CONFIRMATION OF A PESTICIDE-RESISTANT STRAIN OF WESTERN FLOWER THRIPS IN NEW ZEALAND

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SUMMARY

The efficacy of nine pesticides for control of two strains of western flower thrips (*Frankliniella occidentalis* (Pergande)) was compared. Mortality of female thrips was assessed after 24 h exposure to leaf discs sprayed, on both sides, with different concentrations of each pesticide. The susceptible "lupin" strain was usually killed by 0.1 times the recommended concentration of pesticides. Low mortality of the "greenhouse" strain occurred at recommended concentrations of acephate, dichlorvos, dimethoate, endosulfan and methomyl, while there was no significant mortality with tau-fluvalinate at 10 times the recommended concentration. Additional bioassays and field trials showed that maldison and methamidophos give good control of the greenhouse strain. Dichlorvos and methiocarb gave some control at the recommended concentration.

Keywords: western flower thrips, pesticide resistance, greenhouse crops

INTRODUCTION

Western flower thrips (*Frankliniella occidentalis* (Pergande), (Thysanoptera: Thripidae)) has been in New Zealand at least since 1934 (Mound and Walker 1982) but caused no problems to crops. It is frequently found on tree lupins (*Lupinus arboreus* Sims) in sand dunes and has been designated the "lupin" strain of western flower thrips. In spring 1992, a grower experienced problems controlling thrips using insecticide in a greenhouse capsicum crop. The thrips were initially identified as *Frankliniella* species. The Ministry of Agriculture and Fisheries surveyed the district and located *Frankliniella* in other greenhouses in Kumeu, Auckland. Specimens were confirmed as western flower thrips (R. Baker, pers. comm.) and were designated the "greenhouse" strain.

This paper describes a laboratory bioassay for comparing the efficacy of pesticides on these strains of thrips. The aim of the tests was to determine if the "greenhouse" strain of western flower thrips was resistant to pesticides, and to see if any pesticides should be field tested.

MATERIALS AND METHODS

The day before each pesticide test fresh lupin flowers and capsicums flowers were collected from Piha and a greenhouse in Kumeu respectively. Both sites were in west Auckland. Adult female thrips only were used for pesticide bioassays. A sample of thrips from each location has been deposited in the National Arthropod Collection.

In the bioassay female thrips were exposed for 24 h to bean leaf-discs sprayed with pesticides and held in sealed containers before mortality was assessed. Three to five dilutions of each pesticide were tested, and discs sprayed with water were used as controls. Each treatment was replicated 10 times.

The pesticides were applied to both sides of bean leaf discs (25 mm diameter) in a Potter's Tower with 2 ml of "solution" at 69 kPa and with 7 second settling time. The surfaces of the leaf discs were allowed to dry and were then placed individually on filter

Proc. 47th N.Z. Plant Protection Conf. 1994: 144-148

paper in the lids of small plastic petri dishes (35 mm internal diameter and 10 mm high). Each lid with a leaf disk was inserted into a plastic collecting bag with flowers and thrips and approximately five female thrips were tapped in. After the lid was closed, it was sealed with Parafilm and held in the laboratory at 22-25°C. The numbers of live and dead thrips were recorded after 24 h. Mortality was assessed as no movement when gently touched.

In 1993, six pesticides were tested at five concentrations (Tables 1 and 2) to compare the susceptibility of the "lupin" and "greenhouse" strains. In the first test, the 10 times recommended concentration was omitted. This concentration was assessed at a later date when the test with dichlorvos was repeated. A further three pesticides were tested at three concentrations in 1994 (Tables 1 and 3).

TABLE 1: The recommended concentration of the pesticides used in the bioassay.

Pesticide		Recommended concentration		Date of test
Common name	Product	g ai/litre	Product/100 litres	
acephate	Orthene 75	0.075	100 g	2 Mar 1993
avamectin	Avid (0.4%)	0.0012	30 ml	24 Mar 1993
chlorpyrifos	Lorsban 40 EC	0.4	100 ml	24 Mar 1993
dichlorvos	Dichlorvos 100E	1	100 ml	17 Mar 1993
dimethoate	Rogor 20W	0.32	160 g	16 Mar 1993
endosulfan	Thiodan 35EC	0.71	200 ml	16 Mar 1993
maldison	Malathion 50	1	200 ml	24 Mar 1993
methamidophos	Tamaron	0.9	150 ml	15 Feb 1994
methiocarb	Mesurol	0.75	100 g	15 Feb 1994
methomyl	Lannate L	0.24	120 ml	2 Mar 1993
omethoate	Folimat	0.575	100 ml	15 Feb 1994
pyrazophos	Afugan 30 EC	0.15	50 ml	24 Mar 1993
tau-fluvalinate	Mavrik Aquaflow	0.96	40 ml	9 Mar 1993

The "greenhouse" strain only was tested against four additional pesticides and dichlorvos for comparison as a standard. These pesticides (Tables 1 and 4) represented other pesticide groups or other pesticides that recent overseas reports had recommended for good control of western flower thrips.

For comparison between treatments a χ^2 value was calculated for pairs of treatments at each of several concentrations for each strain. The expected values were based on a maximum likelihood fit to the data at that concentration plus appropriate control data assuming separate control mortalities and common treatment mortality.

For comparison between strains the two strains were compared similarly at each of several concentrations for each treatment, generating a χ^2 for each pesticide concentration.

RESULTS

The "greenhouse" strain was more resistant than the "lupin" strain to all of the pesticides tested (Tables 2 and 3). For the pesticides tested in March 1993, 0.1 and 1 times the recommended concentrations for all pesticides caused higher mortality ($P<0.01$) in the "lupin" strain than in the "greenhouse" strain (Table 2). Higher mortality ($P<0.01$) of the "lupin" strain also occurred at 0.01 times the recommended concentration of acephate and dimethoate and at 10 times the recommended concentration of acephate and tau-fluvalinate. For the pesticides tested in February 1994, mortality was greater ($P<0.01$) in the "lupin" strain than the "greenhouse" strain at 0.1 and 1 times the recommended concentrations for methiocarb and omethoate (Table 3).

TABLE 2: Percentage mortality of the "greenhouse" and "lupin" strains of western flower thrips 24 h after exposure to sprayed leaf discs. March 1993 bioassays. The total number of thrips per treatment varied from 39 to 111.

Pesticide	Thrips strain[2]	Concentration of pesticide (times the r2`ecommended concentration[1]) Control	0.001	0.01	0.1	1	10	Second control[3]
acephate	g	3	6	0	2	2	30	3
	l	5	13	73	100	100	100	1
dichlorvos	g	1	4	0	1	42	100	
	l	3	5	14	100	100	100	
dimethoate	g	1	4	0	2	6	77	
	l	3	5	36	79	99	100	
endosulfan	g	3	0	0	4	10	69	
	l	17	8	8	56	100	100	
methomyl	g	2	0	8	0	4	81	3
	l	0	17	20	94	96	100	1
tau-fluvalinate	g	5	6	1	0	0	1	
	l	7	3	22	95	100	100	

[1] See Table 1 for recommended concentration of each pesticide.
[2] g = "greenhouse" strain, l = "lupin" strain
[3] The second control was used for the 10 times treatment only

TABLE 3: Percentage mortality of the "greenhouse" and "lupin" strains of western flower thrips 24 h after exposure to sprayed leaf discs. February 1994 bioassays. The total number of thrips per treatment varied from 65 to 149.

Pesticide	Thrips strain[2]	Concentration of pesticide (times the recommended concentration[1]) Control	0.1	1	10
methamidophos	g	11	30	88	99
	l	59	100	100	100
methiocarb	g	4	3	50	81
	l	10	97	100	100
omethoate	g	3	4	10	96
	l	12	100	100	100

[1] See Table 1 for recommended concentration of each pesticide.
[2] g = "greenhouse" strain, l = "lupin" strain

For the "lupin" strain, there were no differences ($P<0.05$) in susceptibility to the different pesticides at the concentrations of pesticide compared statistically. These were 1 and 10, and 0.1, 1 and 10 times recommended concentration in the 1993 and 1994 bioassays, respectively.

There were differences in susceptibility of the "greenhouse" strain to different pesticides (Tables 2-4). In the first 1993 bioassay (Table 2), dichlorvos caused higher ($P<0.01$) mortality than the other pesticides at the recommended concentration and higher mortality than acephate and tau-fluvalinate at 10 times the recommended concentration. At 10 times the recommended concentration, acephate and tau-

fluvalinate caused less mortality ($P<0.01$) than the other pesticides. In the second 1993 bioassay (Table 4), maldison caused higher mortality ($P<0.01$) than the other pesticides at the recommended concentration. At 10 times concentration, mortality caused by dichlorvos and maldison was similar, and greater than that from the other pesticides ($P<0.01$). All pesticides caused higher mortality than pyrazofos ($P<0.05$). The three pesticides, methamidophos, methiocarb and omethoate which were tested in February 1994, all caused different ($P<0.01$) levels of mortality at the recommended concentration (Table 3).

TABLE 4: Percentage mortality (and numbers tested) of the "greenhouse" strain of western flower thrips 24 h after exposure to sprayed leaf discs. March 1993 bioassays.

Pesticide	Concentration of pesticide (times the recommended concentration[1]) Control	0.1	1	10
avamectin	0 (92)	0 (82)	1 (69)	33 (83)
chlorpyrifos	10 (69)	1 (75)	1 (76)	43 (93)
dichlorvos	3 (87)	3 (94)	23 (101)	100 (92)
maldison	0 (79)	1 (75)	82 (88)	100 (93)
pyrazophos	1 (93)	1 (70)	0 (86)	0 (86)

[1] See Table 1 for recommended concentration of each pesticide.

DISCUSSION

The bioassay used in this study demonstrated that the "greenhouse" strain of western flower thrips was far more resistant to pesticides than the "lupin" strain. Together with differences in colour (Martin, unpublished observations) and host preference (Mound and Walker 1982; Martin, unpublished observations), the evidence from the bioassays supports the view that the "greenhouse" strain was a recent arrival in New Zealand. While it may be argued that a population could have become resistant to pesticides in New Zealand, it is unlikely that a population would have become resistant to such a diverse group of pesticides at once (Tables 2 and 3). The bioassay enabled effective pesticides to be identified and provided a measure of the levels of pesticide resistance through a comparison with a susceptible standard. The differences in susceptibility to pesticides of the "greenhouse" strain in the bioassays has also been observed by growers. They have achieved some control with dichlorvos and good control with maldison and methamidophos.

The bioassay probably under-estimated the efficacy of pesticides when they are used in the greenhouse because the thrips did not spend all their time on the treated leaf surface and the tests only lasted 24 h. A positive aspect of the bioassay was that minimal handling of the insects is involved, but it could be improved by using a more robust plant leaf and by not spraying both sides of the leaf discs. The use of a water control before each set of pesticide treatments was an essential check for contamination by pesticides (Table 3).

In an alternative bioassay, Helyer and Brobyn (1992) immersed thrips larvae in solutions of pesticide before caging them for 72 h on pesticide-treated leaf discs embedded on agar, and results obtained were similar to those presented here. They also found differences in susceptibility amongst strains in England. However, while European data can provide a guide, screening pesticides and monitoring their effec-

tiveness against western flower thrips must be carried out with New Zealand strains of the insect.

ACKNOWLEDGEMENTS

MAF Regulatory Authority gave financial assistance, and Bayer New Zealand gave financial assistance and permission to use data on their products. Dr Rod Ball carried out statistical analyses.

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