AGRICULTURAL DEVELOPMENT AND ADVISORY SERVICE

Report to: Dr J T Braunholtz
Horticultural Development Council
18 Lavant Street
Hampshire
GU32 3EW

ADAS Contract Manager: Dr M Saynor
Block A
Coley Park
Reading
Berks
RG1 6DT

Tel: 0734 581222 Ext 3321

Period of investigation: May-December 1988
Date of issue of report: March 1989
No of pages in report: 19

CONTRACT REPORT

No C/87/0508
FV/13/87

Swede: Cabbage root fly chemical control - 1988

Undertaken for the Horticultural Development Council

YEAR 2

CONTENTS

APPENDICES

Summary

Work in North Humberside compared the performance of granules applied either four or six weeks after sowing or at the onset of cabbage root fly second generation attack. The granular applications were of carbofuran as Yaltox and chlorfenvinphos as Birlane granules. Chlorfenvinphos as Birlane 24 was also evaluated as two or three spray programmes. Cabbage root fly adult activity was monitored and damage by cabbage root fly larvae to swede bulbs was assessed on three occasions.

Yaltox applied at mid-season gave the highest yield of marketable swedes in both September and December. Birlane granules applied at the same time provided the second highest yield of marketable crop and this treatment gave considerably better control of the pest than in previous trials. Mid-season granular applications gave better control of cabbage root fly than equivalent earlier treatments and mid-season spray programmes.

Although relatively few eggs were laid, numbers increased sufficiently in August for accurate timing of mid-season treatments against the pest.

This experiment, completed over two seasons, has conclusively demonstrated the merits of timing mid-season insecticide applications from pest monitoring programmes. In the north of England carbofuran granules have generally been the most effective mid-season treatment whereas in the south west chlorfenvinphos sprays are often preferred.

Introduction

The cabbage root fly (Delia radicum) is an important pest of cruciferous crops throughout Europe, the west of Asia, Canada and the USA (Hill, 1987). In the UK there are always two, and sometimes, three generations a year. Attack by larvae of the second or third generations can result in unacceptable blemishing of culinary swedes.

In 1987 a trial in North Humberside compared the use of Birlane granules or sprays and Yaltox granules applied at a range of timings for control of second generation cabbage root fly in swedes. Treatments applied to coincide with the beginning of egg laying by second generation flies proved to be more effective than the equivalent earlier treatments and Yaltox gave better control of the pest than chlorfenvinphos.

In 1988 this trial was repeated, in an attempt to confirm the findings of the previous season. The main objectives of the study were:-

1. to assess under contract to the Horticultural Development Council, the relative merits of several mid-season treatments or programmes of treatments.

2. to evaluate the efficacy of insecticides applied 4 or 6 weeks after drilling compared with a later timing associated with an increase in numbers of second generation flies. The comparisons would also test the need for, and benefits from a monitoring system for timing treatments to control this pest.

Materials and Methods

Site

Mr R Bannister, Barrow House Farm, Langtoft, North Humberside.

Design

The experiment was of a randomised block design with four replicate blocks. The dimensions of each plot were 7 m x 1.7 m and each consisted of four rows 0.38 m (15 inch) apart. There was no space between blocks but the trial area was separated from the commercial crop by 4 rows of swedes on each of its longest sides and a 1.7 m guard area at each end. The total area occupied by the trial was therefore 31.4 m x 17 m.

Husbandry

The experiment was located in a commercial crop of swedes cv Angela. All treatments other than insecticides were in accordance with grower practice (Appendix I).

Pest Monitoring

Two water traps (circular dishes of 17 cm diameter and painted yellow) were deployed to catch flies from 30 June until 19 October. All cabbage root flies from these traps were identified and sexed.

Egg laying by adult flies was monitored by taking weekly soil samples from around the base of ten marked plants. On each occasion, uninfested soil was used to replace that which was taken. Fly eggs were extracted by washing the soil through a Fenwick can (Fenwick, 1940) and examining the extract. All cabbage root fly eggs were then counted.

Insecticides

Table 1. Insecticides, active ingredients (a.i.) and dose rates.

Insecticide	ai	Amount ai in product g/kg	Dose rate product/ha
Birlane granules	chlorfenvinphos	100	18.4 kg
Birlane 24 ec	chlorfenvinphos	240	3.0 l
Yaltox	carbofuran	50	32.8 kg

Treatments

Table 2. Treatments at drilling, 4 and 6 weeks after drilling, at mid-season (onset of second generation activity) and 2 and 4 weeks subsequently.

Treatment at drilling	4 weeks after drilling	6 weeks after drilling	mid-season (start of 2nd generation)	After onset of second generation	
				2 weeks	4 weeks
1. Birlane granules	-	-	-	-	-
2. Birlane granules	Birlane granules	-	-	-	-
3. Birlane granules	-	-	Birlane granules	-	-
4. Birlane granules	Yaltox	-	-	-	-
5. Birlane granules	-	-	Yaltox	-	-
6. Birlane granules	-	-	Birlane 24	Birlane 24	-
7. Birlane granules	-	-	Birlane 24	Birlane 24	Birlane 24
8. Birlane granules	-	Yaltox	-	-	-
Application dates	20 June	13 July	3 August	17 August	31 August

Insecticide application

Granules were applied with a Horstine Farmery wheelbarrow applicator, fitted with a single fish-tail and delivering a band of 10 cm width. The sprays of Birlane 24 were applied with a carbon dioxide powered, precision knapsack sprayer and a boom 1.33 in length, fitted with 5 fan nozzles of .00 specification. This equipment delivered a band spray of 1.66 m width at a rate of 56.2 ml/second (3.37 l/minute) and 3.0 bar pressure.

Assessments

Root damage was assessed on 3 August and 28 September from 10 plants per plot and on 7 December from 25 plants per plot. Results are expressed as mean per cent infestation index (King and Forbes 1954) and as per cent marketable swedes. Roots were considered to be marketable only if they were assigned to categories 0 or 1 (clean or light) in King and Forbes' grading system (Appendix II).

Statistical analysis

Root damage indices were transformed to $\log_{10}$ values and % marketable swedes to arcsin values before being subjected to an analysis of variance. Where appropriate mean separation was by Duncan's Multiple Range Test.

Results

Pest Monitoring

The data from water trapping and soil sampling are summarised in Figures 1 and 2, Appendix III. Monitoring began on 30 June and second generation flies were caught from 20 July until 19 October. The peak of activity was recorded on 24 August when 9.1 flies per trap per day were trapped.

Cabbage root fly eggs were recovered throughout the monitoring period; numbers were generally low and did not exceed 0.3 eggs/plant/day. Mid-season treatments were timed to coincide with the initial increase in egg laying by second generation adults on 17 August. The number of eggs found then remained constant at 0.3 eggs/plant/day for 7 weeks until 5 October.

Root damage index

Root damage index was assessed on three occasions (Table 3). At the August assessment, only treatments 2, 4 and 8 had been applied and so these data were not statistically analysed. However, all three treatments gave some protection from a small larval attack.

In September and December, RDI differed significantly between treatments ($P < 0.01$ and $P < 0.05$ respectively). In September, Yaltox applied at mid-season gave the best control ($P < 0.05$) of second generation cabbage root fly attack.

Table 3. Infestation indices of root damage by cabbage root fly larvae at three assessment dates (figures in brackets are $\log_{10}$ transformed values).

Treatment	Mean Infestation index		
	3 August	28 September	7 December
1. Untreated	3.4	38.8 (1.58) b	30.1 (1.47) b
2. Birlane granules @ 4 weeks	1.6	32.5 (1.47) b	29.8 (1.42) b
3. Birlane granules @ mid-season	-	27.4 (1.39) b	20.2 (1.28) ab
4. Yaltox @ 4 weeks	1.1	44.0 (1.64) b	35.0 (1.53) b
5. Yaltox @ 6 weeks	1.5	22.7 (1.35) b	36.0 (1.54) b
6. Yaltox @ mid-season	-	11.9 (0.96) a	13.2 (1.08) a
7. Birlane 24 x 2	-	36.3 (1.55) b	33.3 (1.47) b
8. Birlane 24 x 3	-	29.2 (1.44) b	27.7 (1.41) b
SED 21 DF		(0.139)	(0.119)

a and b are Duncans Multiple Range test indices. Treatment means followed by the same letter do not differ significantly.

In December, the best control again resulted from the use of Yaltox Granules at mid-season ($P < 0.05$) but Birlane granules at the same timing were also very effective.

% Marketable swedes

The data for percentage marketable swedes at the September and December assessments are shown in Table 4. Values are not included for the August assessment; at this stage the roots were too small to market.

Table 4. Percentage of marketable roots, on 28 September and at harvest on 7 December 1988. (Figures in brackets are arcsin transformed values).

Treatment	Mean per cent marketable roots	
	28 September	7 December
1. Untreated	45.0 (42.1) a	57.8 (49.5)
2. Birlane granules @ 4 weeks	60.0 (51.1) ab	66.5 (55.7)
3. Birlane granules @ mid-season	63.5 (53.1) ab	72.8 (59.9)
4. Yaltox @ 4 weeks	41.5 (40.0) a	51.3 (45.6)
5. Yaltox @ 6 weeks	75.8 (60.6) b	56.0 (48.5)
6. Yaltox @ mid-season	90.0 (77.1) c	85.0 (67.9)
7. Birlane 24 x 2	47.5 (43.5) a	59.0 (50.3)
8. Birlane 24 x 3	56.5 (49.0) ab	66.3 (55.1)
SED 21 DF	(7.18)	(7.09)

a, b and c are Duncans Multiple Range test indices. Treatment means followed by the same letter do not differ significantly.

In September there was a significant difference in the percentage of marketable swedes between treatments ($P < 0.01$). Yaltox applied at mid-season gave the highest ($P < 0.05$) proportion of marketable swedes (90%). The lowest proportion of marketable swedes (41.5%) were from plots treated with Yaltox 4 weeks after drilling.

In December percentage marketability did not differ significantly between treatments. Most marketable swedes were again recorded where Yaltox was applied at mid-season (85%) and least where it was applied 4 weeks after drilling (51%).

Discussion

Cabbage root fly activity was delayed and protracted as in the 1987 season. However, egg numbers increased sufficiently during the week ending 17 August to enable accurate timing of mid-season control measures against the second generation of the pest. The level of larval attack however, was less severe than in 1987 and at least 58% of roots from the untreated controls were marketable.

The results confirmed the findings from previous trials that Yaltox applied at mid-season provided the best control of second generation cabbage root fly and so yielded a higher proportion of marketable swedes than all other treatments. At least 85% of roots from these plots were marketable at harvest in December.

Birlane granules applied at mid-season gave the second highest yield of marketable swedes at harvest in contrast to 1987, when all Birlane treatments gave inadequate protection for a September harvest. The reduced pest pressure in 1988 is likely to have provided a less rigorous test of this product.

The importance of correct timing is confirmed by the efficacy of the mid-season treatments compared to those applied earlier. Yaltox applied six weeks after drilling gave adequate protection of the crop until September but lacked the necessary persistence for control of late hatched larvae. It is however, difficult to explain why Birlane granules were more effective than Yaltox when applied four weeks after drilling.

Mid-season spray programmes were less effective than Birlane or Yaltox granules, probably because liquid formulations are less persistent than granules, or because less insecticide reaches the soil when the plants are large and the foliage retains most of the spray.

Conclusions 1988

i. Yaltox granules applied at mid-season gave the best control of second generation cabbage root fly and so yielded the highest proportion of marketable swedes at both harvests.

ii. Birlane granules applied at mid-season gave the second highest yield of marketable swedes in contrast to 1987 when control with this insecticide was poor.

iii. Granules applied mid-season gave better control of cabbage root fly than the equivalent treatments applied earlier or mid-season spray programmes.

iv. Pest monitoring enabled accurate timing of mid-season treatments against cabbage root fly despite low numbers of eggs being laid by adult flies.

Conclusions 1987-88

The combined results over two years of this study have shown the following:

i. Insecticides applied at mid-season gave best control of second generation cabbage root fly.

ii. Monitoring of egg laying by second generation cabbage root fly provided an accurate means of timing mid-season treatments against the pest even during seasons when low numbers of eggs were laid or egg laying was protracted.

iii. In the north of England Yaltox was the most effective mid-season insecticide against cabbage root fly and gave the greatest yield of marketable swedes.

iv. In the south west Birlane sprays were often the most effective mid-season treatment particularly under conditions where moisture was limiting.

vi. In some circumstances, the use of Birlane at rates greater than currently recommended, may give more effective control, and may facilitate longer intervals between sprays.

Recommendations

i. This work should be repeated at the same site for at least one more year to clarify the reasons for variable control given by Birlane granules from season to season.

ii. Further work should investigate reasons for observed differences between Birlane and Yaltox at different sites, especially the possibility of enhanced degradation of insecticides by microbial action.

iii. If granules give better control than sprays because they are not retained on the leaves further work might investigate the use of sprays (Birlane) which are either washed off or not washed off the leaves.

iv. The usefulness of mid-season Yaltox applications, especially at sites where spray programmes are unreliable, should be widely promoted.

Acknowledgements

The assistance of Mr R Bannister of Langtoft who provided the trial site and cooperated at all stages of the work, is gratefully acknowledged. We also thank staff of the ADAS Entomology Laboratory at Leeds.

References

Fenwick D W (1940) Methods for the recovery and counting of cysts of Heterodera schactii from soil. Journal of Helminthology 18 p. 155-172.

Hill D S (1987) Agricultural insect pests of temperate regions and their control. Cambridge University Press.

King K M and Forbes A R (1954) Rutabaga root maggot control. Journal of Economic Entomology 47 p. 607-615.

Storage of Data

All the raw data will be retained by ADAS. ADAS will consult the HDC before disposing of the data.

Appendix I

Details of crop

Cultivar:	Angela
Sowing date:	21 May
Fertiliser:	840 kg/ha 0:24:24 400 kg/ha nitrotop 1 l/ha liquid boron
Herbicide:	2.3 l/ha Treflan
Insecticides:	10.65 kg/ha Sapecron 10 FG
Harvest:	Crop still in ground

Appendix II

Cabbage Root Fly Infestation Index (King and Forbes, 1954)

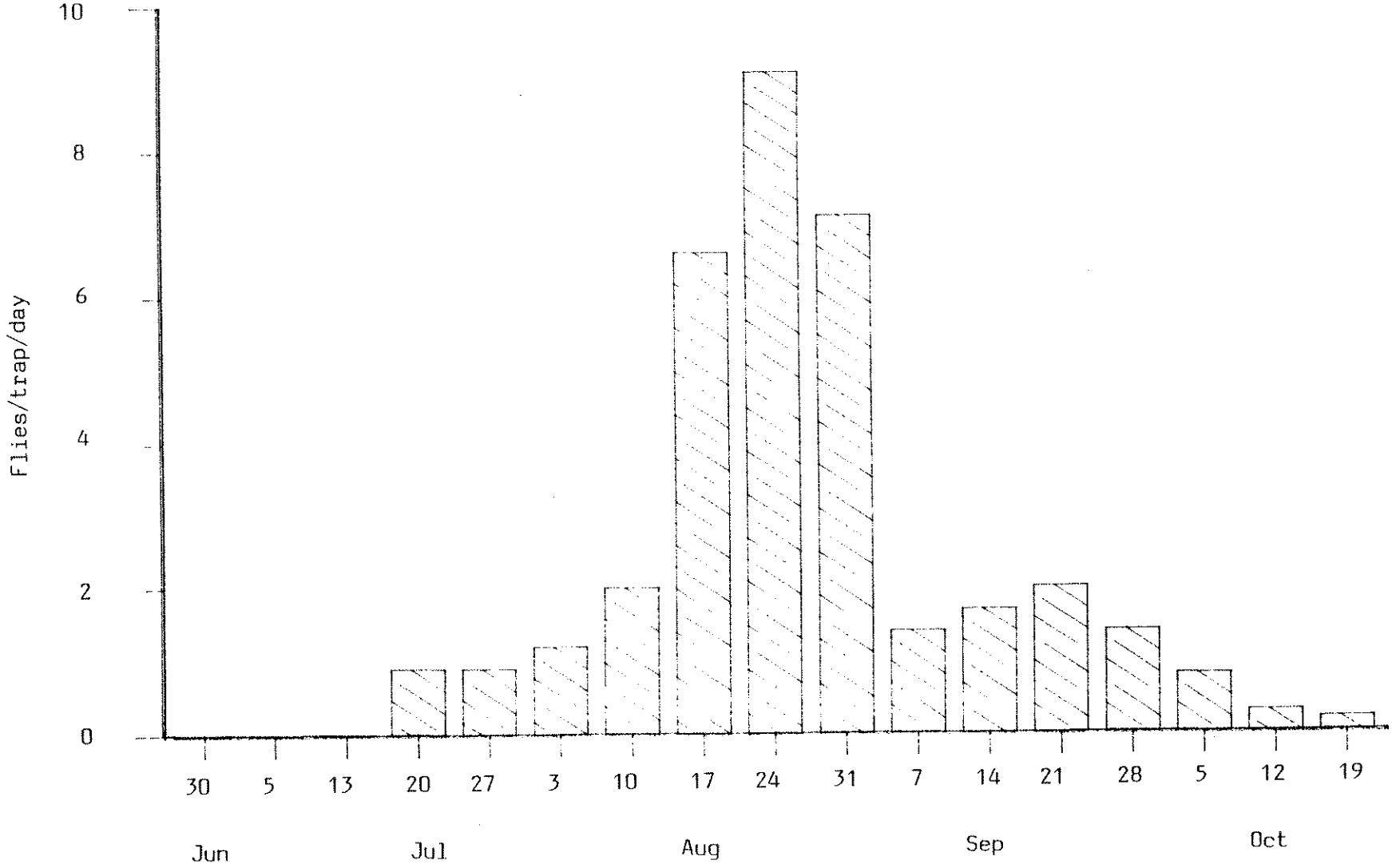
All swedes in each sample are assigned to one of the following categories.

CLEAN	No evidence of any injury.
LIGHT	Injury superficial, slight and fully healed over; ie definite cabbage root fly attack, but of negligible commercial significance, even if all roots are affected.
MODERATE	Marketable for second grade after trimming just above the tap root to remove either a single deep lesion or a moderately extensive surface lesion. Any injury on the fleshy part of the bulb must be fully healed over, must occupy no more than 20 per cent of the surface area, and must be completely removable by normal peeling at the time of preparation for cooking.
SEVERE	Unmarketable for table use. Injury not removable by any practicable amount of trimming. Includes any bulb with deep lesions or unhealed surface injury on the fleshy part of the bulb, or on which larvae are present at harvest.

Where a = the percentage of CLEAN roots
b = the percentage of roots with LIGHT damage
c = the percentage of roots with MODERATE damage
d = the percentage of roots with SEVERE damage

the percentage Infestation Index = $[(1b) + (2c) + (4d)] / 4$
and the percentage of marketable swedes = $a + b$

Appendix III Figure 1. Mean daily catches of adult cabbage root fly in two water traps at Langtoft, June-October 1988.



Appendix III Figure 2. Mean daily numbers of eggs laid by adult cabbage root fly around the base of ten marked plants at Langtoft June-October 1988.