Agricultural Development and Advisory Service

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

Tel: 0730 63736

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

Tel: 0734 581222 Ext 3321

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Assessment of methods of chemical control against slug damage on Brussels sprouts

Undertaken for the Horticultural Development Council

CONTRACT REPORT
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PRINCIPAL WORKERS

M J Savage BSc, C Biol, MI Biol	Entomologist (author of report) Bristol
M J Lole, B Tech	Entomologist, Kirton

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

M J Savage BSc (Hons)
C Biol, MI Biol
Officer Responsible

Date ....30/3/90.....

Report authorised by: .....

Signature

Dr D V Alford
Regional Entomologist
Block 3, Government Buildings
Westbury-on-Trym
Bristol
BS10 6NJ

Tel: 0272 591000

Date .....

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SUMMARY

At Paxford, Gloucestershire and Boston, Lincolnshire two trials were conducted in the 1989 Brussels sprout crop to compare different molluscicides, timings and their efficacy in controlling slug grazing damage to the buttons. The molluscicides were methiocarb (Club) and metaldehyde (PBI Slug Pellets). The timings were designed to coincide with rainfall and critical stages of crop growth.

At both sites, populations of slugs remained very low throughout the growing period. This has no doubt resulted to a large degree from the abnormal weather conditions. 1989 was the driest year since 1976 and one of the warmest this century.

Slug damage to buttons was very low at both sites and no significant differences, between any of the treatments, were obtained.

These results are similar to those of last year when conditions were also unfavourable for slug activity. However, they clearly indicate that control measures against slug damage are not required, routinely, every year.

INTRODUCTION

Approximately 11,000 ha of Brussels sprouts are grown in the UK, of which 2,800 ha are grown in Lincolnshire and 1,200 in the Vale of Evesham/Gloucestershire area. Forty per cent of the Lincolnshire crop is for the processing trade whilst the Evesham/Glos crop is mainly for the fresh market with an increasing proportion going to the supermarket trade. Among other qualities, all of these markets require freedom from surface blemishes and discolourations.

In some years, (eg 1985 and 1987) considerable quantities of Brussel sprouts fail to attain the required standard due to the surface of the buttons being grazed by slugs, mainly during September and October. At that time of year many sprout crops are relatively advanced in growth. The sprout plants are grown close together in order to ensure acceptable, uniform button size, and this produces good conditions for slugs if the weather is wet. Crop debris in the form of fallen lower leaves provides food and shelter for the slugs, whilst autumn rainfall ensures that the relative humidity in the crop remains high, which also favours the pest.

The most important species of slug involved, in arable fields, is the grey field slug, Deroceras reticulatum. Other species may be present in some horticultural situations.

Currently, most growers use bran-based pellets to control the slugs, application usually being timed when damage is first seen. This strategy appears ineffective, probably because there is much alternative food for the slugs within the sprout crop. Slug pellets generally have a short period of activity in the field and tend to kill a relatively small proportion of the slug population.

This experiment was designed to discover whether the application of molluscicide treatments earlier in the life of the crop, before damage has occurred, leads to improved slug control and reduced button damage.

Monitoring of slug activity during this study would provide information concerning conditions when damage is most likely.

MATERIALS AND METHODS

Site 1

Wellacre Farm, Paxford, Gloucestershire. This site was on the holding of an established business at the tip of Gloucestershire within about 3 miles of the border with Warwickshire. A wide range of vegetables are grown for both the fresh market and the pre-packed trade, mainly on clay loam soils.

The experiment was of a randomised block design with four replicate blocks. Each plot was twelve metres by fifteen metres with the Brussel sprouts planted at spacings of approximately one metre between rows and within rows.

Site 2

Southfields Farm, Kirton, Boston, Lincolnshire. This site was on the holding of an established business growing Brussels for processing, mainly on silt soils.

The trial was of a randomised block design with four replicate blocks. Each plot was nine metres by eleven metres, with the Brussel sprouts planted at spacings of approx 60 cm between rows and 50 cm within rows.

See Appendix.

Fig 1: Location of sites

Treatments

Two commercially available molluscicides were used in the treatments at the standard rate. These were:-

1) 4% methiocarb (Club) @ 5.5 kg/ha
2) 6% metaldehyde (PBI Slug Pellets) @ 15 kg/ha

The treatments were

	Chemical	Timing
A	Untreated control	-
B	Methiocarb	Monthly applications, planting to harvest
C	Methiocarb	Single application at canopy closing
D	Methiocarb	Applied after 10 mm rainfall, from canopy closing until one week before harvest. Minimum interval between treatments 2 weeks. Maximum 4 treatments.
E	Methiocarb	Applied after 10 mm rainfall, from canopy closing until one week before harvest. Minimum interval between treatments 4 weeks. Maximum 2 treatments.
F	Methiocarb	First sign of damage to buttons
G	Metaldehyde	As (B)
H	Metaldehyde	As (C)
I	Metaldehyde	As (D)
J	Metaldehyde	As (E)

Treatment Dates

Site 1

B, G - 14 June, 4 July, 1 August, 29 August, 26 September, 24 October, 21 November

C, H - 8 August

D, I - 15 August, 19 September, 10 October, 24 October

E, J - 15 August, 19 September

F - 24 October

Site 2

B, G - 12 May, 14 June, 13 July, 15 August, 15 September, 10 October

C, H - 15 August

D, I - 15 August, 15 September, 10 October

E, J - 15 August, 15 September

F - 10 October

Husbandry

The trials were located in commercial crops that were planted in fields where severe slug damage had occurred on sprouts in 1987. In order to provide a sequence of picking dates across the field, different cultivars with different maturity dates had been planted.

At Site 1 the trial was located in a crop of cv Steven and at Site 2 in cv Dolmic.

The sprouts were raised in cellular trays and planted by the growers in early June (Site 1) and mid April (Site 2).

The plots were marked out on 14 June (Site 1) and 27 April (Site 2) and traps consisting of a small quantity of wheat bran covered by an upturned plant pot saucer were placed within the rows. The traps were examined for slugs at weekly intervals and all captured slugs were removed. Traps were then moved within the plot to avoid recapture of the same individuals.

The treatments were applied by hand to the plots on the dates described.

Weekly readings of rainfall were taken using a rain gauge installed at the site.

Assessments

The weekly catches of slugs were recorded and some treatments were applied after significant levels of rainfall, other treatments by predetermined crop growth stages or by calendar dates.

At harvest a random sample of 100 buttons was picked from each plot and the amount of damage on each button assessed.

Each button was given a damage score using the following system:

No damage	=	nil
1 or 2 grazed areas	=	low damage level
3 or 4 grazed areas	=	moderate damage level
More than 4 grazed areas	=	high damage level

Statistical Analysis

At Site 1 slug numbers and damage were too low for analysis. Because of this only 25 buttons were assessed and the four replicates of each treatment were aggregated.

At Site 2 the total amount of damage was assessed and analysed. This was done by Analysis of Variance and Duncan's multiple range test was used to separate different treatments. Angular transformation was used during the analysis to transform skewed data.

RESULTS

Table 1: Slug damage

Site 1

	Treatment	% buttons in damage category			
		Nil	Low	Moderate	High
A	Untreated	75	22	2	1
B	Methiocarb, monthly from planting to harvest	96	4	0	0
C	Methiocarb, at canopy closing	93	4	3	0
D	Methiocarb, after 10 mm rainfall from canopy closing until one week before harvest. Minimum interval between treatments 2 weeks. Maximum 4 treatments.	100	0	0	0
E	Methiocarb, after 10 mm rainfall, from canopy closing until one week before harvest. Minimum interval between treatments 4 weeks. Maximum 2 treatments.	89	10	1	0
F	Methiocarb, at first sign of damage to buttons	84	5	11	0
G	Metaldehyde as (B)	93	6	1	0
H	Metaldehyde as (C)	91	5	3	1
I	Metaldehyde as (D)	97	2	1	0
J	Metaldehyde as (E)	94	5	1	0

Site 2

	Treatment	% buttons in damage category			
		Nil	Low	Moderate	High
A	Untreated	71	22	6	1
B	Methiocarb, monthly from planting to harvest	84	12	3	1
C	Methiocarb, at canopy closing	74	17	7	2
D	Methiocarb, after 10 mm rainfall from canopy closing until one week before harvest. Minimum interval between treatments 2 weeks. Maximum 4 treatments	82	14	3	1
E	Methiocarb, after 10 mm rainfall from canopy closing until one week before harvest. Minimum interval between treatments 4 weeks. Maximum 2 treatments.	79	16	5	1
F	Methiocarb, at first sign of damage to buttons	74	23	3	0
G	Metaldehyde as (B)	84	14	3	0
H	Metaldehyde as (C)	74	22	3	1
I	Metaldehyde as (D)	82	15	2	1
J	Metaldehyde as (E)	78	17	1	0

Trap catches of slugs are recorded on graphs 1 and 2.

At Site 1 a total of only 3 slugs were caught throughout the entire trapping period, these were Deroceras reticulatum.

The majority of the slugs caught at Site 2 were Deroceras reticulatum and Arion intermedius. Two Milax budapestienisis were also caught.

Table 2: Total slugs caught - Site 1

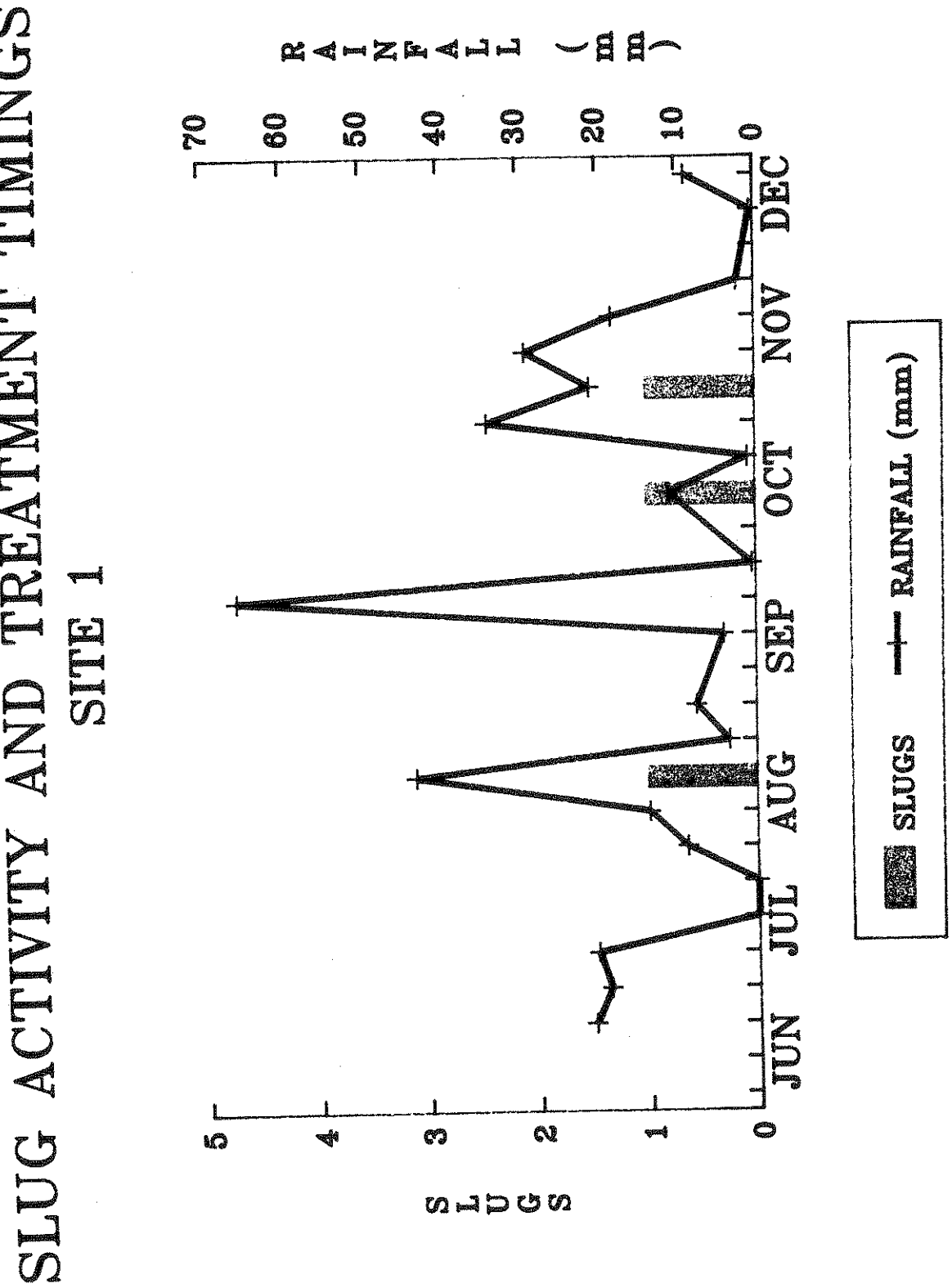
Date	Treatment A	B	C	D	E	F	G	H	I	J	
20 June 89	0	0	0	0	0	0	0	0	0	0	
27 June 89	0	0	0	0	0	0	0	0	0	0	
4 July 89	0	0	0	0	0	0	0	0	0	0	
12 July 89	0	0	0	0	0	0	0	0	0	0	
20 July 89	0	0	0	0	0	0	0	0	0	0	
1 Aug 89	0	0	0	0	0	0	0	0	0	0	
8 Aug 89	0	0	0	0	0	0	0	0	0	0	
15 Aug 89	0	0	0	0	0	0	0	0	1	0	Deroceras reticulatum
23 Aug 89	0	0	0	0	0	0	0	0	0	0	
29 Aug 89	0	0	0	0	0	0	0	0	0	0	
5 Sept 89	0	0	0	0	0	0	0	0	0	0	
12 Sept 89	0	0	0	0	0	0	0	0	0	0	
19 Sept 89	0	*	0	0	0	0	0	*	0	0	
26 Sept 89	0	0	0	0	0	*	0	*	*	0	
3 Oct 89	0	0	0	0	0	0	0	0	*	0	
10 Oct 89	*	0	0	0	0	0	0	1	0	0	Deroceras reticulatum
17 Oct 89	0	0	*	0	0	*	0	*	*	0	
24 Oct 89	0	0	*	0	*	0	*	*	0	0	
31 Oct 89	1	0	*	0	0	0	0	0	0	0	Deroceras reticulatum
8 Nov 89	0	0	0	0	0	0	0	0	0	0	
14 Nov 89	0	0	0	0	0	0	0	0	*	0	
21 Nov 89	0	0	0	0	0	0	0	0	0	0	
28 Nov 89	0	0	0	0	0	0	0	0	0	0	
5 Dec 89	0	0	0	0	0	0	0	0	0	0	
TOTAL	1	0	*	0	*	*	*	1	1	0	

* Slime trails found under slug trap

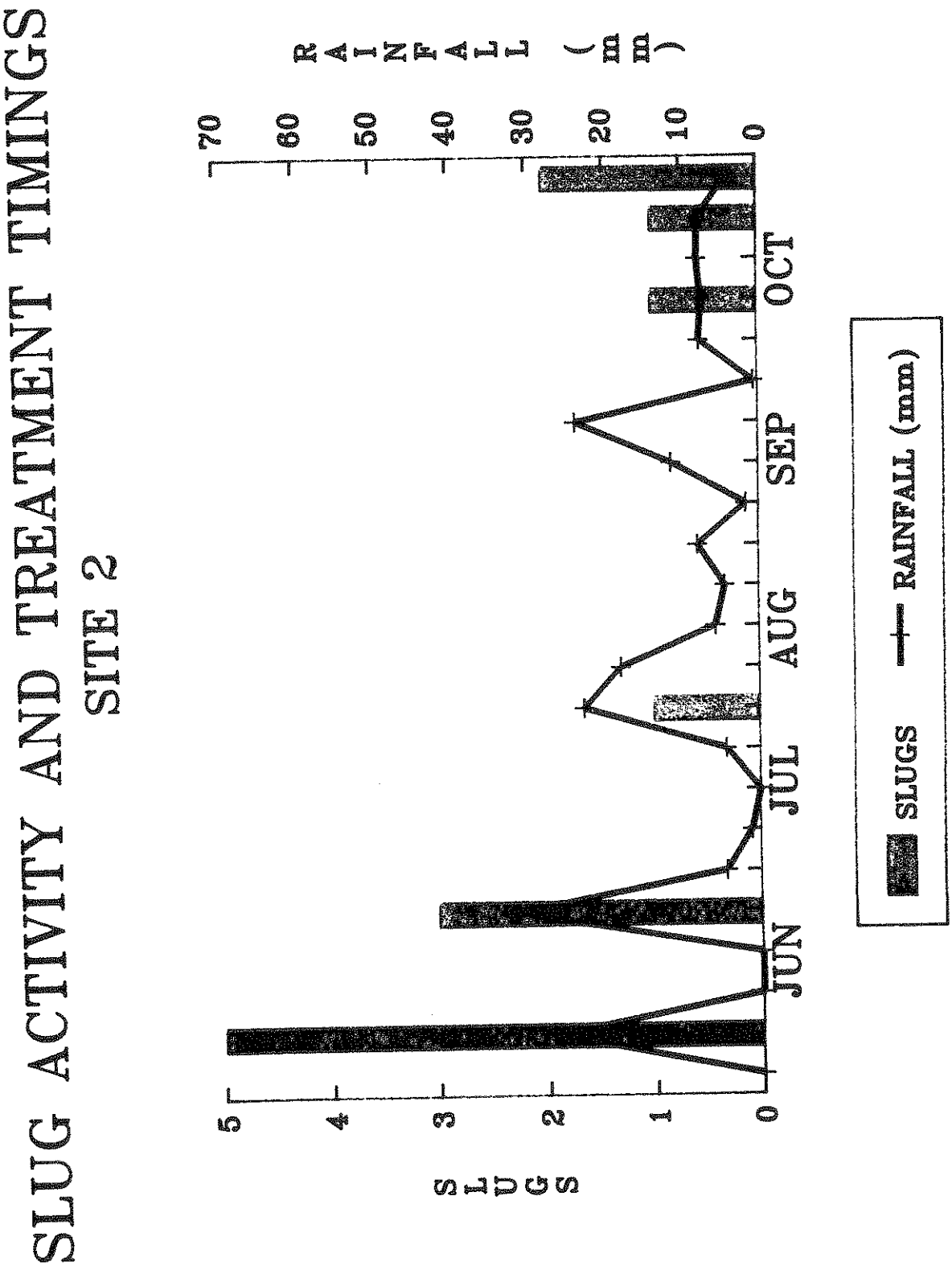
Table 3: Total slugs caught - Site 2

Date	Total slugs from 10 traps placed alongside trial	
31 May 89	0	
5 June 89	0	
9 June 89	5	3 Deroceras reticulatum 2 Arion intermedius
14 June 89	0	
23 June 89	0	
28 June 89	3	2 Milax budapestienisis 1 Arion intermedius
13 July 89	0	
25 July 89	0	
31 July 89	1	1 Deroceras reticulatum
10 Aug 89	0	
15 Aug 89	0	
1 Sept 89	0	
15 Sept 89	0	
18 Sept 89	0	
20 Sept 89	0	
2 Oct 89	0	
10 Oct 89	1	1 Deroceras reticulatum
20 Oct 89	0	
24 Oct 89	1	1 Arion intermedius
1 Nov 89	2	1 Deroceras reticulatum 1 Arion intermedius

Slug activity and treatment timings - Site 1



Slug activity and treatment - Site 2



DISCUSSION

Even in dry summers such as those of 1988 and 1989 many producers routinely treat their Brussels sprout crops with molluscicide baits. On the soils which are prone to slug damage growers may make repeated applications, often at reduced rates. The major problem remains in predicting when increased slug activity will occur and the optimum strategy to control it. Currently most growers make their first application at the growth stage they regard as having the greatest damage risk. Follow-up treatments would usually be made 2-6 weeks later.

An important part of this study has been the investigation of optimum treatment times relative to slug activity. When this study was designed it was decided to use three sets of criteria to act as triggers for application of treatments. These triggers were slug activity, crop growth stage, and calendar date. In the event, slug activity as monitored by the bran traps was minimal, throughout the two year period.

When slug numbers are low it is not easy to use them as triggers for treatment. Rainfall was low throughout the two summers and definite patterns of activity and hence triggering, were impossible to see. However, it seems likely that the optimum triggers for control are either crop growth stages or calendar dates.

In 1989 all molluscicide treatments were ineffective at Site 2 and at Site 1 only methiocarb pellets applied three times (each after 10 mm of rainfall) gave total control of damage. However, even at Site 1 none of the treatments were statistically significant where compared with the untreated plots.

Only at Site 2 in 1988 was it evident that pellet baits are effective in reducing slug damage to sprout buttons. Differences between pellet formulations were also insignificant although at Site 2 (1988) the level of damage in the plot treated with the aluminium ammonium sulphate/copper sulphate mixture was almost identical to those found in the untreated controls.

There is no evidence that multiple applications of pellets show any advantage over single or double applications, or that any of the timings used in this study show a significant advantage.

CONCLUSIONS

To draw meaningful conclusions from four trials, in two years, where only one produced significant results is difficult. Care should be exercised in the interpretation of these trials but several valid inferences may be possible especially since they are in agreement with anecdotal evidence from advisory experience.

(1) The use of methiocarb or metaldehyde pellets in a Brussels sprout crop will reduce the level of damage by slug grazing and may also reduce the severity. There appeared to be no significant differences between methiocarb and metaldehyde pellets but the copper sulphate mixture used in year 1 was not effective.

(2) The use of slug traps may not be a practical, accurate or reliable method of timing treatments applied against slugs.

(3) The efficiency of pellet baits may increase after periods of moderate or heavy rainfall when slugs are most active.

(4) Routine slug pellet applications to Brussels sprouts may be difficult to justify. Even on soils where slug damage is frequently observed, slug activity and therefore their susceptibility to baits may reduce to an insignificant level in dry conditions.

(5) Optimum timing for control measures is not obvious from this study. There is some evidence (from 1988 trial only) to suggest that optimum control results from one or two applications at the time when the crop canopy closes.

RECOMMENDATIONS

In the long-term further investigations are required. However, with the past two years of hot dry summers, useful results have not been forthcoming. It would be useful to repeat this work in a few year's time following wet conditions when slugs have been active and when numbers have returned to normal levels.

ACKNOWLEDGEMENTS

The co-operation of Mr Drinkwater of Ebrington, Chipping Campden and Mr Cheer of Kirton, Boston is gratefully acknowledged.

STORAGE OF DATA

The raw data will be stored by the ADAS Regional Entomologist, Block A, Government Offices, Coley Park, Reading, RG1 6DT for a period of 10 years. HDC will be consulted before disposal.

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APPENDIX

Details of Crop - Site 1

Location:	Wellacre Farm, Paxton, Gloucestershire	
Soil type:	Clay loam (Banbury Association series)	
Cultivar:	Stephen (late season)	
Planting date:	1 June 1989	
Trial plots marked out:	14 June 1989	
Farm applied treatments:	2 July 1989	Aziprotryne) $\frac{1}{2}$ rate Desmetryne)
	11 July 1989	Desmetryne
	3 August 1989	Benomyl Chlorothalonil Cypermethrin
	30 August 1989	Chlorothalonil Triadimenol Demeton-S-methyl
	8 October 1989	Triadimenol Dimethoate
	All at recommended rates, except where indicated	
Plots harvested:	12 December 1989	

Details of Crop - Site 2

Location:	Southfields Farm, Kirton, Boston, Lincs	
Soil type:	Coarse silty marine alluvial Silt (Wisbech Association series)	
Cultivar:	Dolmic (mid-season)	
Planted:	17 April 1989 (after raising in cellular trays)	
Trial plots marked out:	27 April 1989	
Farm applied treatments:	28 April 1989	- Propachlor
	16 June 1989	- Cypermethrin Demeton-S-methyl
	12 July 1989	- Pirimicarb Cypermethrin Chlorothalonil
	14 August 1989	- Cypermethrin Demeton-S-methyl Chlorothalonil Mancozeb + metalaxyl
	31 August 1989	- Cypermethrin Demeton-S-methyl Chlorothalonil Mancozeb + metalaxyl
	11 September 1989	- Cypermethrin Demeton-S-methyl
	2 October 1989	- Cypermethrin Demeton-S-methyl Triadimenol Mancozeb + metalaxyl
	17 October 1989	- Cypermethrin Dimethoate
	All at recommended rates	
Plots harvested:	First week November 1989	