Horticulture Research International, Stockbridge House, Cawood, Selby, N.Yorks.

FINAL REPORT

To:
Horticultural Development Council
18 Lavant Street
Petersfield
Hants, GU32 3EW

Efficacy and safety evaluation of Luxan Dichlorvos 600 EC and Luxan Aerosol 15 on cucumbers in support of On-Label Approval

August 1995

Commercial - In Confidence

FINAL REPORT

Project Number:	PC115
Project Title:	Efficacy and safety evaluation of Luxan Dichlorvos 600 EC and Luxan Dichlorvos Aerosol 15 on cucumbers in support of On-Label Approval.
Project Leader:	Rob Jacobson
Trial Manager (Part 1) & Joint Author of Report (Volume 1):	Vivian Powell
Location of Project:	Horticulture Research International Stockbridge House Cawood Selby North Yorkshire YO8 0TZ Tel: 01757 268275 Fax: 01757 268996
Project Co-ordinator:	Derek Hargreaves
Date Project Commenced:	February 1995
Date Project Completed:	July 1995
Report Date:	August 1995
Key Words:	Dichlorvos, Western flower thrips, cucumbers

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.

Signature .....R Jacobson.....

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Date ..22/8/95.....

Signature .....V.G. Powell.....

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Relevance to Growers and Practical Application

Dichlorvos is the only insecticide currently available to UK cucumber growers which is effective against *Frankliniella occidentalis*. However, the products, which may be used under Off-Label Agreement, contain dibutyl phthalate which is acutely phytotoxic.

Previous studies at HRI, Stockbridge House identified two safer formulations of dichlorvos which are marketed by Luxan BV in the Netherlands; ie, an emulsion concentrate, Luxan Dichlorvos 600EC, and an aerosol, Luxan Dichlorvos Aerosol 15.

This project generated residue, crop safety and efficacy data required by the UK Pesticide Safety Directorate to support applications for On-Label Approval of both Luxan BV products.

Summary

Dichlorvos is the only insecticide currently available in the UK for use on cucumber crops which is effective against *Frankliniella occidentalis*. Two products containing this active ingredient have been available under Off-Label Agreements but both contain dibutyl phthalate, a chemical known to be acutely phytotoxic (Hardwick et al., 1984). The insecticide should form an important part of the cucumber growers integrated pest management (IPM) programme but due to crop damage can only be used for end of season 'clean-up' treatments.

A series of experiments at HRI, Stockbridge House in 1994 identified two formulations of dichlorvos, marketed by Luxan BV in the Netherlands, which did not cause acute phytotoxicity (Jacobson, 1995); ie, an emulsion concentrate, Luxan Dichlorvos 600 EC, and an aerosol, Luxan Dichlorvos 15. On the basis of these results, Luxan UK Ltd agreed to seek registration of these products in the UK in a joint financial venture with the HDC.

The Pesticides Safety Directorate (PSD) acknowledged the importance of these products to the UK cucumber industry and assisted the production of an agreed package of data requirements to support applications for On-Label Approval of both products.

The objectives of this project were to generate the data required in that package. This included residue data from four trials performed in compliance with the principals of Good Laboratory Practice (GLP), crop safety data from four trials and efficacy data from a single trial. Luxan UK Ltd undertook to supply any additional data from the Netherlands, including results of efficacy studies equivalent to three UK trials.

The residues and crop safety data were produced from a series of three treatments at four day intervals, while efficacy was assessed by single treatments.

All the data will be submitted to PSD for evaluation. It is not appropriate for the authors to anticipate the outcome of that evaluation but it is possible to summarise the results of the crop safety and efficacy studies:

> No acute phytotoxic effects to the foliage of the cucumber plants were observed after the full treatment programmes with either product. The percentage of fruit which developed normally was similar in the treated crops to the untreated control.
>
> All treatments reduced the number of *F. occidentalis* on leaves by over 99%, the only survivors being pre-pupae. Small numbers of adult *F. occidentalis* were found in flowers 24 hours post-treatment. These may have survived the treatment deep in the flower structure or have emerged from pupae on the leaves or floor after the insecticides had been vented off.

Approval of these products would provide UK cucumber growers with valuable new weapons in their IPM armoury. There would also be important benefits to growers of UK ornamental crops who would then have access to the products under Off-Label arrangements.

Introduction

Dichlorvos is the only insecticide currently available to UK cucumber growers which is effective against *Frankliniella occidentalis*. It should form an important part of the integrated pest management (IPM) programme, ie:

1) as a clean up treatment at the end of the crop.

2) as a means of killing thrips which carry over to the mid-season replanted crop thereby reducing pest pressure in the early stages of growth.

3) as a spot treatment in localised areas of pest activity to prevent the insects spreading to other parts of the crop.

Dichlorvos has been available in the UK under Off-Label agreements as Darlingtons Dichlorvos (Darmycel) and Nuvan 500EC (Ciba), which are virtually identical emulsion concentrate formulations intended for fly control in mushroom and poultry houses. Both formulations contain 50% dibutyl phthalate.

Only limited use can be made of these formulations because they are acutely phytotoxic to the cucumber plants. High volume applications have resulted in 70% reduction of main stem fruit load. This has been attributed to dibutyl phthalate which is known to damage plant tissue (Hardwick et al, 1984).

There are emulsion concentrate (EC) and aerosol formulations of dichlorvos marketed by Luxan BV in the Netherlands which do not contain dibutyl phthalate; ie, Luxan Dichlorvos 600EC and Luxan Dichlorvos Aerosol 15. These products were tested in a series of experiments at HRI Stockbridge House during 1994 without any acute phytotoxic effects (Jacobson, 1995). Luxan UK now wish to register these products in the UK.

In preliminary discussions with PSD it was agreed that the following data would be required to support an On-Label Approval application for each product:

1. RESIDUES — Data required for both products from four trials performed in compliance with the Principles of Good Laboratory Practice (GLP). It was agreed that the trials could be concurrent with a common untreated control.

2. CROP SAFETY — Data relating to both foliar damage and flower/fruit development for both products from 4 trials.

3. EFFICACY — Normally data are required from 4 trials, but in this instance it was agreed that up to 3 could be substituted with appropriate observations from crop treatments in the Netherlands. The latter will be supplied independently by Luxan UK Ltd.

The project was in three discrete parts with separate protocols. The final report is in a similar format.

Objectives

Part 1 - Generation of residue data for Luxan Dichlorvos 600 EC and Luxan Dichlorvos Aerosol 15 on protected cucumber crops.

Part 2 - Generation of crop safety data for Luxan Dichlorvos 600 EC and Luxan Dichlorvos Aerosol 15 on protected cucumber crops.

Part 3 - Generation of data to determine the efficacy of Luxan Dichlorvos 600 EC and Luxan Dichlorvos Aerosol 15 against *F. occidentalis* on protected cucumber crops.

VOLUME 1

(PROJECT PART 1)

GENERATION OF RESIDUE DATA FOR LUXAN DICHLORVOS 600 EC AND LUXAN DICHLORVOS AEROSOL 15 ON CUCUMBERS IN SUPPORT OF ON-LABEL APPROVAL

For the purpose of registration all residue studies must be conducted in compliance with GLP. This requires the report to be submitted as a separate audited package. In this case the package consists of three volumes; 1, 1A and 1B, plus a separate report for the analytical phase of the study. This information is confidential to Luxan (UK) Ltd, the co-sponsors of this work.

VOLUME 2

(PROJECT PART 2)

CROP SAFETY EVALUATION OF LUXAN DICHLORVOS 600 EC AND LUXAN DICHLORVOS AEROSOL 15 ON CUCUMBERS IN SUPPORT OF ON-LABEL APPROVAL

Materials and Methods

Site

Fairfield Glasshouse Unit, HRI Stockbridge House, Cawood, Selby, North Yorkshire, YO8 0TZ

Details of Crop

At all trial sites details were as follows:

Cultivar:	Bronco
Sowing Date:	08.12.94
Planting Date:	27.12.94
Growth Medium:	Rockwool block on rockwool slab
Training System:	Cordon V System

Experimental Layout/Treatments

The four trial sites for each product were located as follows in Houses 1 to 6 of the Fairfield Glasshouse Unit:

Fairfield House 1	Untreated control (common to all trials)
Fairfield Houses 2-5	Luxan Dichlorvos Aerosol 15 (one trial per glasshouse, total 4 trials)
Fairfield House 6	Luxan Dichlorvos 600 EC HV spray (one trial per 2 crop rows, total 4 trials)

Each greenhouse was 148 m^2 (428 cubic m) and contained 190 plants (7 rows of 24 and one row of 22).

Application Details

The two formulations of dichlorvos were applied to mature cucumber crops in a series of three treatments, as follows:

Luxan Dichlorvos 600 EC - Applied as a run-off application at a concentration of 100 ml product per 100 litres water using an Oxford Precision Sprayer with an 03 Cone nozzle and swivel plate.

Luxan Dichlorvos Aerosol 15 - Applied at the rate of 500 g product per 3750 cubic metres of glasshouse.

Timing - Treatments were applied on:

13 March 1995
17 March 1995
21 March 1995

Ventilation - The glasshouse ventilation system was shut down for two hours post-treatment. Ventilators were then opened for one hour at a setting of approximately 10% before returning to normal fully automatic use.

Pesticide Applications Other Than The Test Substance

None.

Assessments

1. Application of Dichlorvos

The Oxford Precision sprayer and the Aerosol canisters were calibrated before each use to determine their delivery rate. The duration of each application was recorded to calculate the actual quantity of pesticide applied.

2. Crop Safety Assessments

2.1 Foliar Assessments

An assessment of damage to foliage was done before any treatments were applied, and 48 hours after the first and third applications of the test substances.

At each assessment, the youngest 500 mm of growth of 20 plants per plot were examined for chlorosis, necrosis and any other indications of chemical damage.

2.2 Fruit Development

This was done at the third application of the test substances.

Twenty newly developed flowers were marked in the untreated crop and in each of the eight treated crops before the third application of the test substance. The marked flowers were re-examined seven days after treatment to determine whether the fruits were developing normally.

Results

1. Application of Dichlorvos

The actual quantity of product used in each application of each chemical is listed in Table 1.

2. Environmental Conditions at Time of Treatment

2.1 13 March 1995

Treatments applied between 0800 and 0930 hours. Conditions bright but not excessively hot (22-24°C).

2.2 17 March 1995

Treatments applied between 0730 and 0930 hours. Conditions breezy and intermittently bright. Temperatures 21-23°C.

2.3 21 March 1995

Treatments applied between 0730 and 0930 hours. Conditions bright but not excessively hot (21-25°C).

3. Foliar Damage

No foliar damage attributable to these treatments was detected after either one or three applications of either product.

4. Fruit Development

The percentages of fruit which developed normally in the untreated crop and in each of the eight treated crops are summarised in Table 2.

This was at least as good in all the treated crops as the untreated control.

Conclusions

The application of a series of three treatments of Luxan Dichlorvos 600 EC or Luxan Dichlorvos Aerosol 15 at four day intervals caused no detectable damage to the leaves or developing fruit of cucumber (cv. Bronco) crops.

Table 1: Actual quantities of products used in all applications.

Product	Trial	Actual Quantity Applied In:			Units
		Application 1	Application 2	Application 3	
Luxan Dichlorvos 600 EC	1	2331	2654	2675	litres of 1% product per hectare
	2	2179	2535	2613	
	3	2182	2471	2572	
	4	2144	2500	2555	
Luxan Dichlorvos Aerosol 15	1	500.3	569.5	520.4	grammes of product per 3750 cubic metres of glasshouse
	2	560.7	514.3	547.6	
	3	573.9	529.2	502.9	
	4	545.8	517.8	541.5	

Table 2: The percentage of fruit which developed normally in the untreated crop and in each of the eight treated crops.

Treatment	Trial	Percentage of Fruit which Developed Normally
Untreated	All	85
Luxan Dichlorvos 600 EC	1	100
	2	95
	3	95
	4	95
Luxan Dichlorvos Aerosol 15	1	95
	2	95
	3	95
	4	95

VOLUME 3

(PROJECT PART 3)

EFFICACY EVALUATION OF LUXAN DICHLORVOS 600 EC AND LUXAN DICHLORVOS AEROSOL 15 AGAINST FRANKLINIELLA OCCIDENTALIS ON CUCUMBERS IN SUPPORT OF ON-LABEL APPROVAL

Materials and Methods

Site

Headley Hall glasshouse unit, Tadcaster (leased by HRI, Stockbridge House, Cawood, Selby, North Yorkshire, YO8 0TZ).

Details of crop

Cucumbers: cv. Pyralis
Sowing date: 27 January 1995
Planting date: 15 February 1995
Growth medium: Rockwool block on peat bag
Training system: Cordon V System

Experimental Layout/Treatments

One discrete glasshouse section, of 36.1 m^2 (109 m^3), with 42 plants, per treatment.

Treatment Number	Glasshouse Section	Treatments	Date
1	3	Untreated	N/A
2	4	Luxan Dichlorvos 600 EC. Rate: 0.1% solution of product applied as high volume spray to run-off with an Oxford Precision Sprayer.	03.04.95
3	5	Luxan Dichlorvos Aerosol 15. Rate: One canister per 3750 cu.m.	03.04.95
4	3	Additional Treatment: Luxan Dichlorvos 600 EC. Rate: 0.1% solution of product applied as high volume spray (limited to equivalent of 2100 litres per hectare) with Oxford Precision Sprayer.	04.04.95
The glasshouse ventilation system was shut down for two hours post-treatment, then operated continuously for one hour before returning to the normal fully automatic setting.			

Pest Introduction

Adult female *F. occidentalis*, collected from HRI cultures, were released at the rate of 12.5 per plant on 17 February 1995.

Assessments

1. Application of Dichlorvos:

The Oxford Precision Sprayer and the Aerosol Canisters were calibrated before each use to determine their delivery rate. The duration of each application was recorded to calculate the actual quantity of pesticide applied.

2. Pest Populations:

2.1 On Leaves

An assessment was made of the pest population in each glasshouse section immediately before, and 24 hours after, each treatment.

In each assessment, 16 leaves were collected at random from both the upper and middle strata of the crop (ie 32 in all) and examined microscopically. The number of adult and immature *F. occidentalis* were recorded on each occasion.

2.2 In Flowers

Twenty flowers were examined in each glasshouse section 24 hours after treatment and the number of adult *F. occidentalis* recorded. The mean number of adult thrips per plant was then calculated.

Results

1. Application of Dichlorvos

Treatment 2 - 1% Luxan Dichlorvos 600 EC applied to run-off at the rate equivalent to 3362 litres/ha.

Treatment 3 - Luxan Dichlorvos Aerosol 15 applied at the rate equivalent to 515 g per 3750 cu.m.

Treatment 4 - 1% Luxan Dichlorvos 600 EC applied at the rate equivalent to 2100 litres/hectare.

2. Pest Populations

The results of the pre and post treatment assessments of *F. occidentalis* numbers on leaves are summarised in Table 1.

The only thrips found to survive the treatments on leaves were pre-pupae which were present in very small numbers.

Small numbers of adults were noted in flowers post-treatment. The mean numbers per plant are summarised in Table 2.

Conclusions

Each treatment of Luxan Dichlorvos 600 EC and Luxan Dichlorvos Aerosol 15 reduced the number of *F. occidentalis* on leaves by over 99%. The only survivors on leaves were pre-pupae.

Small numbers of adult *F. occidentalis* were found in flowers the day after treatment. They may have survived deep within the flower structure or emerged from pupae after the chemicals had been vented off.

The quantity of pesticide used in a high volume spray applied to run off in a cucumber crop depends on the amount of foliage. This can vary enormously depending on crop growth and trimming practices. In the 'residue' trials (see Volume 1 of this report) the smallest quantity of chemical used was equivalent to 2144 litres/hectare. However, Treatment 2 of this trial was applied to a more vigorous crop which required 3362 litres/hectare to run off. This difference would be acceptable if the chemical acted solely as a contact or stomach poison, but dichlorvos acts in the vapour phase. The quantity of active ingredient used per cubic metre of glasshouse in this treatment was therefore 60% greater than in the 'residue trial'. To cover this discrepancy, an additional treatment (Treatment 4) was applied in Section 3, to test the products' efficacy when the rate was limited to the equivalent of 2100 litres/hectare. The product was found to be equally effective at this rate.

References

Hardwick, R. C., R. A. Cole & T.P. Fyfield (1984). Injury and death of cabbage seedlings caused by vapours of dibutyl phthalate emitted from certain plastics. Ann. app. Biol. (1984) 105, 97-105.

Jacobson, R. J. (1995). Distinguishing Dichlorvos. Grower, March 23 1995, 24-25.

Table 1: Results of pre and post treatment assessments of numbers of F. occidentalis on cucumber leaves.

Treatments	Mean Number of Live WFT per Leaf			
	Pre-Treatment		Post-Treatment	
	Adult WFT	Immature WFT	Adult WFT	Immature WFT
1	1.2	8.2	1.9	15.6
2	2.1	20.6	0	0.1*
3	2.3	35.5	0	0.3*
4	1.9	15.6	0	0.1*

* All survivors were pre-pupae.

Table 2: Numbers of adult F. occidentalis in flowers post treatment.

Treatment	Mean Number of Adult WFT per Plant
1	5.4
2	0.2
3	0.5
4	0.2