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Biology and control of western flower thrips on chrysanthemums

PC 18 b

Chrysanthemums: Western Flower
Thrips biology and chemical control

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AUTHENTICATION

I declare that this work was done under my supervision according to the procedures described herein and that this report represents a true and accurate record of the results obtained.

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Summary

Trials and observations were made on a crop of natural season chrysanthemums cv Yellow Fred Shoesmith No 3 artificially infested with Western Flower Thrips - WFT (Franklinella occidentalis) in an experimental glasshouse at Reading. Programmes of insecticide sprays were applied either to prevent or to control attacks of WFT. The merits of two insecticides, endosulfan and deltamethrin applied either separately or in combination were also compared. Observations were made to assess which parts of the crop WFT preferred and where it pupated.

Insecticides used as preventive treatments were applied one day before WFT was introduced into the crop and 14 days later. Sprays of deltamethrin were slightly more effective than ones of either abamectin or pyrazophos; those of endosulfan were least effective.

None of the treatments used to control established infestations of WFT was particularly effective when applied three times at 14 day intervals. Dichlorvos was slightly more effective than pyrazophos, which in turn was slightly more effective than 'Savona'.

A tank-mix of deltamethrin and endosulfan was no more effective than sprays of each insecticide applied individually.

In chrysanthemums most WFT appeared to pupate in the flowers and not in the soil. More active stages (adults and nymphs) were found in flowers, particularly the primary and secondary blooms, rather than on the leaves. The value of soil-applied insecticides in chrysanthemum houses is therefore perhaps questionable, but plants in flower might be useful as 'trap crops' to attract WFT from plants at earlier stages of development.

Introduction

Western flower thrips WFT (Frankliniella occidentalis) is a North American species which has spread internationally since about 1980. Although it is now widespread in the UK it is still deemed to be a non-indigenous species, and so is subject to statutory control wherever an outbreak occurs.

It can attack most of the protected crops grown in the UK and can transmit virus diseases (eg tomato spotted wilt virus - TSWV) and it can survive outdoors. It therefore poses a serious threat to the protected crops industry and more information about the biology and control of this pest is urgently needed. The main objectives of this study, most of which were funded by the HDC, were:-

i. to assess the efficacy of pre-planting foliar sprays of abamectin, deltamethrin, endosulfan or pyrazophos used as a preventative measure against WFT.

ii. to compare the efficacy of dichlorvos, 'Savona' and pyrazophos for the control of established infestations of WFT.

iii. to evaluate the efficacy of a tank mix of deltamethrin and endosulfan against WFT compared with applications of each insecticide separately.

iv. to study the pupation of WFT in soil under a crop of natural season chrysanths in comparison with similar studies in pot chrysanthemums (CSG - funded).

v. to examine the distribution of WFT within a crop of natural season chrysanthemums.

Materials and methods

Site

All experiments were done on a crop of natural season chrysanthemums (cv Yellow Fred Shoesmith No3) grown in a glasshouse at Coley Park, Reading. The crop was planted on 12 August 1987 and WFT were introduced from a stock culture, maintained on dwarf French bean plants, approximately one month later on 8 September. All doors and vents in the glasshouse were sealed with a fine mesh net curtain material to minimise the risk of thrips escaping.

Design

The glasshouse was divided into three compartments each consisting of four beds of chrysanthemums. An individual bed of chrysanthemums was used as the experimental unit.

Treatments

The insecticides used in each experiment and the rates at which they were applied are given in the relevant experimental section. All were applied to run off with a Fox Motori motorised knapsack sprayer, although the pressure and boom attachment varied between experiments.

Assessments

The numbers of adult and immature WFT were assessed by beating three randomly chosen plants per bed over a white tray (430 x 330 mm) (except in the experiment to evaluate the efficacy of a deltamethrin/endosulfan where ten flower heads were used).

Experiment 1: To assess the efficacy of foliar sprays used to prevent attack of WFT

Introduction

Where WFT is common growers are likely to want to apply insecticides to prevent infestations developing. The effectiveness of four insecticides used this way was assessed.

Materials and Methods

The insecticides and the rates used are given in Table 1. Each insecticide was applied twice, the first one day before the thrips were introduced, the second two weeks later. The sprays were applied with a 1.0 m boom at a pressure of 40 psi.

Table 1. Insecticides used to prevent infestation of WFT

Insecticide	Trade Name	Amount of a.i. in product g/l or g/kg	Rate (ml/l water)
Pyrazophos	Afugan	300	1.50
Deltamethrin	Decis	25	0.70
Abamectin	Dynamec	18	0.25
Endosulfan	Thiodan	350	2.00

Forty dwarf French bean plants (Vicia fabae cv The prince) infested with WFT were used to infest the glasshouse artificially. These were cut up and distributed evenly between all compartments. Approximately 2000 WFT were introduced.

The number of thrips present in each bed was assessed on three occasions, ten days after the application of the first sprays and one and 12 days after the second sprays were applied.

Results

The numbers of thrips present on each occasion are given in Table 2.

Table 2. The effect of four foliar sprays on WFT on three sampling occasions

Treatment	Mean number thrips/plant								
	Sampling 1			Sampling 2			Sampling 3		
	Adult	Immature	Total	Adult	Immature	Total	Adult	Immature	Total
Abamectin	0.2	0.2	0.4	0.6	0	0.6	0	0.4	0.4
Deltamethrin	0.2	0.2	0.4	0	0.6	0.6	0	0.2	0.2
Endosulfan	0.2	0.2	0.4	0.4	0.2	0.6	0	1.6	1.6
Pyrazophos	0.2	0	0.2	0	0.2	0.2	0	0.6	0.6

Sampling 1 was made after the first spray treatments
Sampling 2 and 3 were made after the second spray treatments.

Conclusion

In general the number of thrips present in each treatment was low throughout the experimental period. However deltamethrin, abamectin and pyrazophos all kept thrips numbers below one per plant. Indeed on the last sampling occasion only 0.2 thrips/plant were recorded in the deltamethrin treated plot.

Experiment 2: To assess the efficacy of foliar sprays applied to control an established infestation of WFT.

Introduction

Established infestations of WFT have to be controlled as quickly as possible to limit damage to the crop and to avoid the pest spreading. This experiment was designed to compare the effectiveness of three insecticides to control an established infestation of WFT.

Materials and methods

The insecticides and the rates used are given in Table 3. Each was allocated to an individual glasshouse compartment and applied to all four beds within that compartment. Three applications of each treatment were made at 14 day intervals. All sprays were applied with a single 00 classification nozzle and a spray lance at a pressure of 80 psi.

The numbers of WFT present in each bed were assessed seven times, once the day before the first sprays were applied and 1-3 and 8-12 days after each application.

Table 3. Insecticides used to control established infestations of WFT

Trade Name	Insecticides	Amount a.i. in product	Rate (ml product/l water
Afugan	Pyrazophos	300 g/l	1.5
Dichlorvos	Dichlorvos	500 g/l	1.0
'Savona'	Organic fatty acids	-	10.0

Results

Because the numbers of WFT in each bed varied considerably (Table 4), the number of WFT present after treatment was expressed as the percentage of

the numbers present initially. These values are shown in Figures 1-3.

Table 4. Mean numbers of thrips per plant both before and after application of dichlorvos, pyrazophos and 'Savona'. (Three applications of each pesticide were made on days 0, 14 and 29.)

Days before /after treatment	Mean number thrips/plants Pesticide treatment								
	Dichlorvos			Pyrazophos			'Savona'		
	Adult	Immature	Total	Adult	Immature	Total	Adult	Immature	Total
Pre-treatment	0.2	2.2	2.4	1.1	4.3	5.3	1.1	11.2	12.3
3	0.4	4.2	4.6	0.2	8.2	8.4	0.5	22.8	23.3
12	0.3	0.8	1.1	0.7	6.6	7.3	1.5	15.3	16.8
15	0	1.0	1.0	0.1	3.5	3.6	0.8	17.4	18.2
25	0.3	1.4	1.7	0.8	5.3	6.1	1.1	9.3	10.4
32	0.2	1.7	1.9	3.4	1.0	4.4	1.9	15.5	17.4
36	2.4	0.3	2.7	6.6	1.8	8.4	3.4	10.9	14.3

Total thrips: More WFT were recovered in all plots three days after the first application of insecticides than were present initially (Figure 1). Subsequently numbers decreased and this was most obvious in plants treated with dichlorvos. Once the second applications had been made the effect of different insecticides on thrips numbers varied. Dichlorvos kept numbers below the pre-treatment level until the last assessment. However the numbers present generally increased from one day after the second spray was applied until the end of the experiment.

The numbers of WFT on plants treated with pyrazophos declined below the pre-treatment level after the application of the second and third sprays, but they soon recovered.

The reverse seemed to happen in the plots treated with 'Savona' where the numbers of thrips initially increased but then decreased after both the second and third applications.

Figure 1. EFFECT OF SPRAYS OF INSECTICIDES USED TO CONTROL AN EXISTING INFESTATION OF WFT: TOTAL NUMBERS OF WFT

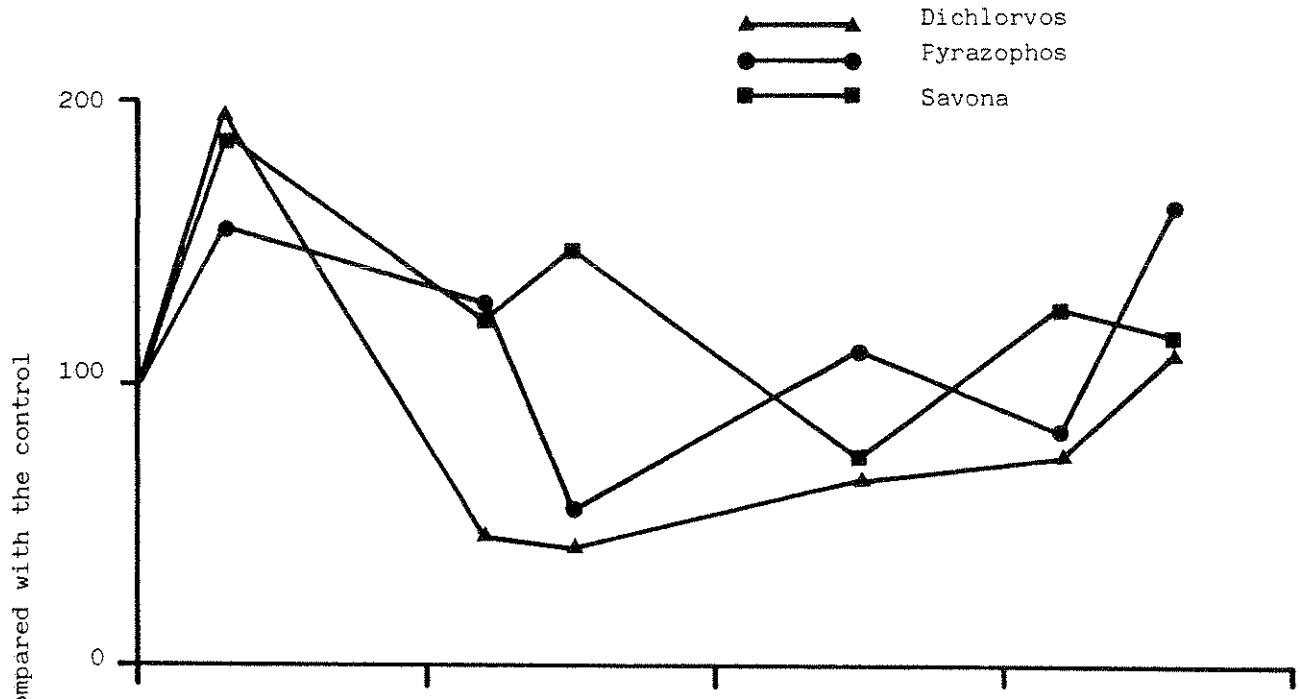


Figure 2. EFFECT OF SPRAYS ON INSECTICIDES USED TO CONTROL AN EXISTING INFESTATION OF WFT: NUMBERS OF ADULT WFT

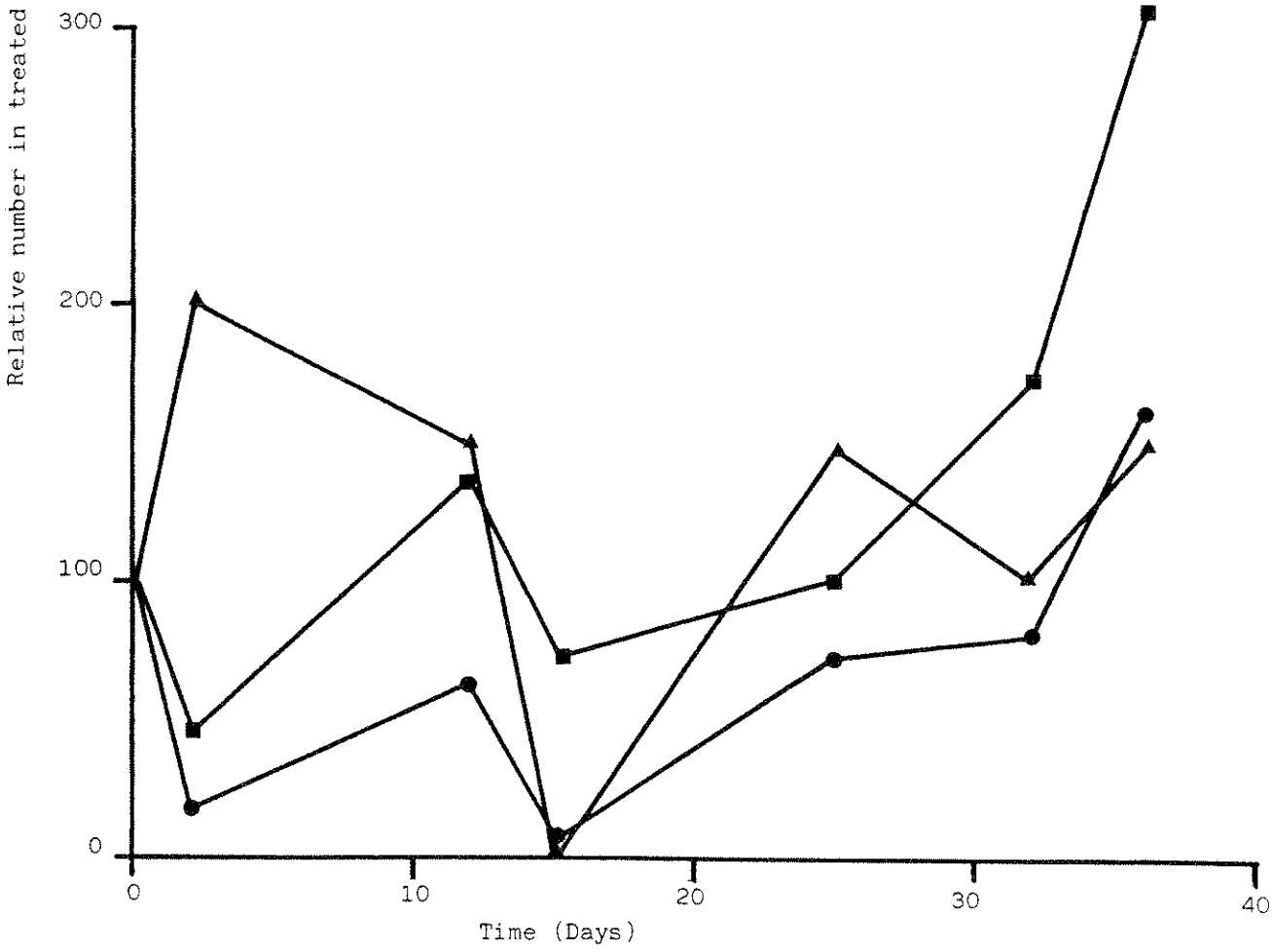
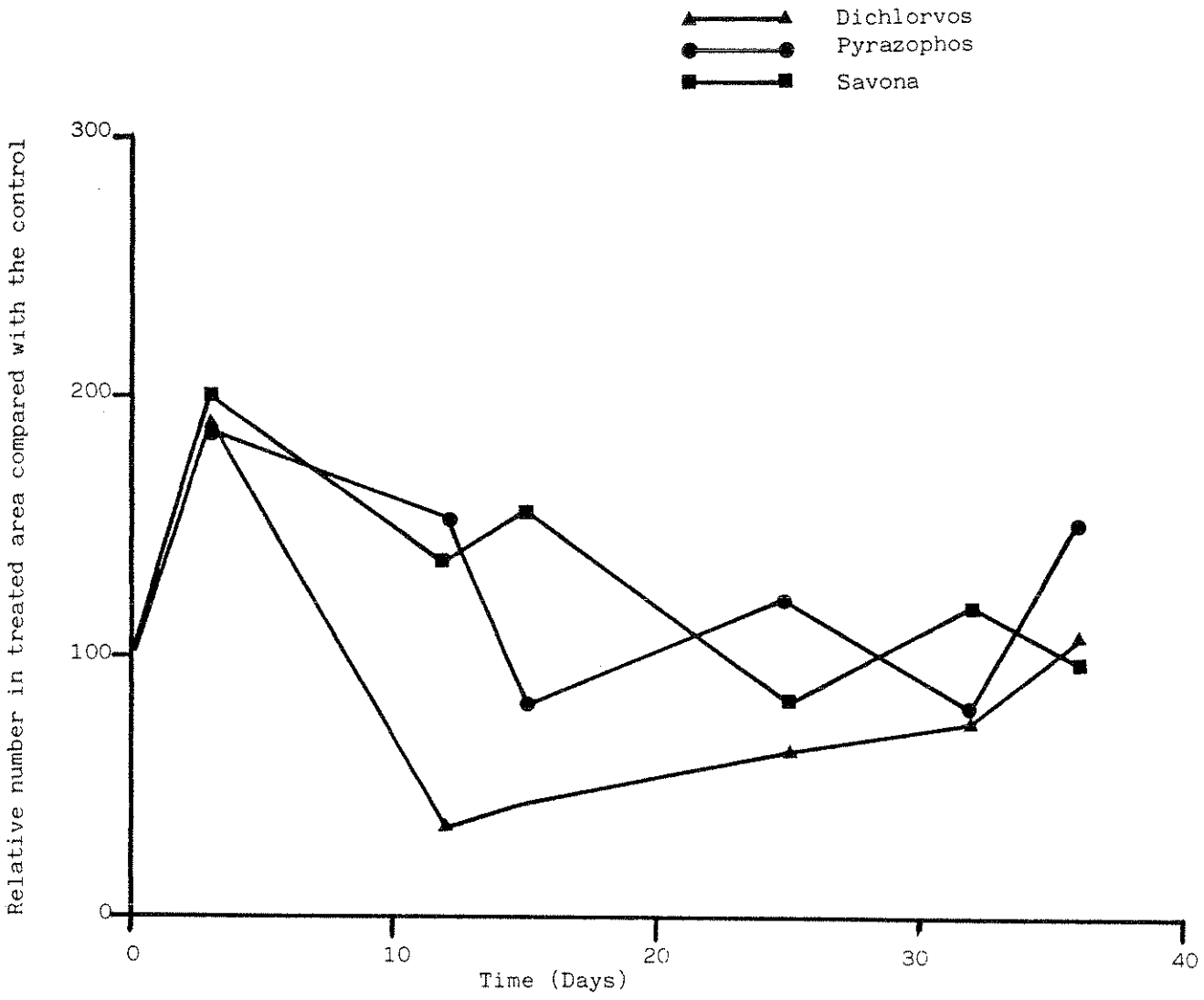


Figure 3. EFFECT OF SPRAYS OF INSECTICIDES USED TO CONTROL AN EXISTING INFESTATION OF WFT: NUMBERS OF IMMATURE WFT



Adult thrips: Smaller numbers of adult WFT were generally recovered immediately after spraying although the trend was for numbers to increase during the course of the experiment. Dichlorvos and pyrazophos were (with one exception) appreciably more effective than 'Savona'.

Immature thrips: The effect of all insecticides on immature thrips was very similar to that on total thrips (Figure 3) as far more immature thrips than adults were recovered from chrysanthemum plants.

Conclusion

In general the poor level of control achieved by each insecticide was probably because the interval of 14 days between treatments was too long. Subsequent work at ADAS Entomology Department Leeds showed that pyrazophos gave good control of WFT on cucumbers when applied at 4-5 day intervals.

Experiment 3: To assess the efficacy against WFT of deltamethrin and endosulfan applied together compared with individual sprays of both insecticides.

Introduction

Information from a commercial grower suggested that a tank-mix of endosulfan and deltamethrin (Thiodan and Decis) was particularly effective at controlling WFT. This finding was tested in the following experiment by comparing the mixture with separate applications of each insecticide.

Materials and methods

The insecticides and the rates used are given in Table 5. Three insecticide treatments were used, deltamethrin, endosulfan and a tank-mix of the two. Each treatment was applied in a single compartment of the glasshouse, each consisting of four replicated experimental beds. Only one application of each treatment was made. All sprays were applied with a single 00 classification nozzle and a spray lance at a pressure of 80 psi.

Table 5. Insecticides, active ingredients (a.i.) and dose rates

Insecticide	Trade Name	Formulation	Rate (ml product/l water)
Deltamethrin	Decis	25	0.7
Endosulfan	Thiodan	350	2.0

The numbers of thrips in each bed were assessed on four occasions, before treatment and 24, 48 and 120 hours after the sprays were applied.

Figure 4. EFFECT OF INDIVIDUAL SPRAYS OR TANK-MIXES OF INSECTICIDES TO CONTROL WFT: TOTAL NUMBER OF WFT

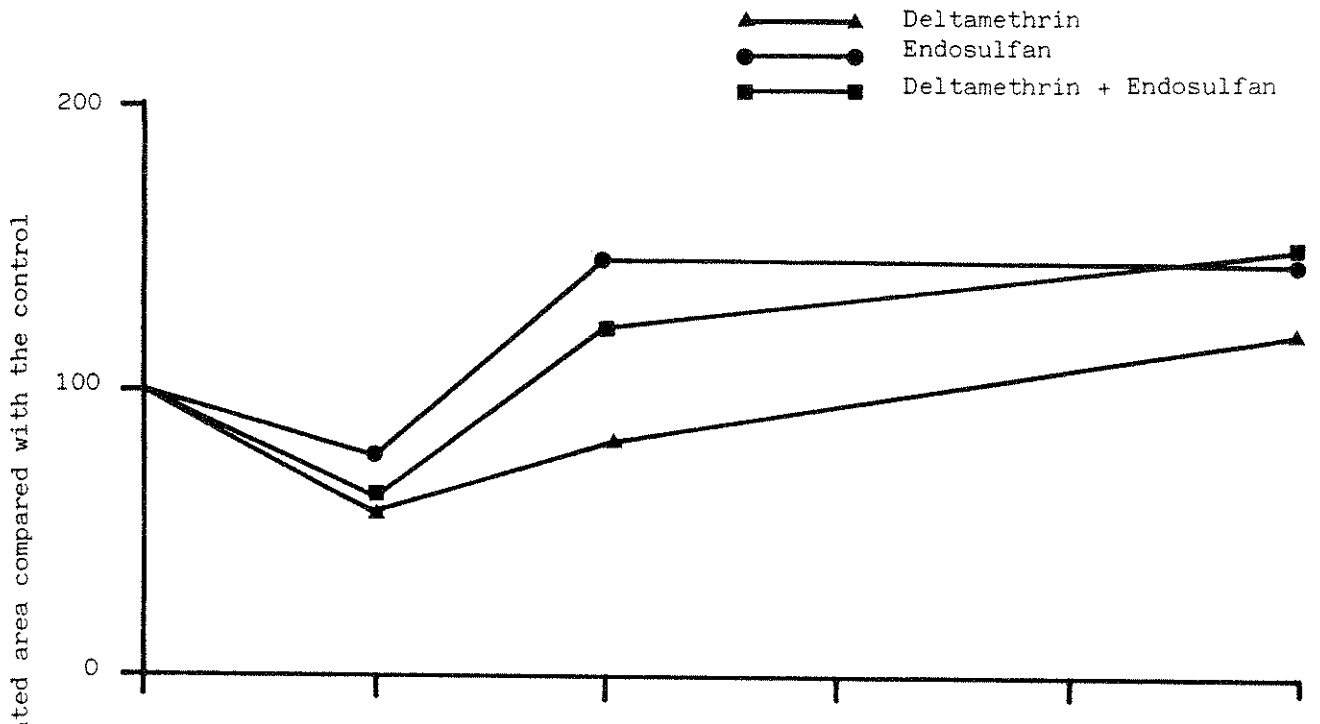


Figure 5. EFFECT OF INDIVIDUAL SPRAYS OR TANK-MIXES OF INSECTICIDES TO CONTROL WFT: NUMBERS OF ADULT WFT

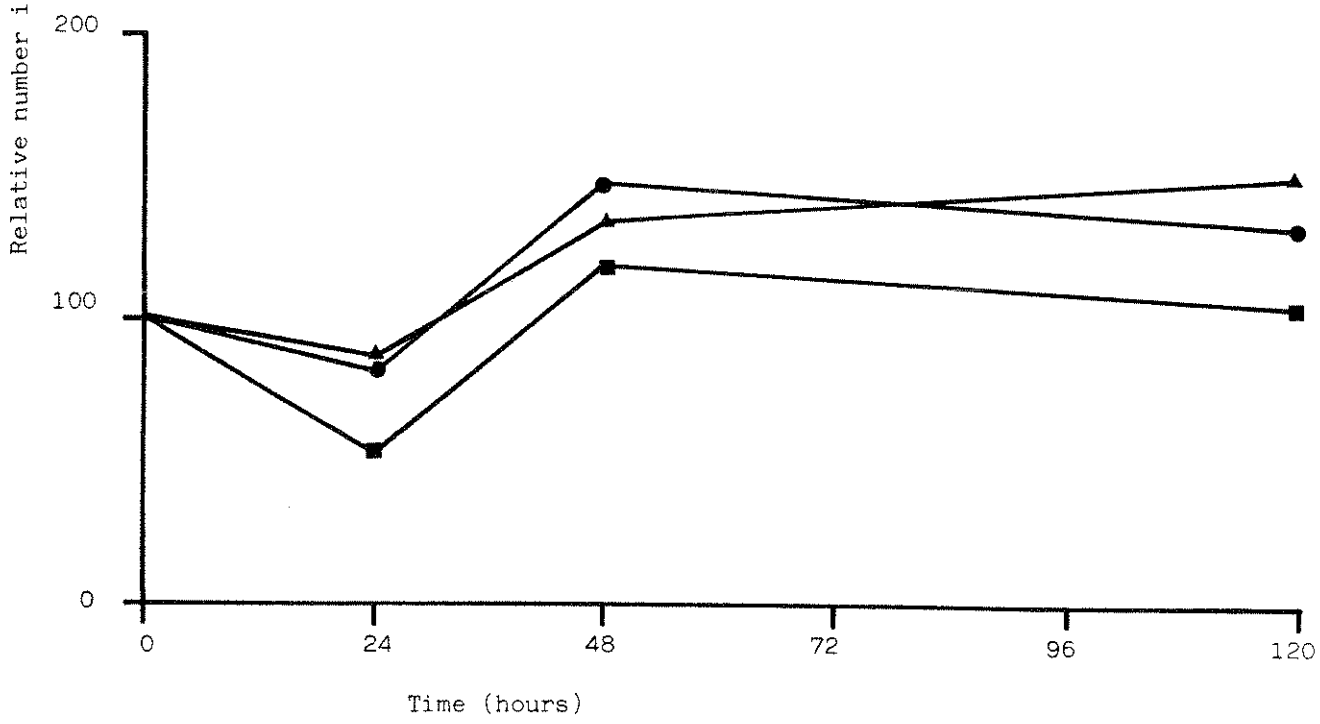
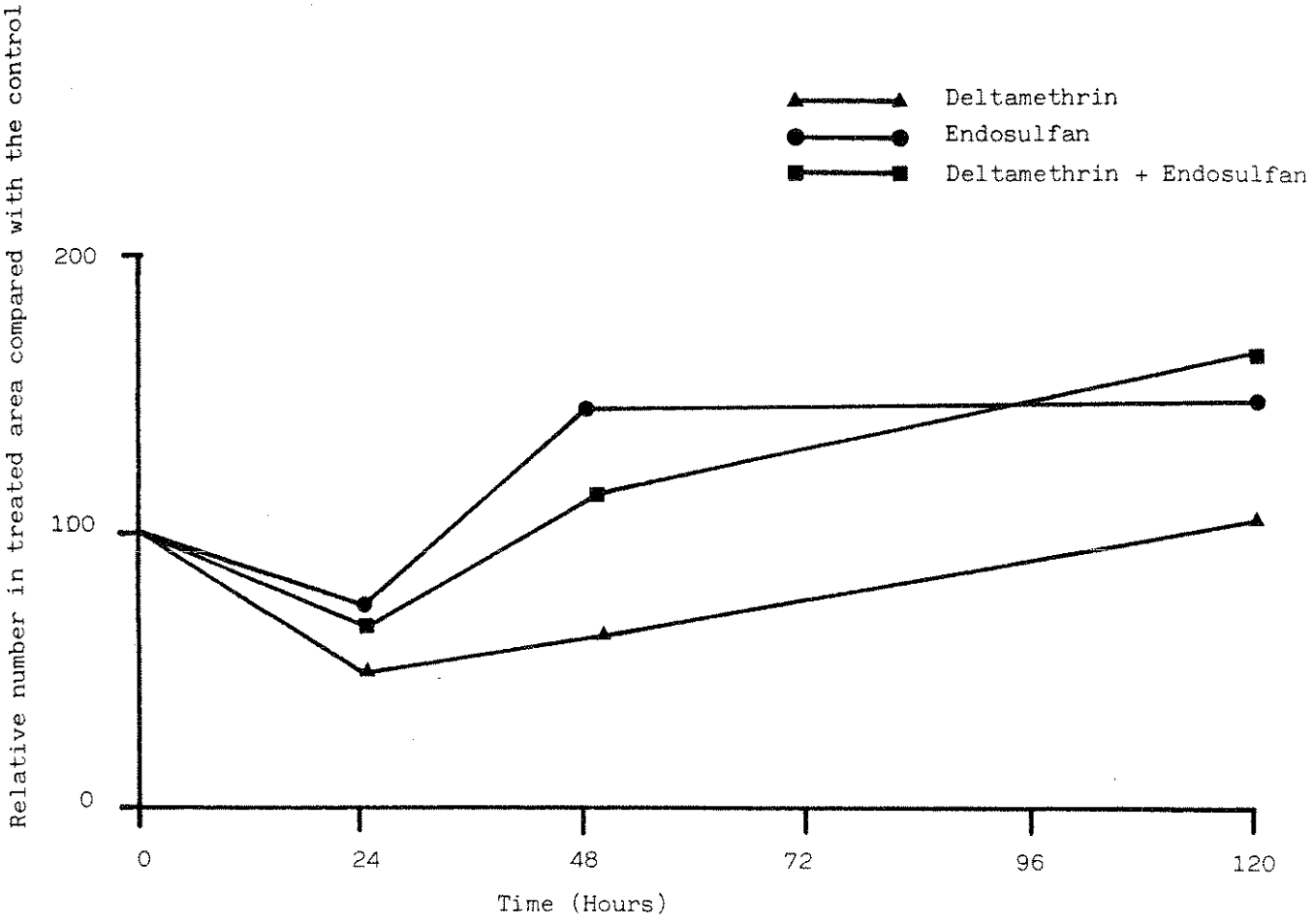


Figure 6. EFFECT OF INDIVIDUAL SPRAYS OR TANK-MIXES OF INSECTICIDES TO CONTROL WFT: NUMBERS OF IMMATURE WFT



Results

All treatments had a similar effect on the numbers of WFT recovered (Figures 4-6 and Table 6). Numbers dropped 24 hours after treatment, but then appeared to recover to levels slightly higher than those present initially.

Deltamethrin alone appeared to give marginally better control than deltamethrin plus endosulfan.

Table 6 Mean numbers of thrips per plant both before and after application of deltamethrin, endosulfan and a combination of both insecticides

	Mean number thrips/plants								
	Pesticide treatment								
							Deltamethrin +		
Hours before /after treatment	Deltamethrin			Endosulfan			Endosulfan		
	Adult	Immature	Total	Adult	Immature	Total	Adult	Immature	Total
Pre-treatment	0.8	2.0	2.8	3.4	5.9	9.3	3.1	8.2	11.3
24	0.7	1.0	1.7	2.8	4.4	7.2	1.8	5.4	7.2
48	1.1	1.3	2.4	5.0	8.8	13.8	3.8	9.4	13.2
120	1.2	2.2	3.3	4.5	8.9	13.4	3.2	13.8	17.0

Conclusion

The combined treatment of deltamethrin and endosulfan was no more effective than a spray of deltamethrin.

Experiment 4: Studies on the site of pupation of WFT in a crop of natural season chrysanthemems

Introduction

Conventionally WFT pupates in soil, but it need not do so if/when it feeds on plants that themselves provide sites in which it can pupate. When most of the insects pupate in soil, chemical or physical treatments applied to the soil can be highly effective. They would be almost useless, however, if most of the insects pupated on the plant, eg in the flowers. Observations were therefore made on chrysanthemums to see what proportion of the population pupated on the crop and in the soil.

Materials and Methods

The numbers of thrips pupating in the soil were assessed in two ways. Either the soil under an infested crop was removed and any adults that emerged were caught or adults were caught in situ as they emerged.

1. Soil removal: Soil from an area of 135 x 350 mm was removed to a depth of 25 mm from each of all twelve beds in the glasshouse. The soil was placed in an opaque, plastic tray and the tray covered and made insect proof with a sheet of polythene coated on its inside with Thripstick. These trays were maintained in the glasshouse for two weeks.

2. Trapping in situ: Twelve wooden tomato boxes (385 x 292 mm) were adapted to provide traps. The bottoms were removed and their corner supports sawn off so that they would lie level with the soil surface. The bottoms were replaced with polythene sheet again coated on the inside with Thripstick. One trap was then placed over the soil in each of the 12 beds and was left in position for two weeks.

After two weeks in position the polythene was removed from both the traps and the trays of soil and the numbers of adult WFT were counted.

Results

Numbers of adult WFT caught were converted to numbers per 12.7 x 12.7 mm (0.0161 m^2), the area occupied by each plant. These figures could then be compared directly with the numbers of thrips per plant when the traps were first put in position.

It was assumed that all the immature thrips found in the flowers would pupate either in the flowers or in the soil. The number pupating in the soil was assumed to be equal to the number of adults caught emerging from the soil and so the proportion of individuals pupating in the soil was equivalent to:

$$\frac{\text{Number of adults emerging from soil}}{\text{Number of immatures in flowers}}$$

This value was calculated for each of the twelve experimental beds and the data are given in Table 6.

Table 7 Number of adult thrips caught emerging from pupae in the soil in two types of trap and the porportion of thrips pupating in flowers and in the soil.

	Trap type									
	Soil removal					Trapping in situ				
			Mean	% pupation				Mean	% pupation	
Bed	Number adults caught	Equivalent number adults/ plant	number immature thrips/ plant	Soil	Flower	Number adults caught	Equivalent number adults/ plant	number immature thrips/ plant	Soil	Flower
1	12	4.1	12.0	34	66	19	2.7	12.0	23	77
2	4	1.4	11.6	12	88	14	2.0	11.6	17	83
3	0	0	4.0	0	100	3	0.4	4.0	10	90
4	2	0.7	7.9	9	91	5	0.7	7.9	9	91
5	3	1.0	18.4	5	95	0	0	18.4	0	100
6	0	0	23.3	0	100	1	0.1	23.3	1	99
7	0	0	8.4	0	100	3	0.4	8.4	5	95
8	0	0	4.9	0	100	1	0.1	4.9	2	98
9	5	1.7	2.1	81	9	3	0.4	2.1	19	81
10	2	0.7	3.7	19	81	1	0.1	3.7	3	97
11	1	0.3	1.5	20	80	0	0	1.5	0	100
12	0	0	1.3	0	100	0	0	1.3	0	100
Mean				15	85				7	93

Conclusions

The results suggest that few individuals pupate in the soil. This is perhaps not surprising as the dense flower head of the chrysanthemum would give considerable protection to the pupae. As a result there would appear to be little benefit from using "Thripstick" under a crop with dense flowers which form ideal sites in which thrips can pupate.

Experiment 5: To investigate the distribution of WFT in a crop of natural season chrysanthemums

Introduction

Most thrips on chrysanthemums are found on the flowers. There is however little information about the proportions of the population present on flowers and on foliage. A simple study was designed to examine the distribution of WFT on natural season chrysanthemums.

Materials and Methods

Ten chrysanthemum plants were sampled from the same bed in the experimental glasshouse. Each flower was removed separately, starting at the top of the plant. Each was beaten 20 times over a white tray to shake out any WFT present. The stem of each plant was also divided into the "top half" and the "bottom half" and these were again beaten 20 times over a white tray.

Results

The number of thrips recovered from the flowers and stems of chrysanthemum plants is shown in Table 8.

Table 8 Number of thrips recovered from the flowers and stems of natural season chrysanthemum plants

Consecutive flower number	Number of thrips per flower		
	Adult	Immature	Total
1	4.9	4.9	9.8
2	2.2	2.8	5.0
3	3.0	2.7	5.7
4	1.5	1.7	3.2
5	1.2	0.8	2.0
6	1.3	1.3	2.6
7	2.2	1.8	4.0
8	1.5	1.8	3.3
9	1.3	2.0	3.3
10	0	1.0	1.0
Total	19.1	20.8	39.9
Top half of stem	0.4	0.2	0.6
Bottom half of stem	0.3	0.2	0.5
Total	0.7	0.4	1.1

Conclusion

Most thrips (97%) were recovered from the flowers, with few (3%) from the stems and leaves. Generally fewer thrips were present in the lower, and younger flowers than in the upper, older ones.

General Conclusion

The results from the chemical control studies were disappointing as none of the insecticides appeared to give consistently good control of WFT. Deltamethrin may be effective as a preventative spray but because the numbers of thrips present in the study were low the results need to be treated with caution. The insecticides used to control established infestations of WFT gave some control. The period between sprays (two weeks) was however too short for any worthwhile reduction in the numbers of thrips.

Studies of the biology of WFT suggested that in natural season chrysanthemums most thrips pupate in the flowers. More information is needed about the proportions of WFT that pupate on other crops rather than in soil and whether this is influenced mainly by the morphology of the plant. If this varies control measures might have to be modified for different crops. In chrysanthemums for example, where most thrips (active stages and pupae) are found in the flowers, ideally non-phytotoxic insecticides that will not damage the flowers, are needed.