*HORTICULTURE RESEARCH INTERNATIONAL*

*KIRTON*

# CONTRACT REPORT FV148
# ADAPTION OF RAMSAY STARTER SOLUTION APPLICATOR TO ALSO APPLY CABBAGE ROOT FLY TREATMENTS AT TRANSPLANTING

## UNDERTAKEN FOR THE HDC

1993

THE QUEEN'S AWARD FOR ENVIRONMENTAL ACHIEVEMENT

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**PRINCIPAL WORKER**

R W P Hiron

**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.

.............................. R W P Hiron
(Signature)

Date 2/6/94..............

Report authorised by.............................. M B Wood
(Signature) Project Leader

Date 2/6/94..............

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## RELEVANCE TO GROWERS AND PRACTICAL APPLICATION

## APPLICATION

None until more extensive trials are done.

## SUMMARY


The Ramsay starter solution applicator, attached to a tractor-mounted transplanter, was adapted by David Ramsay to also accurately apply a cabbage root fly (CRF) control chemical in the field at transplanting.

The efficacy of this transplanter application using chlorpyrifos (Dursban 4) was compared to field-applied chlorfenvinphos (Birlane) and plastic tray-applied Dursban 4 just prior to transplanting. The trial was done on two cauliflower crops. The first planting was vulnerable to the pests first generation peak and the second crop to the second generation of the pest.

CRF control by mechanical applicator at transplanting was poor and little better than the untreated control, whilst the control treatments of Dursban 4 on the tray and Birlane in the field gave very good control. The possible reasons for this failure are discussed and it is suggested that, spatial arrangement of spray application, and spray strength, should form the basis of further studies.


## EXPERIMENTAL SECTION

## INTRODUCTION

Equipment has been developed by Ramsay Soil Injection Ltd to precisely apply small volumes of water or water containing nutrients to transplanted crops in the field at planting (see HDC contract FV149 for an evaluation of its efficacy). It was considered likely that with suitable modifications, further uses could be made of such equipment, to precisely apply other treatments, such as insecticides, to a crop at transplanting. One such treatment that was identified was the application of chemicals for cabbage root fly control. At present, transplants which have been raised in plastic trays are treated with small amounts of very effective chemicals in the glasshouse prior to dispatch. This has had a beneficial effect upon the amount of insecticide being used in the environment but has two disadvantages. Firstly, treated plants have to be handled by machinery operators, and secondly, if a transplant is planted deeply then some of the insecticidal efficacy is lost. It had been suggested that the starter solution applicator could be adapted to accurately apply a chemical to the base of a transplants stem in sequence after planting and applying the starter solution. This modification was duly made by David Ramsay of the above firm. This report concentrates on initial investigations on evaluating the efficacy of the modification.

## MATERIALS AND METHODS

1. Site

HRI-Kirton is located in the village of Kirton situated five miles south of the town of Boston on the A17 in the county of Lincolnshire. The facilities used included a propagation unit, a modern block of Venlo glass and the field designated Asplands 3.

2. Test crops

i Early summer cauliflower cv Plana

ii Summer cauliflower cv Freemont

3. Treatments and trial design

Treatments

i Field applied granules of chlorfenvinphos as Birlane spot applied at a rate of 70 g/100 m row which means approximately 0.4 g product directly around each plant (control)

ii Chlorpyrifos as Dursban 4 applied in propagation area at the normal rate 50 ml Dursban 4 in 5 l water to treat 5,000 plants (ie 0.01 ml product in 1 ml water/plant, second control)

iii Chlorpyrifos as Dursban 4 applied in propagation area at double rate (ie 0.02 ml product in 1 ml water/plant)

iv 0.01 ml Dursban 4 applied by applicator in 30 ml water plant

v 0.01 ml Dursban 4 applied by applicator in 50 ml water per plant

vi 0.02 ml Dursban 4 applied by applicator in 30 ml water per plant

vii 0.02 ml Dursban 4 applied by applicator in 50 ml water per plant

viii Untreated control

Trial Design

The eight treatments were fully randomised per replicate block, and there were three replicates giving 24 plots. The trial was done twice to coincide with crops at a vulnerable stage to both the first and second generations of the pest. The first and most damaging occurs during mid to late May and the second in early July.

As only a two row machine was available each plot consisted of two rows of 23 plants with two rows of 15 plants being recorded at harvest leaving the others for destructive recording before harvest if needed.

4. Husbandry

The field crops were grown to a good even standard except for methods of cabbage root fly control which formed the basis of the treatments and varied accordingly.

5. Records

1. Crop diary including crop losses
2. Crop vigour scored on two occasions
3. Harvest and yield data
4. Cabbage root fly root damage index at harvest

**TRIAL DIARIES**

Trial 1

| | |
|---|---|
| Crop: | Early summer cauliflowers |
| Field/soil type: | Asplands 3/gley soils/coarse silty alluvial with disturbed soils |
| Soil analysis: | PH 7.8 Index: P - 4, K - 2, Mg - 4 |
| Previous cropping: | 1991 - Brassicas<br>1992 - Grass |
| Cultivations: | 13.11.92 - 4 tonnes/ha ground limestone applied<br>24 & 25.11.92 - Ploughed |
| Fertiliser: | |
| Base: | 22.04.93 - 150 kg/ha nitrogen as 15:8:24 compound fertiliser applied |
| Top: | 26.05.93 - 100 kg/ha nitram as Kaynitro fertiliser applied |
| Propagation: | 17.02.93 - Variety Plana sown in 308 trays |
| Planting: | 22.04.93 - Trial planted |

| | |
|---|---|
| Herbicides: | 20.05.93 - Propachlor as 9 l/ha Ramrod and chlorthal-dimethyl as 6 kg/ha Dacthal applied |
| Insecticides: | 03.07.93 - Pirimicarb as 420 g/ha Aphox and cypermethrin as 250 ml/ha Ambush applied |
| Fungicides: | None |
| Irrigation: | None |
| Notes: | Final pre-harvest inspection date 6/7, first harvest date 9/7, final harvest date 28/7<br>Root damage assessments done on 5/8 |

Trial 2

| | |
|---|---|
| Crop: | Summer cauliflowers |
| Field/soil type: | Asplands 3/gley soils/coarse silty alluvial with disturbed soils |
| Soil analysis: | pH 7.8 Index: P - 4, K - 2, Mg - 4 |
| Previous cropping: | 1991 - Brassicas<br>1992 - Grass |
| Cultivations: | 13.11.92 - 4 tonnes/ha ground limestone applied<br>24&25.11.92 - Ploughed |
| Fertiliser: Base:<br>Top: | 22.06.93 - 150 kg/ha nitrogen as 15:8:24 compound fertiliser applied<br>16.07.93 - 100 kg/ha nitrogen as Kaynitro fertiliser applied |
| Propagation: | 04.05.93 - Variety Freemont sown |
| Planting: | 22.06.93 - Trial planted |
| Herbicides: | 29.06.93 - Propachlor as 9 l/ha Ramrod and chlorthal-dimethyl as 6 kg/ha Dacthal applied |
| Insecticides: | 29.06.93 - Demeton-S-methyl as 560 ml/ha Campbell's DSM and cypermethrin as 250 ml/ha Ambush applied<br>03.07.93 - Pirimicarb as 420 g/ha Aphox and cypermethrin as 250 ml/ha Ambush applied<br>04.08.93 - Demeton-S-methyl as 560 ml/ha Campbell's DSM applied |
| Fungicides: | None |

Irrigation: None

Notes: Root damage assessments done on 6/8
Final pre-harvest inspection date 31/8, first harvest date 2/9, final harvest date 24/9

## RESULTS AND DISCUSSION

1. Adaption made to the Ramsay starter solution applicator to also apply CRF control chemicals.

This was done by Mr David Ramsay of Ramsay Soil Injection Ltd at his works near Lincoln. The starter solution applicator basically consists of a set of nozzles, a control box, piping and a liquid fertiliser container and applies a specific, but small, quantity of liquid fertiliser to the root-ball at planting. The adaption was to add a second set of nozzles to apply CRF control chemicals to the plant immediately planted prior to the plant to which fertiliser was being applied. Therefore the complete sequence to an individual plant is that it is planted with the starter solution applied and then once it is planted the CRF chemical control is applied.

Both the water/fertiliser and the chemical nozzles are operated by the one control box, which times the application of both the nutrients and CRF chemical at precisely the correct moment. It does this by the use of a magnet on the planting wheel which sends a signal to the control box. After a pre-set delay the signal is passed to a solenoid valve which opens to apply the liquid containing the CRF control agent. The time delays can be altered to cope with different inter-row plant spacings.

2. Mean vigour scores on two occasions for each trial.

These are given in Table 1 and basically shows that the two controls: Birlane as field granules or Dursban 4 as a propagation treatment, produced very vigorous plants with, if anything, Birlane-treated plants being a little more vigorous than the Dursban treated ones. However, all the Dursban 4 applied as transplanting treatments in the field were similar but disappointing with poor vigour and lost plants. The untreated control was only slightly worse than the Dursban 4 in the field treatment. The reasons for this will be discussed at the end of this section.

Table 1 Mean vigour scores (range 1 - 10) on two occasions for each trial

| Treatment | | Trial 1 | | Trial 2 | |
|---|---|---|---|---|---|
| Insecticide | Application | 3 June | 6 July | 27 July | 31 August |
| Birlane | Field granules | 9.7 | 9.0 | 9.3 | 9.0 |
| Dursban 4 | 0.01 ml/plant applied in propagation | 9.0 | 8.7 | 8.3 | 7.3 |
| | 0.02 ml/plant applied in propagation | 9.3 | 8.7 | 8.7 | 8.7 |
| | 30 ml/plant injected containing 0.1 ml | 6.7 | 5.3 | 6.0 | 5.7 |
| | 50 ml/plant injected containing 0.1 ml | 6.3 | 5.0 | 6.7 | 6.0 |
| | 30 ml/plant injected containing 0.2 ml | 5.7 | 5.7 | 6.7 | 7.0 |
| | 50 ml/plant injected containing 0.2 ml | 6.0 | 5.7 | 6.7 | 7.3 |
| Untreated control | | 4.7 | 5.0 | 5.3 | 5.7 |

NB 1 = Poor vigour
10 = Very vigorous plant

2. Harvest data

The harvest data is given for Trial 1 in Table 2 and Trial 2 in Table 3. There is no consistent effect of treatment upon harvest data. In Trial 1 Dursban 4 applied in the propagation area appears to lengthen the spread of cut but this was not substantiated in Trial 2.

Table 2 Trial 1 - Harvest data

| Treatment | | Date | | | Length of |
|---|---|---|---|---|---|
| Insecticide | Application | 10% cut | 50% cut | 90% cut | cutting period |
| Birlane | Field granules | 8 July | 12 July | 16 July | 8.3 |
| Dursban 4 | 0.01 ml/plant applied in propagation | 8 July | 13 July | 19 July | 10.5 |
| | 0.02 ml/plant applied in propagation | 8 July | 14 July | 20 July | 11.5 |
| | 30 ml/plant injected containing 0.1 ml | 9 July | 14 July | 17 July | 7.9 |
| | 50 ml/plant injected containing 0.1 ml | 10 July | 14 July | 20 July | 9.5 |
| | 30 ml/plant injected containing 0.2 ml | 9 July | 14 July | 19 July | 9.1 |
| | 50 ml/plant injected containing 0.2 ml | 8 July | 13 July | 18 July | 9.7 |
| Untreated control | | 7 July | 10 July | 14 July | 7.8 |
| SED | days (14 df) | 1.91 | 2.45 | 3.27 | 1.63 |

Table 3 Trial 2 - Harvest data

| Treatment | | Date | | | Length of |
|---|---|---|---|---|---|
| Insecticide | Application | 10% cut | 50% cut | 90% cut | cutting period |
| Birlane | Field granules | 1 Sept | 6 Sept | 17 Sept | 16.0 |
| Dursban 4 | 0.01 ml/plant applied in propagation | 1 Sept | 6 Sept | 13 Sept | 11.6 |
| | 0.02 ml/plant applied in propagation | 1 Sept | 8 Sept | 16 Sept | 14.3 |
| | 30 ml/plant injected containing 0.1 ml | 2 Sept | 8 Sept | 18 Sept | 15.2 |
| | 50 ml/plant injected containing 0.1 ml | 2 Sept | 7 Sept | 16 Sept | 13.6 |
| | 30 ml/plant injected containing 0.2 ml | 2 Sept | 8 Sept | 17 Sept | 15.2 |
| | 50 ml/plant injected containing 0.2 ml | 1 Sept | 7 Sept | 15 Sept | 13.9 |
| Untreated control | | 3 Sept | 7 Sept | 17 Sept | 13.3 |
| SED | days (14 df) | 1.28 | 1.37 | 2.08 | 1.69 |

## 3. Yield data

Yield data is given in Table 4 for Trial 1 and Table 5 for Trial 2. In Trial 1 the highest yields came from plants treated with Dursban 4 applied during propagation as there were no missing plants and very little of the crop was rated unmarketable. The Birlane treated plots had some missing plants (a total of five from all three plots) and some unmarketable which resulted in a slight yield loss. All the Dursban 4 applied in the field by the transplanter plots, had similar disappointing yields and numbers of missing plants (approximately 20 from all three plots). The untreated control had an even slightly lower yield.

In the second trial there were very few missing plants and all treatments, except the untreated control, gave a very high yield of reasonable quality curds. The lower yield of the untreated control was from unmarketable rather than missing plants and this was mainly due to discoloured curds.

Table 4 Trial 1 - yield data (crates/ha) and percent missing plants (ang.)

| Treatment Insecticide | Application | Class I heads cr/ha | Class II heads cr/ha | Total mkbl yield cr/ha | % of missing plants angle transform |
|---|---|---|---|---|---|
| Birlane | Field granules | 957 | 1386 | 2343 | 13.2 |
| Dursban 4 | 0.01 ml/plant applied in propagation | 1089 | 1683 | 2772 | 0.0 |
| | 0.02 ml/plant applied in propagation | 990 | 1749 | 2739 | 0.0 |
| | 30 ml/plant injected containing 0.1 ml | 639 | 924 | 1617 | 31.9 |
| | 50 ml/plant injected containing 0.1 ml | 528 | 1221 | 1749 | 26.0 |
| | 30 ml/plant injected containing 0.2 ml | 561 | 1089 | 1650 | 32.6 |
| | 50 ml/plant injected containing 0.2 ml | 627 | 1188 | 1815 | 24.9 |
| Untreated control | | 495 | 924 | 1491 | 32.4 |
| SED | (14 df) | 337.20 | 315.70 | 452.10 | 7.70 |

Table 5 Trial 2 - yield data (crates/ha) and percent missing plants (ang.)

| Treatment<br>Insecticide | Application | Class I heads cr/ha | Class II heads cr/ha | Total mkbl yield cr/ha | % of missing plants angle transform |
|---|---|---|---|---|---|
| Birlane | Field granules | 1716 | 1188 | 2904 | 0.0 |
| Dursban 4 | 0.01 ml/plant applied in propagation | 1419 | 1386 | 2805 | 3.5 |
| | 0.02 ml/plant applied in propagation | 1815 | 1023 | 2838 | 3.5 |
| | 30 ml/plant injected containing 0.1 ml | 1386 | 1254 | 2640 | 5.0 |
| | 50 ml/plant injected containing 0.1 ml | 1188 | 1650 | 2838 | 0.0 |
| | 30 ml/plant injected containing 0.2 ml | 1485 | 1254 | 2739 | 3.5 |
| | 50 ml/plant injected containing 0.2 ml | 1386 | 1419 | 2805 | 3.5 |
| Untreated control | | 1056 | 1419 | 2475 | 6.1 |
| SED | (14 df) | 231.20 | 216.80 | 115.00 | 5.60 |

4. Cabbage root fly root damage index (RDI) assessments

The results of these assessments are given in Table 6 for Trial 1 and Table 7 for Trial 2. In Trial 1, despite the differences already seen in yield and vigour between treatments, all treatments including the Dursban 4 controls had a high RDI. The assessment on this trial was done post-harvest which was also after the second generation peak and therefore the observed results are considered to be second generation damage masking any chemical control of the first generation attack. Therefore, in the second trial the assessment was done one month after the second generation peak and here it can be seen quite clearly that the three chemical control treatments have effectively prevented cabbage root fly attack whereas all the Dursban 4 applied in the field had a similar level of attack to the untreated controls and so despite the yield results which showed that in this trial all treatments except the control yielded similarly, the RDI results show that this was not due to CRF control, but that the plants were able to tolerate the level of attack sustained.

Table 6 Trial 1 - post-harvest root damage index assessments

| Treatment<br>Insecticide | Application | Mean<br>Root damage<br>index |
|---|---|---|
| Birlane | Field granules | 37.3 |
| Dursban 4 | 0.01 ml/plant applied in propagation | 49.1 |
| | 0.02 ml/plant applied in propagation | 52.6 |
| | 30 ml/plant injected containing 0.1 ml | 62.4 |
| | 50 ml/plant injected containing 0.1 ml | 50.6 |
| | 30 ml/plant injected containing 0.2 ml | 60.6 |
| | 50 ml/plant injected containing 0.2 ml | 62.4 |
| Untreated control | | 49.1 |

Table 7 Trial 2 - post-second generation CRF attack root damage index assessments

| Treatment<br>Insecticide | Application | Mean<br>Root damage<br>index |
|---|---|---|
| Birlane | Field granules | 0.7 |
| Dursban 4 | 0.01 ml/plant applied in propagation | 7.0 |
| | 0.02 ml/plant applied in propagation | 1.0 |
| | 30 ml/plant injected containing 0.1 ml | 34.3 |
| | 50 ml/plant injected containing 0.1 ml | 47.2 |
| | 30 ml/plant injected containing 0.2 ml | 38.7 |
| | 50 ml/plant injected containing 0.2 ml | 38.3 |
| Untreated control | | 42.3 |

The above are a rather disappointing set of results for what was considered an interesting and perhaps exciting project. However, there are mitigating circumstances and this should be considered as the start of this project rather than the end. The first trial was in fact the very first outing of the machine and despite strenuous efforts to calibrate it even between treatments it is considered probable that there could have been occasions where the planter and applicator had slipped synchronisation and thus cause of the poor results from the first trial.

However, by the time of the second trial, this tendency to slippage had been rectified and we were happy that the Dursban 4 was being applied to short strips either side of the base of the stem. Therefore, another reason for the non control of CRF had to be found and there are two possibilities. Firstly the two strips applied either side of the stem did not give total protection as there was a slight gap between the strips and this could allow eggs to escape control, but more probably the reason for the failure was that the amount of Dursban 4 applied was equivalent to the propagation application and that this would be too low and should in future be related to the field rate which would be 3.5 times as much chemical as used in the stronger application above. It is even a possibility that a combination of the two factors are causing the effect seen, this should be investigated in the future.

## CONCLUSIONS

1. The machine can accurately apply CRF control chemicals but the arrangement of the coverage achieved with the chemical needs further investigation.

2. It is probable that a higher strength solution of Dursban 4 is required.

## RECOMMENDATIONS FOR FURTHER WORK

The above two conclusions should form the basis of a further trial.


## ACKNOWLEDGEMENTS

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