THE TOXICITY OF COMMONLY USED ORCHARD CHEMICALS TO *STETHORUS NIGRIPES* (COLEOPTERA: COCCINELLIDAE)

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[*Manuscript received August* 31, 1972]

Abstract

The toxicity of 40 pesticides commonly used in orchards to adults of the predatory coccinellid, *Stethorus nigripes* (Kapur), was determined. Twelve of these chemicals including azinphos methyl 0.05%, carbaryl 0.1%, malathion 0.05% and aminocarb 0.075% proved to be highly toxic to the beetles while fifteen chemicals were relatively non-toxic. These latter materials and possibly some with intermediate toxicity could be considered for use in an integrated control programme.

INTRODUCTION

The members of the genus *Stethorus* are considered to be important predators of the European red mite, *Panonychus ulmi* (Koch) in the limited published data available (Colburn and Asquith 1970, 1971). In Australia species of *Stethorus* have been found in orchards and are now considered to be important predators of both European red mite and two-spotted mite, *Tetranychus urticae* (Koch).

This paper reports the evaluation of 40 insecticides, miticides and fungicides for their toxicity to the adults of *S. nigripes*. Colonies of this species were found in an unsprayed orchard at Woodbridge in southern Tasmania. The method of evaluation was adapted from the dipping method described by Colburn and Asquith (1970).

MATERIALS AND METHODS

Two separate experiments, the first on 24th January, 1972, and the second on 2nd-3rd February, 1972, were carried out. Temperatures for these two periods as recorded by the Bureau of Meteorology at Kingston, Tasmania, were 24th January max. 24°C, 2nd-3rd February max. 30°C min. 16°C.

The adult beetles were collected in large glass tubes from an orchard which had been neglected and unsprayed for at least a year, at Woodbridge, Tasmania, and taken to a nearby packing shed where the tests were carried out. Representative samples of these beetles forwarded to the Division of Entomology, CSIRO, Canberra, were identified as *S. nigripes*.

The formulation, active ingredients and rates of useage of the test materials† are given in Table 1. Each material, either pre-weighed or measured, was thoroughly mixed in 50 ml of water and the mixture was then placed in a 50 ml glass beaker.

Three groups of ten fully active beetles were placed in contact with the mixture concerned for 15 seconds. They were then removed from the top of the mixture with a needle and placed on a wad of filter paper in the bottom of a test cup. These were 57g No G5 plastic cups with two 25 mm holes covered with cotton gauze cut in opposite sides. Styrene lids with a gauze covered 25 mm diameter hole in the centre were used to confine the beetles.

For food during the period of the test, two or three leaves or pieces of leaves infested with all stages of European red mite were placed in each cup. These leaves maintained their turgidity for the duration of the test.

The number of dead and alive beetles from each of 10 adults per cup was counted after one hour in the first experiment and after one and again after 18 hours in the second experiment. A similar number of beetles was maintained in control cups after being dipped in water for the same period.

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†The names for chemicals are in accordance with the British Crop Protection Council (1972) Pesticide Manual 3rd. ed.

TABLE 1
THE TOXICITY OF ORCHARD CHEMICALS TO ADULTS OF *S. NIGRIPES*

Classification Chemical	Formulation	Amount Product/kl	Survival rate × 100		
			Experiment 1	Experiment 2*	
			1 hour	1 hour	18 hours
1 *Highly Toxic after 1 hour*					
Aminocarb	75% w.p.	1½ kg	0	0	0
Azinphos-methyl	50% w.p.	1 kg	17	14	0
Carbaryl	50% liquid	1.135 l	3	0	0
Carbophenothion	3% in oil	0.568 l	10	8	0
Chlorpyrifos	25% w.p.	2 kg	20	0	0
'Omite'	30% w.p.	2 kg	73	49	0
Diazinon	50% w.p.	1 kg	0	0	0
Dicofol	48% e.c.	0.568 l	100	59	0
Malathion	25% w.p.	2 kg	0	3	0
Methidathion	40% w.p.	1¼ kg	0	35	21
Phosmet mixed esters	35% w.p.	2⅛ kg	7	0	0
2 *Highly Toxic after 18 hours*					
Captan	80% w.p.	1¼ kg	77	80	14
DDT	25% e.c.	1.816 l	80	93	20
Dicofol	35% w.p.	1½ kg	100	77	14
Mancozeb	45% w.p.	1½ kg	100	80	30
Omethoate	80% e.c.	0.341 l	47	71	14
Pirimicarb	50% w.p.	½ kg	67	73	23
Sulphur	89% w.p.	3 kg	100	80	30
TDE	25% w.p.	2 kg	100	97	27
Tricyclohexyltin hydroxide	50% w.p.	⅜ kg	100	100	10
3 *Moderately Toxic*					
Bromopropylate	30% e.c.	1.135 l	100	90	47
Captafol	80% w.p.	1¼ kg	100	84	38
Carbophenothion	30% w.p.	1 kg	—	97	44
Demeton-methyl	25% e.c.	0.284 l	—	90	67
Dimethoate	40% e.c.	0.227 l	73	100	50
Dinocap	48% e.c.	0.170 l	100	84	65
Dodine	65% w.p.	¾ kg	100	76	37
Endosulfan	48% e.c.	0.85 l	83	94	40
Fenazaflor	20% w.p.	1½ kg	100	97	67
Leptophos	50% w.p.	1 kg	100	70	53
Phosmet	50% w.p.	1½ kg	100	73	37
Thiram	80% w.p.	1½ kg	100	100	60
4 *Relatively Non-toxic*					
Bacillus thuringiensis	85% w.p.	⅜ kg	70	94	86
Benomyl	50% w.p.	½ kg	100	100	97
Binapacryl	50% w.p.	1 kg	—	100	70
Chlordimeform	50% e.c.	0.85 l	100	100	78
Copper oxychloride	50% w.p.	4 kg	100	100	70
Lead arsenate	31% w.p.	4 kg	—	100	70
Menazon	80% w.p.	3/16 kg	—	100	94
Tetradifon	20% w.p.	1 kg	100	100	72
Vamidothion	40% e.c.	0.568 l	100	100	70
5 *Control*					
1.	Water	—	93	93	82
2.	Water	—	77	100	93

*LSD at 5% level for survival rate in Experiment 2 is 0.31.

RESULTS AND DISCUSSION

A summary of the results is presented in Table I. The division of the chemicals into groups is an arbitrary one, but the non-toxic group and the highly toxic group are based on statistical evidence from Experiment 2 only. The former contains those chemicals which do not show a statistical difference from the controls, while the highly

toxic group is significantly different from the controls at the 5% level of probability either at 1 hour (Group 1) or 18 hours (Group 2).

The compounds which were highly toxic to the adult beetles and, in fact, gave nearly instant knockdown were all insecticides and included commonly used materials such as aminocarb, azinphos methyl, carbaryl, diazinon and malathion. The largest group of compounds did not give immediate knockdown of beetles but showed some degree of toxicity 18 hours after treatment.

The group of compounds which were statistically non-toxic to *S. nigripes* included the insecticides *Bacillus thuringiensis*, lead arsenate, menazon and vamidothion, the miticides chlordimeform and tetradifon, and the fungicides benomyl, binapacryl (also a miticide) and copper oxychloride. As a class of compounds the carbamates were highly toxic and the phosphorus compounds contained representatives in each group with systemic materials the least toxic. Miticides appeared to be of intermediate or low toxicity, while as a group the fungicides were the least toxic.

A change in formulation from a wettable powder to an in oil formulation (carbophenothion) or to an emulsifiable concentrate (dicofol) resulted in an increase in toxicity to the adult beetles.

As suggested by Colburn and Asquith (1971) we consider this test to be far more severe than the conditions found in an orchard and the figures given are only the relative toxicities of the chemical to adults of *S. nigripes*. The information, however, can be used to determine the chemicals which could be used in integrated control programmes in orchards. As it is not known what the toxicity of the many mixtures of pesticides used in orchards would be to *Stethorus*, it is hoped to carry out further work on this aspect when another opportunity arises.

Acknowledgements

The authors wish to thank Mr V. L. Paul of ICI Australia Ltd's Central Research Laboratories for carrying out the statistical analysis.

References

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