Pot and Bedding Plants: Crop Safety and Control of Western Flower Thrips with Dichlorvos Fogs

CONTRACT REPORT

CONTRACT NUMBER - PC/18g

AGRICULTURAL DEVELOPMENT AND ADVISORY SERVICE

Report to;	Dr J.T. Braunholtz Scientific Adviser Horticultural Development Council 18 Lavant Street Petersfield Hants GU32 3EW
ADAS Contract Manager:	Dr M. Saynor ADAS Bridgets (Reading) Block A Coley Park Reading RG1 6DE Tel: 0734 581222 ext 3321
Period of investigation:	April to June, 1992
Date of issue of report:	September, 1992
No of pages in report:	16

COMMERCIAL - IN CONFIDENCE

Principal Workers

M Saynor PhD	Senior Consultant, Contract Manager and Author of the Report
Mr J N Oakley BSc	Team Leader
Miss C Sutherland	Sandwich Course Student

Authentication

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

.....Michael Saynor.....

M Saynor BSc PhD
(Contract Manager)

Date 18 September 1992

Report authorised by .....J N Oakley.....

J N Oakley
Team Leader
ADAS, Bridgets (Reading)

CONTENTS

POT AND BEDDING PLANTS: CROP SAFETY AND CONTROL OF WESTERN FLOWER THRIPS WITH DICHLORVOS FOGS

Summary

The effects of dichlorvos fogs on pot and bedding plants and on the control of western flower thrips (WFT) (*Franklinella occidentalis*) were investigated by ADAS in an HDC-commissioned trial in 1991. Two aspects of that trial that required further study, the effects of very low rates of dichlorvos and of short times of exposure to it, were investigated in 1992. In this trial crop damage (phytotoxicity) was assessed on mature plants of the three most sensitive species identified in 1991 (*Begonia semperflorens*, impatiens and pansy). The effectiveness of the treatments against WFT was assessed on impatiens and verbena, two of the best hosts of the pest, that were deliberately infested for the purpose.

Exposure to even the lowest rates of dichlorvos fog (0.25 and 0.5 litres per hectare) for short periods (0.5, 1.0 or 2 hours) damaged *B. semperflorens* slightly and pansy seriously. Apart from slight flecking on open flowers, impatiens were not affected by dichlorvos at 0.25 or 0.5 litres per hectare, although it caused some damage (chlorosis of the leaves) at 1.0 litres per hectare.

Damage on impatiens and particularly pansy was appreciably was worse after two applications of each treatment, than it was after one. Only on impatiens did the amount of damage appear to increase the longer the interval between treatment and ventilating the glasshouse afterwards.

Large but variable numbers of WFT were present on both verbena and impatiens. Most were found in those plants with the largest numbers of flowers, regardless of species.

Significantly fewer ($p=<0.001$) adult and immature WFT were present on "fogged plants" (mean of the three rates of dichlorvos used) after both applications of dichlorvos fog. More adults and larvae survived fogging at 0.25 than at 0.5 or 1.0 litres dichlorvos per hectare. Inexplicably however, more thrips particularly larvae, were often present on plants

fogged at 1.0 than at 0.5 litres per hectare. The interval, 0.5, 1 or 2 hours, between fogging and when the glasshouses were ventilated, did not affect the degree of control of thrips achieved.

The relevance to growers of the results obtained from this trial and an earlier trial are discussed.

Introduction

Dichlorvos is probably the most effective insecticide approved in the UK for the control of WFT. Unfortunately it damages (is "phytotoxic" to) many species, although the effects are less serious when the insecticide is applied as a fog, rather than as a spray.

In 1991 the HDC commissioned ADAS to assess the tolerance to dichlorvos fogs on a wide range of pot and bedding plants and to assess how well the insecticide controlled WFT. That trial identified a number of areas that warranted further study and two of these, the effects of very low rates of dichlorvos and of short periods of exposure to them, were investigated in this trial.

Objectives

To evaluate both the crop safety and its effectiveness against WFT of low rates of dichlorvos fogs (0.25, 0.5 or 1.0 litres per hectare), used in glasshouses ventilated at short intervals (0.5, 1 or 2 hours) after treatment.

Materials and Methods

The trial was done in the same glasshouses at ADAS, Bridgets (Reading) where the trial in 1991 was done. Almost identical methods were used to grow, transport, treat and score the plants in both years. A video that shows what and how the trial in 1991 was done is available from the HDC.

Crop safety was assessed on the three species, *B. semperflorens*, impatiens and pansy, that appeared in the earlier trial to be most

sensitive to dichlorvos. The effectiveness of the treatments was assessed on impatiens and verbena, good hosts of WFT, that were deliberately infested for the purpose.

Plants

The plants used in the trial were bought-in as young seedlings ("mini-plugs", ex Colegrave Seeds) and potted-up individually into larger containers (Cookson Plantpak P12 pots) into a peat/bark compost containing 3.5 kg/m^3 Osmocote Plus (5-6 Month-Spring Potting). The plants were then grown-on in the same glasshouse for approximately 10 weeks before the experiment began. During this time large numbers of WFT were released in the glasshouse, although they only began to multiply rapidly once the plants began to flower.

A few days before the first treatments were applied, nine sets of 3 trays each of *B. semperflorens* and pansy and 6 trays each of impatiens and verbena, selected at random from within the glasshouse, were placed on "carrying frames". The plants were moved as required on these frames into the smaller (13 x 3 m) glasshouse compartments where the fogging was done. Two other sets of plants were selected, which stayed in the main glasshouse. These acted as the untreated controls.

After treatment the plants were returned to the main glasshouse where each batch of plants was covered with polypropelene fleece to minimise the movement of WFT. Half the impatiens and verbenas (3 trays each) were used 24 hours later* to assess how many WFT had survived. The rest stayed in the glasshouse for a week, when they were assessed for signs of crop damage before being re-treated. The second thrips assessment was done a week after the second fogging operation, immediately after* the second crop-damage assessment.

---

* The first assessment to determine the numbers of WFT that survived fogging began 24 hours after treatment and the second began 7 days after treatment. However they took 3 and 2 days respectively to complete.

Cultural details and information about when the treatments were applied and their effects assessed are shown in Table 1.

Table 1. Site details showing when and how the trial was done

Glasshouses and Fogging Machine	
Main compartment:	13 x 9 m
Compartments used for fogging:	13 x 3 m
Fogging machine:	IGEBA Starfog Fog Generator
Cultural Details	
Pricked out:	31 March-1 April
Container size:	Cookson Plantpak P12
Cultivars	
Begonia semperflorens:	Red Devil and Devil Mixed (6 plants of each cultivar per tray)
Impatiens:	Accent Pink and Accent Scarlet (6 plants of each cultivar per tray)
Pansy:	Senator Mixed
Verbena:	Garden Party Mixed
Treatments and Assessments	
1st Fogs applied:	9 June
1st WFT assessment:	10-12 June
1st Assessment of crop damage:	16 June
2nd Fogs applied:	16 June
2nd Assessment of crop damage:	25 June
2nd WFT assessment:	25-6 June

Treatments

The treatment used are shown in Table 2.

The insecticide was applied with an IGEBA Starfog Fog Generator. A special container, made by the manufacturers for use when small amounts of pesticide are being applied, was fitted. The machine applied all liquid in this tank, so the exact amount of the insecticide:carrier mixture required each time was put into the tank. This was easier, and possibly more accurate, than calibrating the machine and then fogging for an exact time, as was in 1991.

Darmycel Dichlorvos 50% e.c., with Nevolin as a carrier, was used. On each occasion the insecticide was applied in the equivalent of 12 litres of the insecticide:carrier mixture per hectare (47 ml per 39 m^2 compartment), but the proportions varied (Table 2). Each rate of insecticide was fogged in three identical compartments to which were ventilated 0.5, 1 or 2 hours after fogging.

Table 2. Treatments used and proportions of dichlorvos and carrier (Nevolin) used

Rate of dichlorvos (litres per hectare)	Amounts of dichlorvos and Nevolin used			
	Per 12 litres		Per 200 ml	
	Dichlorvos	Nevolin	Dichlorvos	Nevolin
0.25	0.25	11.75	4.2	195.8
0.5	0.5	11.5	8.3	191.7
1.0	1.0	11.0	16.6	183.3

Each of the three compartments used to fog the plants was equipped with extractor fans that could bring about a complete change of air in 4 minutes. Fogging had to be done at various times if all the treatments were to be applied on the same day. However with the shade screens set three quarters closed, conditions inside the glasshouses were similar for each trial.

Crop Damage

The amount of damage visible on treated plants, mainly leaf chlorosis and flecking on the flowers, was assessed 7 days after each fogging operation. Damage visible on the second occasion may therefore have been caused by either treatment or to the combination of each. Damage was assessed on 0-3 score, where 0 = no damage visible and 3 = severe damage. The untreated plants were used for comparative purposes.

Control of WFT

The numbers of live and dead adult and immature WFT were assessed 24 hours or 7 days after the first and second treatments respectively (but see footnote on p 3). The numbers of WFT present on each of 24 plants (2 trays) per treatment was assessed individually. (When necessary plants from a third tray were examined to make a total of 24).

Each plant was cut-off at ground level and tapped vigorously 10 times over a white tray, when the numbers of live and dead adult and immature thrips were counted.

Analysis of the Data

The numbers of live (adults, immature and 'total') WFT from each tray (replicate) was analysed separately, using a "nested" factorial analysis.

Results

Crop Damage

The amount of damage caused to the leaves of *B. semperflorens*, impatiens and pansy, 7 and 14 days after fogging once or twice respectively, is shown in Table 3. No damage was seen on the verbena.

Table 3. Assessments of damage caused to *Begonia semperflorens*, impatiens and pansy by dichlorvos fogs

Rate of dichlorvos (l/ha)	Ventilation time (hr)	Leaf Damage Score (1 = slightly; 3 = severe)					
		Begonia semperflorens		Impatiens		Pansy	
		1st Fog	2nd Fog	1st Fog	2nd Fog	1st Fog	2nd Fog
Untreated control	-	0	0	0	0	0	0
0.25	0.5	0.7	0	0	0	0	1.3
	1.0	0.3	0	0	0.3	0	1.7
	2.0	0.7	0	0	0	0	1.2
0.5	0.5	1.0	1.0	0	0	0	1.7
	1.0	1.0	0.6	0	0	0	1.3
	2.0	1.0	1.0	0	0	0	1.3
1.0	0.5	1.0	1.0	0	0.3	0.3	1.3
	1.0	1.0	1.7	0.3	0.6	0.3	1.7
	2.0	1.0	1.3	0.6	1.3	1.0	1.7

Begonia semperflorens: One application of dichlorvos, at any of the rates used, appeared to damage *B. semperflorens* slightly, although the effect was marginally less obvious at the lowest rate. Seven days after the second application the effects were slightly worse at the higher rates, but less obvious at 0.25 litres per hectare.

Impatiens: One or two applications of dichlorvos at 0.25 or 0.5 litres per hectare did not seem to affect impatiens leaves (although it caused flecking on any flowers open at the time - data not shown), but it caused slight damage (chlorosis) at 1.0 litre per hectare. Damage increased appreciably after the second application and it tended to be worse the longer the plants were exposed to it.

Pansy: The cumulative effects of the treatments were more obvious in pansy, where the first application at either 0.25 or 0.5 litres per hectare did not appear to do any harm. Damage, also chlorosis of the leaves, was however clearly visible on all the treated plants 7 days after the second applications. Neither the exposure time, nor the rate used, seemed to have much effect on the severity of the symptoms.

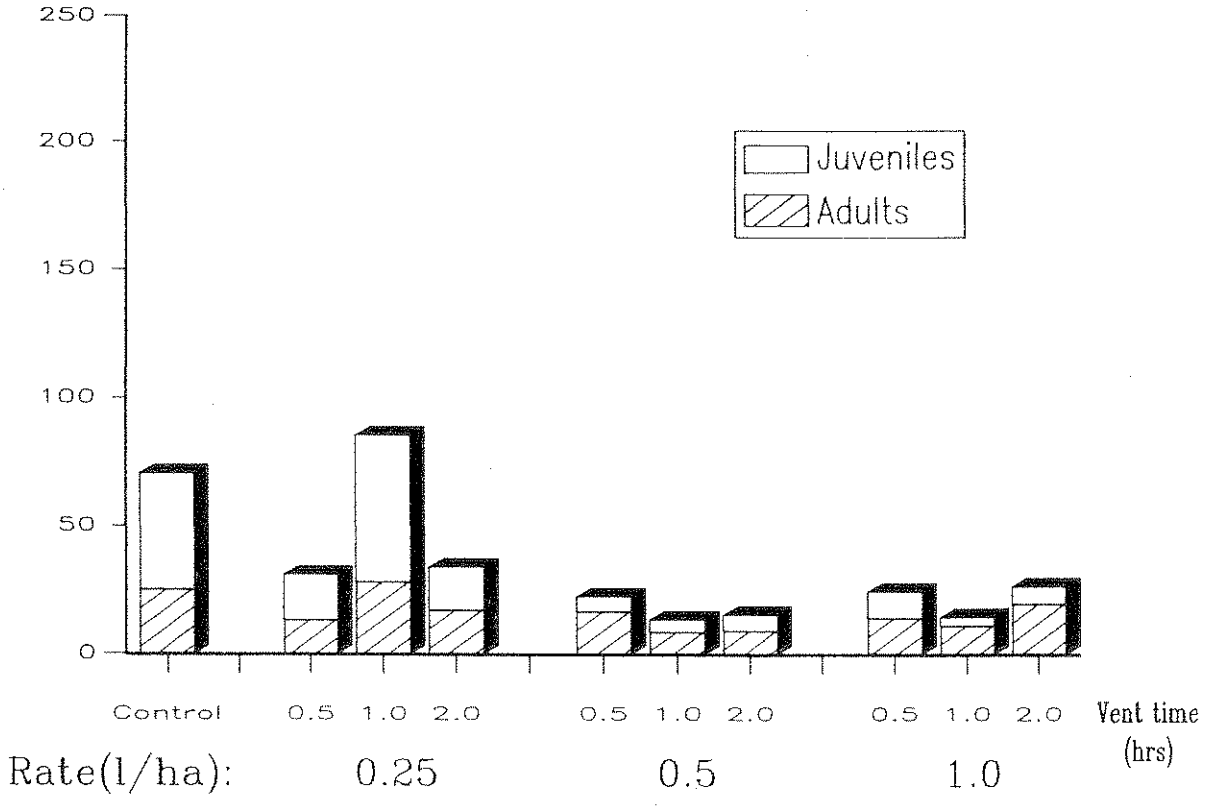
Control of WFT

The numbers of WFT on plants in different trays and on individual plants in the same tray varied considerably (Data not shown). Either species could be the more heavily infested within a treatment. Generally the more flowers on a plant, the more WFT there were on it.

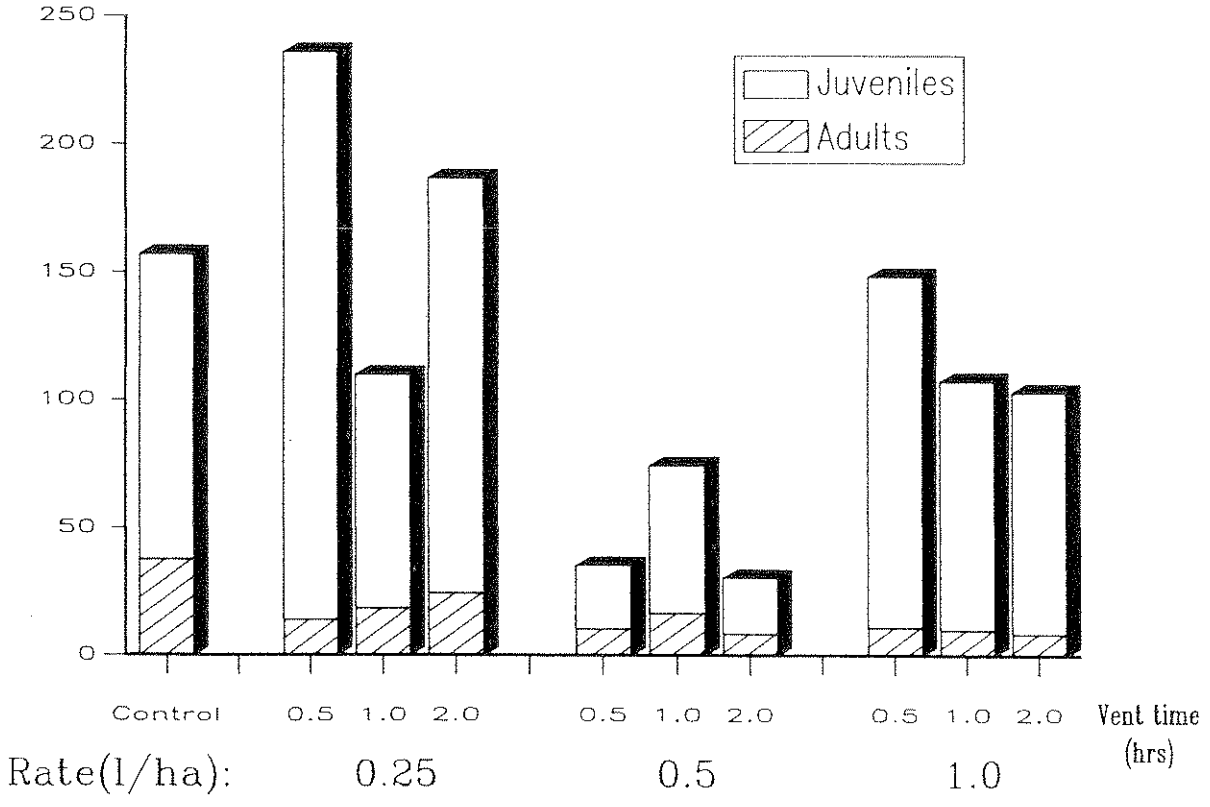
Significantly fewer ($p=>0.001$) adult and immature WFT were present on "fogged plants" (mean of three rates of dichlorvos used) after each application of dichlorvos fog (Fig. 1 and 2; Appendix 1a-c). More adult and immature WFT survived fogging at 0.25 than at 0.5 or 1.0 litres per hectare. Inexplicably however more thrips, particularly larvae, were often present on plants fogged with 1.0 than at 0.5 litres per hectare.

The interval, 0.5, 1 or 2 hours, between application and when the glasshouses were ventilated did not affect the degree of control of thrips achieved (Fig. 1 and 2; Appendix 1a-c).

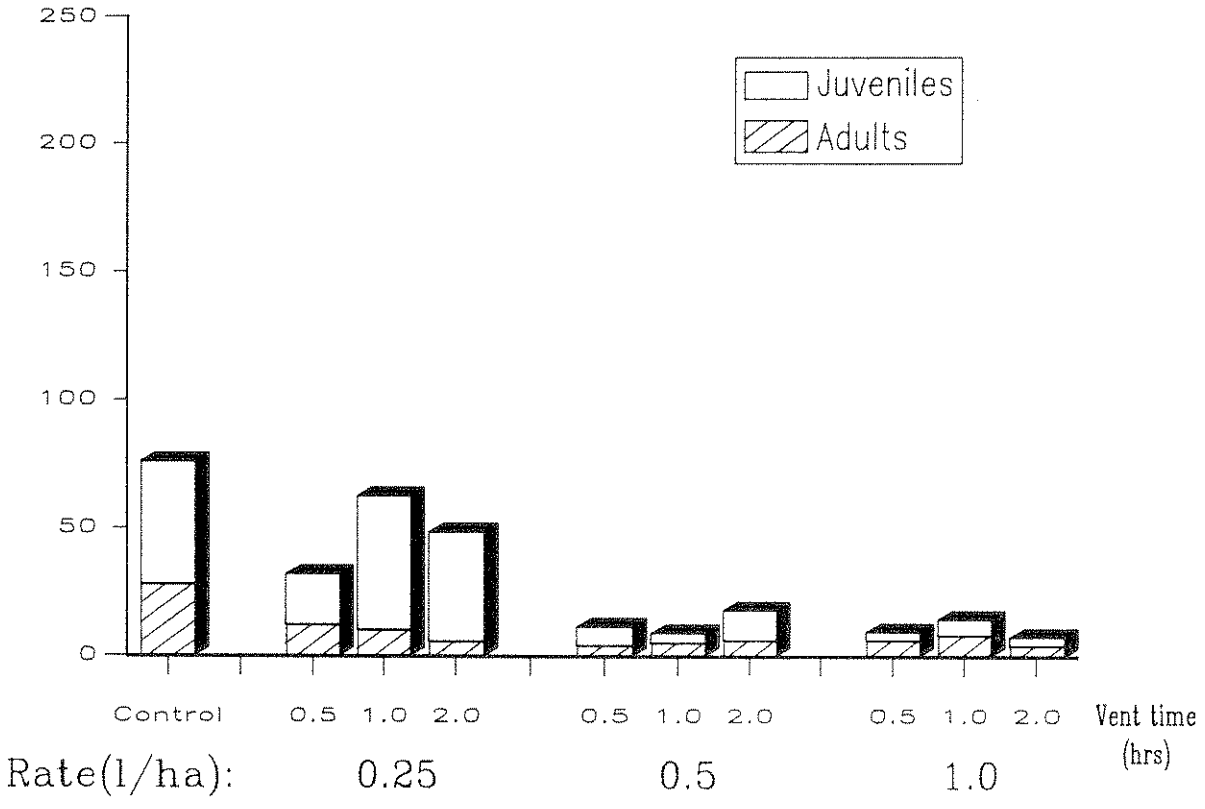
Numbers of WFT per tray on Impatiens after one application of dichlorvos fog



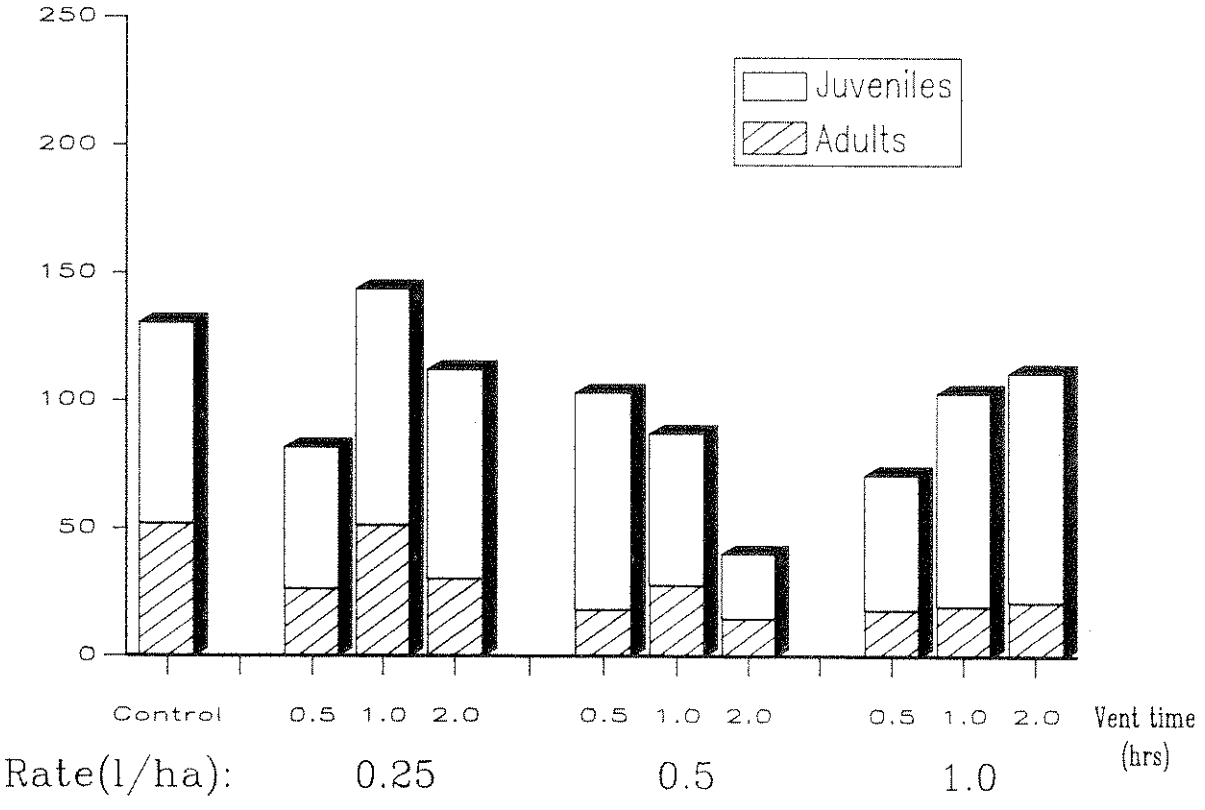
Numbers of WFT per tray on Impatiens after two applications of dichlorvos fog



Numbers of WFT per tray on Verbena after one application of dichlorvos fog



Numbers of WFT per tray on Verbena after two applications of dichlorvos fog



Discussion

The three plant species damaged by dichlorvos in the earlier trial were again damaged in this one, although only the highest rate (1.0 litres per hectare) affected impatiens and the amount of damage to *B. semperflorens* was slight and it did not appear to get worse after a second application of each treatment. Verbena, a good host of WFT, again was unaffected by dichlorvos.

In an emergency, for example if plants are suddenly found to be infested with WFT and something has to be done quickly, low rates of dichlorvos fog would be a useful treatment in many situations. They are unlikely to give complete control, so other measures should be used as well. Certain plants, for example pansy are, however, so sensitive to dichlorvos that they should never be treated.

Although WFT is potentially a threat to many plants, the results from this trial showed again how much the pest prefers flowers to the vegative parts of plants. Attacks of WFT are therefore less likely to be serious in glasshouses where only young plants are present. The risk is greater, particularly if the population of WFT is infected with tomato spotted wilt virus (TSWV), where older (in flower) and young plants are both present.

Dichlorvos fogs appeared to be just as effective when glasshouses were ventilated shortly after treatment (0.5 or 1 hour afterwards), instead of 2 hours later, although they often damaged the plants rather less. Such findings should be borne in mind, not just when fogging pesticides, but when using some of the newer methods of application now available, for example low volume mist (LVM) systems. With these machines close control of the glasshouse environment is often possible so it may be possible to produce the conditions whereby maximum benefit and the least harm is obtained from pesticides.

Conclusions

1. Low rates of dichlorvos fog (0.5 and particularly 0.25 litres per hectare) caused little damage to *B. semperflorens* and impatiens, although more was caused at 1.0 litres per hectare.

2. Pansy was highly sensitive to dichlorvos fogs and rates as low as 0.25 litres per hectare eventually caused damage (chlorosis). The effects were appreciably more obvious 7 days after the application of a second treatment at each rate. The effects of the insecticide are therefore either cumulative or the symptoms take time to develop.

3. Although control was not complete and there were some anomalous results, 0.5 litres per hectare appeared to be the lowest rate of dichlorvos fog that gave significant control of WFT.

Acknowledgements

I thank colleagues at Reading for help and assistance with this trial, particularly Ivor Parry, Experimental Gardener who looked after the plants throughout.

Storage of the Data

The raw data will be stored by ADAS, Bridgets (Reading), Coley Park, Reading RG1 6DE for a period of 10 years. The HDC will be consulted before disposal.

Appendix 1a. Numbers of live adult western flower thrips on impatiens and verbena after one or two applications of dichlorvos fog

Rate of dichlorvos fog (l/hectare)	Ventilation time (hrs)	Impatiens 1st Assessment	Impatiens 2nd	Verbena 1st	Verbena 2nd
*Untreated control		25.0	37.5	27.75	52.0
0.25	0.5	13.0	14.0	12.0	26.5
	1.0	28.0	18.5	10.0	51.5
	2.0	17.0	24.5	5.5	30.5
		19.3	19.0	9.17	36.2
0.5	0.5	16.5	10.5	4.0	18.5
	1.0	8.5	16.5	5.0	28.0
	2.0	9.0	8.5	6.0	15.0
		11.33	11.8	5.0	20.5
1.0	0.5	14.0	11.0	6.0	18.5
	1.0	11.0	10.0	8.0	20.0
	2.0	19.5	8.5	4.0	21.5
		14.83	9.8	6.0	20.0
SEDs ± Between means of rates					
Between Rates and Control		3.870	6.81	3.870	6.81
Between Rates		4.240	6.22	4.240	6.22
Between Rate and Ventilation times					
Between Rate/Time and Control		5.192	8.35	5.192	8.35
Between different Rates/Times		5.996	9.64	5.996	9.64

*Mean of 4 trays

Appendix 1b. Numbers of live western flower thrips larvae on impatiens and verbena after one or two applications of dichlorvos fog

Rate of dichlorvos fog (l/hectare)	Ventilation time (hrs)	Impatiens 1st Assessment	Impatiens 2nd	Verbena 1st	Verbena 2nd
*Untreated control		45.5	119.5	48.2	78.7
0.25	0.5	18.0	222.0	20.0	55.5
	1.0	57.5	91.5	52.5	92.5
	2.0	17.0	162.5	43.0	82.0
		30.8	158.7	38.5	76.7
0.5	0.5	6.0	25.0	7.5	85.0
	1.0	5.0	58.0	4.0	59.5
	2.0	6.5	22.0	12.0	25.5
		5.8	35.0	7.8	56.7
1.0	0.5	10.5	137.5	3.5	53.0
	1.0	3.5	97.5	6.5	83.5
	2.0	7.0	94.5	3.5	90.0
		7.0	109.8	4.5	75.5
SEDs ± Between means of rates					
Between Rates and Control		9.93	16.20	9.93	16.20
Between Rates		10.88	17.75	10.88	17.75
Between Rate and Ventilation times					
Between Rate/Time and Control		13.33	21.74	13.33	21.74
Between different Rates/Times		15.39	25.10	15.39	25.10

*Mean of 4 trays

Appendix 1c. Total numbers of western flower thrips on impatiens and verbena after one or two applications of dichlorvos fog

Rate of dichlorvos fog (l/hectare)	Ventilation time (hrs)	Impatiens 1st Assessment	Impatiens 2nd	Verbena 1st	Verbena 2nd
*Untreated control		70.5	157.0	76.0	130.7
0.25	0.5	31.0	236.0	32.0	82.0
	1.0	85.5	110.0	62.5	144.0
	2.0	34.0	187.0	48.5	112.5
		50.2	177.7	47.7	112.8
0.5	0.5	22.5	35.5	11.5	103.5
	1.0	13.5	74.5	9.0	87.5
	2.0	15.5	30.5	18.0	40.5
		17.2	46.8	12.8	77.2
1.0	0.5	24.5	148.5	9.5	71.5
	1.0	14.5	107.5	14.5	103.5
	2.0	26.5	103.0	7.5	111.5
		21.8	119.7	10.8	95.5
SEDs ± Between means of rates					
Between Rates and Control		12.57	18.61	12.57	18.61
Between Rates		12.68	20.39	12.68	20.39
Between Rate and Ventilation times					
Between Rate/Time and Control		15.53	24.97	15.53	24.97
Between different Rates/Times		17.93	28.84	17.93	28.84

*Mean of 4 trays

Contract between ADAS (hereinafter called the "Contractor") and the Horticultural Development Council (hereinafter called the "Council") for a research/development project.

PROPOSAL

1. TITLE OF PROJECT **Contract No: PC/18g**

POT AND BEDDING PLANTS: CROP SAFETY AND CONTROL OF WESTERN FLOWER THRIPS WITH DICHLORVOS FOGS

2. BACKGROUND AND COMMERCIAL OBJECTIVE

Dichlorvos is the most effective treatment for the control of western flower thrips (WFT), but it damages many plants, although it is less harmful applied as a fog than as a spray. Useful information was gained from a trial done last year on this topic, funded by the HDC (PC18f). The tolerance or susceptibility of a wide range of species was established, and information about the rates of dichlorvos necessary to control WFT effectively was obtained. However the experiment highlighted a number of aspects that warrant further investigation.

3. POTENTIAL FINANCIAL BENEFIT TO THE INDUSTRY

WFT is the most important pest that affects pot and bedding plants. Although dichlorvos would not be the main method growers would normally use to control it, it is probably the best treatment to use in an emergency, when a bad attack occurs.

Knowing the lowest rates to use to control WFT effectively and whether or not these rates damage even the most sensitive species is vital.

4. SCIENTIFIC/TECHNICAL TARGET OF THE WORK

The experiment done in 1991 highlighted various aspects that warrant further investigation:-

a) How safe (to the most sensitive species) are very low rates of dichlorvos for very short periods of time?

   For example 0.25, 0.5 and 1.0 litres per hectare for 0.5, 1 or 2 hours.

b) How effectively do these low rate/short exposure time treatments control WFT?

c) How often do you need to treat heavily infested plants to control all stages (eggs, larvae, pupae and adults) of WFT?

5. CLOSELY RELATED WORK - COMPLETED OR IN PROGRESS

The proposals are an extension of the HDC experiment done last year.

Little government-funded R & D is being done on the chemical control of WFT: most of this work concentrates on integrated or biological methods of control. Although it kills any parasites and predators present at the time, dichlorvos is very short-lived. Fresh introductions of parasites and predators could therefore be made soon after fogging, so the treatment is not totally incompatible with integrated pest management (IPM) techniques.

6. DESCRIPTION OF THE WORK

The experiment proposed would be done in a similar way to the one done last year, on four species of plants, *Begonia semperflorens*, impatiens, pansy and verbena. The first three species were the ones most badly affected by dichlorvos fogs last year: impatiens and verbena are good hosts of WFT. Doing the trial this way, information on crop safety and efficacy (against WFT) would be obtained from the same experiment.

The plants would be grown in a glasshouse heavily infested with WFT and the treatments would be applied, when the plants were in flower. (WFT multiplies more quickly once plants begin to flower and pollen is available to them). Any damaging effects caused by the treatments would be assessed on *Begonia semperflorens*, impatiens and pansy. Their effectiveness against WFT would be assessed on impatiens and verbena.

The treatments proposed are:-

Crops to be treated:	*Begonia semperflores*, impatiens, pansy, verbena
Rates of dichlorvos fog (litres per hectare):	Nil, 0.25, 0.5, 1.0
Interval between fogging and ventilating the glasshouses (hours):	0.5, 1.0, 2.0
Number of applications of each treatment:	2, one week apart
Number of replicates:	3

<u>Assessments to be made</u> (type of timing)

Day 1	1st application of dichlorvos fog
Day 2	Assess numbers of live WFT on half the impatiens and verbena (Destructive assessment - plants cut off at soil level)

Day 7	Score remaining plants for crop damage
Day 7	2nd application of dichlorvos fog
Day 14	Score remaining plants for crop damage
Day 14	Assess numbers of live WFT on remaining impatiens and verbena

7. COMMENCEMENT DATE AND DURATION

01.04.92; duration 5 months.

8. STAFF RESPONSIBILITIES

Project Leader: M Saynor
Other staff: Scientific staff at ADAS, Reading

9. LOCATION

ADAS, Reading

10. COSTS

Total cost of the trial - £9,800.

11. PAYMENT

On each quarter day the Council will pay to the Contractor in accordance with the following schedule:

Quarter/Year	1992
1	-
2	5880
3	3920
4	-

TERMS AND CONDITIONS

The Council's standard terms and conditions of contract shall apply.

Signed for the Contractor(s)

Signature.....

Position.....R2D Manager.....

Date.....2/9/92.....

Signed for the Contractor(s)

Signature.....

Position.....

Date.....

Signed for the Council

Signature.....

Position.....CHIEF EXECUTIVE.....

Date.....26.8.92.....