations in unsprayed Australian apple orchards, Readshaw (1971) concluded that for *T. urticae* "the only predators of practical significance are the small black beetles of the genus *Stethorus*".

Laboratory investigations have confirmed that insecticides are highly toxic to *Stethorus* species and have also revealed the varying toxicity of orchard acaricides (Edwards and Hodgson, 1973; Walters in press).

Field work conducted at Bathurst Agricultural Research Station as part of the Co-operative Research Program into Pest Management from 1966 to 1969, revealed that it took 3 years for the native predators to establish themselves in an orchard block after the application of highly toxic insecticides ceased. During this intervening period, *T. urticae* was a major problem if left unchecked. Therefore, in the event of changing over to an integrated control program an acaricide non-toxic to the predators yet toxic to *T. urticae* would have to be applied for temporary control.

This paper reports on the efficacy of 5 acaricides against *T. urticae* and their toxicity to *Stethorus* spp. under field conditions. Conclusions are made as to the suitability of these chemicals being used in an integrated control program dependent on *Stethorus* spp as the major predators of *T. urticae*.

Materials and Methods

The trial was conducted on Granny Smith apple trees at Bathurst Agricultural Research Station. A randomised complete block design was adopted using single tree plots with five replications of each treatment.

Treatments

Each tree was sprayed with approximately 23 litres of the appropriate mixture, at the recommended field rate, using a handgun to ensure a thorough, even wetting of the tree. Treatments were chlordimeform 0.1% w/v, binapacryl 0.05% w/w, phenisobromolate 0.075% w/v, cyclosulfyne 0.06% w/w and tricyclohexyltin-hydroxide 0.019% w/w, plus an untreated control. As part of the orchard's commercial spray programme, azinphos-methyl 0.05% w/w was applied to all trees as a routine codling moth treatment 19 days after the acaricide treatments were applied. During the first 20 days of the trial, commencing immediately after spraying, 260 mm of rain fell.

Assessments

Twenty mature leaves were sampled from each tree immediately prior to treatment application and then 4, 11 and 24 days after. Mobile stages of mites were counted with the aid of a stereomicroscope. If the population exceeded 15 mites per leaf, a mite brushing machine (Henderson and McBurnie 1943) was used to assess the sample population. All stages of *Stethorus* were counted in order to obtain the highest numbers possible for the statistical analysis.

Statistical analysis

(a) *T. urticae*: The total number of mites counted at the post spray sample times was analysed, using a logarithmic transformation prior to an analysis of variance and the establishment of the least significant difference.

(b) *Stethorus* spp: The total number of *Stethorus* spp counted at each of the four times was analysed by an analysis of variance and the least significant difference was then established. An analysis of covariance was also used to ascertain whether the fluctuation in *Stethorus* spp. numbers was due to the toxicity of the chemical or was in response to the decline in mite numbers.

Results

The results are summarised in Tables 1 and 2. At all three post-spray times, *T. urticae* populations were significantly lower in the chemically treated plots than in the unsprayed control plots (Table 1). At 4 days, all treatments were equally effective in reducing *T. urticae* populations, thereafter only tricyclohexyltin-hydroxide and cyclosulfyne were still effective after 11 days. At 24 days, tricyclohexyltin-hydroxide and cyclosulfyne gave equal control and were significantly better than all other treatments.

The predator *Stethorus* spp populations were also monitored concurrently. At each sampling, *S. loxtoni* was by far the most prevalent species (90.8-99.8%) whilst *S. nigripes* (0-1.4%) and *S. vagans* (0.2-8.8%) were much less abundant. In the untreated plots, the populations of each increased substantially (Table 2). The *Stethorus* spp populations were significantly lower in the phenisobromolate treated plots than in the cyclosulfyne and untreated control plots at 4 days.

At 11 days, there was no significant difference between the treatments but they had significantly smaller predator populations than the untreated plots. However there was no significant difference between acaricides in the *Stethorus* spp populations. Azinphos-methyl, applied at day 19 for the control of *C. pomonella*, resulted in the complete elimination of *Stethorus* spp by day 24.

TABLE 1
MEAN NUMBERS OF *T. URTICAE* PER LEAF AT PRE-SPRAY, 4, 11 AND 24 POST SPRAY ASSESSMENT DATES

Treatment	No. of <i>T. urticae</i> at time of sampling			
	Pre-Spray	Post Spray		
		4 day	11 day	24 day
Chlordimeform	118.0	5.2 b	8.7 c	6.9 bc
Binapacryl	116.4	2.5 ab	4.6 bc	8.9 bc
Bromopropylate	80.3	0.9 a	5.9 abc	10.9 b
Cyclosulfyne	52.4	2.9 ab	1.6 a	1.8 a
Tricyclohexyltin-hydroxide	65.0	5.7 b	1.9 ab	1.7 a
Control	98.4	121.2 c	169.9 d	37.1 d
l.s.d. with $P < 0.05$		5.0	4.3	3.2

a b c d Indicates that one mean does not significantly differ from another mean with the same annotation.

Discussion

Effect on T. urticae

Despite high *T. urticae* populations immediately prior to spraying, all treatments achieved excellent initial reductions of *T. urticae* numbers. Cyclosulfyne and tricyclohexyltin-hydroxide exhibited good residual activity for the duration of the trial. It is difficult to conclude whether the reduction in *T. urticae* numbers in the control plots on day 24 was a result of the high rainfall experienced during the trial or the azinphos-methyl application on day 19. Two acaricide trials during the previous season failed to show such a marked response after azinphos-methyl was applied, and it is considered that the major cause for the decrease in *T. urticae* numbers was the abnormally high rainfall. Azinphos-methyl was applied, 2 weeks prior to the commencement of the trial, during excessively hot dry conditions. Hence it is assumed that a rapid breakdown of the chemical occurred, enabling the *Stethorus* spp. to survive in the block after migration from the pest-management block, adjacent.

Effect on Stethorus spp

Laboratory screening of the 3 species on known dry residues revealed that azinphos-methyl 0.05% and tricyclohexyltin-hydroxide 0.02% killed 100% of adults after 48 hours. Binapacryl 0.05% killed between 70 and 100%, while chlordimeform 0.1%, phenisobromolate 0.075% and cyclosulfyne 0.06% proved to be non-toxic after 48 hours (Walters in press).

This field trial has demonstrated the difficulty experienced when interpreting field and laboratory data. For example the analysis of covariance implied that a reduction in the predator population in the tricyclohexyltin-hydroxide and binapacryl treated plots was in response to the reduction in *T. urticae* numbers, whereas the analysis of variance and the laboratory tests implied that it was directly due to the toxicity of the chemicals. However, there is no contradiction with the reduction in the predator populations in the chlordimeform, phenisobromolate and cyclosulfyne treated plots, where it was due entirely to the reduction in the food supply, *T. urticae*.

Therefore, in an integrated control program dependent on *Stethorus* spp as the major predator of *T. urticae*, chlordimeform, phenisobromolate and cyclosulfyne may be used to reduce the mite numbers in the event of the predator temporarily failing to exert control.

It should be noted that Clancy and Pollard (1952) observed a close correlation between the abundance of *Stethorus* and that of its prey at various population levels whilst Dosse (1967) noted that *Stethorus* disappeared when the mite population was reduced. In this trial the Australian species have behaved in a similar manner. Further work is required involving lower concentrations of these non-toxic acaricides in order to maintain a reservoir of *T. urticae* and thus minimise the dispersal of *Stethorus* spp from the treated trees.

TABLE 2

MEAN NUMBER OF *STETHORUS* SPP PER 20 LEAF SAMPLE AT PRE-SPRAY AND 4 AND 11 DAY POST SPRAY ASSESSMENT DATES

Treatment	No. of <i>Stethorus</i> spp at time of sampling		
	Pre-Spray	4 day	11 day
Chlordimeform	4.8	5.8 ab	9.4 a
Binapacryl	5.2	5.3 ab	4.8 a
Bromopropylate	3.2	2.3 a	6.2 a
Cyclosulfyne	4.2	14.5 bc	4.0 a
Tricyclohexyltin-hydroxide	3.2	8.3 ab	5.4
Control	3.6	18.8 c	40.4 b
l.s.d. with $P < 0.05$		9.52	12.15

a b c Indicates that one mean does not significantly differ from another with the same annotation.

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