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Pollen beetle: Control on cauliflowers and calabrese

Undertaken for the Horticultural Development Council

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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.

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Summary

In the second year of this project, a replicated field trial on calabrese at Arthur Richwood EHF (AREHF) and a replicated pot trial on ox-eye daisy (Chrysanthemum leucanthemum) at HRI Stockbridge House (HRISH) were again undertaken to evaluate a number of insecticides for control of pollen beetle. In 1991 the synthetic pyrethroids alphacypermethrin, cypermethrin and deltamethrin, were used, sometimes at reduced rates, to assess their ability to deter beetles. Yellow sticky traps were again deployed at the station boundary and in a brassica crop at AREHF and HRI Kirton (HRIK) to monitor pest migration and to provide data for use at HRI Wellesbourne to validate a mathematical model of pollen beetle development. At HRISH traps were positioned in a cauliflower crop and also at the north, east, south and west boundaries of the station to determine if beetle immigration predominated from any particular direction.

Insecticides reduced the number of pollen beetles on treated plants in comparison with the controls although the differences were not always statistically significant. The superiority of synthetic pyrethroids over an organophosphorus active ingredient (triazophos) was confirmed. Alphacypermethrin at half the recommended rate was in general the most effective insecticide tested.

Yellow sticky traps were effective at monitoring pest invasion despite much smaller numbers than in 1990. There was, however, no evidence that traps at station boundaries could provide an early warning of pest attack. There was little difference in the total catch of beetles at the four main compass points but most beetles were caught when the wind blew from the west.

Introduction

Work has continued in 1991 to evaluate a range of insecticide treatments for control of pollen beetle on calabrese and the test plant, Oxe-eye daisy (C.leucanthemum). Previous studies at AREHF showed that beetles sheltered within the heads of calabrese plants and sometimes died there. These individuals became trapped when the heads were overwrapped and could emerge whilst the product was on display and/or could be discovered by the consumer. Experiments in 1991 have therefore concentrated on testing reduced-rate applications of pyrethroid insecticides for their ability to deter beetles from the crop.

Yellow sticky traps were also deployed at HRISH, AREHF and HRIK to monitor the timing, size and direction of beetle migration into brassica crops.

1. THE EFFICACY OF TWO DOSE RATES OF SYNTHETIC PYRETHROID INSECTICIDES FOR CONTROL OF POLLEN BEETLE ON OX-EYE DAISY (CHRYSANTHEMUM LEUCANTHEMUM).

Materials and methods

Site details

The trial was done at HRISH. Pots were set out on a concrete path close to an area of flowering mayweed which was heavily infested with pollen beetle.

Design

The trial was of a randomised block design replicated six times. Individual pots of ox-eye daisy were used as experimental units.

Insecticides

Table 1 Insecticides, active ingredients (ai) and dose rates

Insecticide	ai	Amount ai in product (g/l)	Dose rate product ml/ha
Decis	deltamethrin	25	250 and 125
Fastac	alphacypermethrin	100	200 and 100

Decis is approved for control of cabbage stem flea beetle, rape winter stem weevil and beet western yellows virus on winter oilseed rape at 250ml/ha of product. Fastac is approved for pollen beetle control on oilseed rape at 200ml/ha of product.

Treatments

Table 2 Experimental treatments

Treatment
1. Control
2. Decis @ 250ml/ha normal rate (N)
3. Decis @ 125ml/ha (0.5N)
4. Fastac @ 200ml/ha (N)
5. Fastac @ 100ml/ha (0.5N)

Insecticide application

Prior to insecticide treatment all plants were set up in the field and left for one hour so that they became infested with pollen beetles. Insecticides were applied with a hand held Killaspray 8. All replicates of each treatment were placed on a sheet of polythene before treatment to facilitate the recording of dead beetles immediately after insecticide application. One hundred millilitres of each spray solution was used for each treatment (approx. 17ml/plant). This was a considerably lower volume than in previous work where each plant received the equivalent of 250ml of spray. This reduced volume was intended to highlight the deterrent effect of the insecticides.

Assessments

The numbers of live and dead beetles on each flower on each plant was assessed immediately before and after insecticide application and again 1, 2, 3, 24 and 48 hours post treatment. After treatments the pots were stood on plastic trays to capture beetles which fell from the flowers. The trays were covered with dull green paper to prevent them from attracting live beetles.

Statistical analysis

Where appropriate data were subjected to an analysis of variance. Data on percentage beetle mortality were transformed to arcsin values and data on beetle counts to $\sqrt{(x+1)}$ values prior to analysis. Treatment means were separated using Duncan's Multiple Range Test.

Results

i Beetle mortality

Dead beetles were recorded immediately after insecticide application. Percentage mortality was significantly greater in all treated pots, except those sprayed with reduced rate deltamethrin, than in the control (P<0.05, Table 3).

Table 3 The effect of full and reduced rate insecticides on the mean percentage mortality of pollen beetle immediately after treatment. (The figures in brackets are arcsin transformed values).

Treatment	% beetle mortality	
Alphacypermethrin N	17	(23.4b)
Alphacypermethrin 0.5N	17	(20.8b)
Deltamethrin N	15	(28.1b)
Deltamethrin 0.5N	21	(17.4ab)
Control	6	(2.2a)
SED (20DF)		7.61

a and b are Duncan's Multiple Range Test indices. Treatment means followed by the same letter do not differ significantly (P<0.05).

ii Live beetles/plant

A significant difference (P<0.05) in numbers of beetles/plant between treatments was evident 2 hours after insecticide application (Table 4). Smaller numbers were found on plants treated with reduced rate alphacypermethrin and deltamethrin than on the controls (P<0.05). Control plants were infested with more beetles than those with insecticide at each assessment after application.

The effect of reducing the rate of insecticide varied between treatments. Plants to which reduced rate alphacypermethrin was applied had fewer beetles than plants receiving the full rate at out of 6 assessments post treatment. Plants with reduced rate deltamethrin however, always had more beetles than those treated at the full rate.

Table 4 The effect of full and reduced rate insecticides on the mean numbers of pollen beetles found on plants immediately before and after treatment and 1, 2, 3, 24 and 48 hours subsequently. (The figures in brackets are $\sqrt{(x+1)}$ transformed values)

	Pre-Treatment	Hours after insecticide application					
		0	1	2	3	24	48
Alphacypermethrin N	25.3(5.1)	13.5(3.7)	16.3(3.9)	32.5(5.6ab)	33.5(5.8)	2.5(1.7)	2.2(1.7)
Alphacypermethrin 0.5N	27.0(5.3)	13.2(3.7)	16.2(4.0)	24.0(4.9a)	24.5(5.0)	2.0(1.6)	1.5(1.5)
Deltamethrin N	29.0(5.3)	13.8(3.8)	22.8(4.7)	26.5(5.2a)	28.5(5.3)	4.5(2.2)	2.2(1.7)
Deltamethrin 0.5N	29.8(5.5)	16.7(4.1)	24.0(4.8)	32.7(5.7ab)	35.6(6.0)	4.8(2.4)	3.8(2.2)
Control	19.2(4.3)	22.2(4.7)	32.7(5.7)	46.8(6.8b)	39.3(6.2)	5.6(2.4)	4.3(2.2)
SED(20DF)	0.63	0.47	0.69	0.55	0.58	0.32	0.30

a and b are Duncan's Multiple Range Test indices. Treatment means followed by the same letter are not significantly different (P<0.05).

Discussion

Although numbers of beetles were consistently higher on control plants than on those treated with insecticides the differences were only statistically significant at the assessment 2 hours after application. This probably reflects the much lower volume of spray solution applied than in similar work in 1990. However, despite little significance between treatments it was apparent that lowest numbers of beetles were generally found on plants sprayed with reduced rate alphacypermethrin. As no dead beetles were recorded from 1 hour after insecticide application it is likely that they were deterred from colonising the plants.

Whilst reducing the rate of alphacypermethrin resulted in lower levels of beetle colonisation the opposite was true of deltamethrin. Plants treated with the reduced rate of this insecticide consistently had more beetles than those treated with the full rate throughout the experiment.

No insecticide was able to keep the plants completely free of beetles. However, it is possible that a pyrethroid, particularly alphacypermethrin, applied to the head of a cauliflower would have a greater deterrent effect on beetles because of the larger surface area which would be treated. Also Ox-eye daisy have a bright yellow centre which is likely to be more attractive than a cauliflower head.

Conclusions

1. Pollen beetle numbers were generally lower on insecticide-treated than on untreated plants. Statistical differences were only evident two hours after treatments were applied.

2. Lowest numbers of beetles were generally found on plants sprayed with half rate alphacypermethrin.

3. No insecticide kept plants completely free of beetles.

2. A COMPARISON OF THE EFFICACY OF A RANGE OF INSECTICIDES AS SINGLE OR REPEAT APPLICATIONS AND FULL OR REDUCED DOSES FOR CONTROL OF POLLEN BEETLE ON CALABRESE.

Materials and Methods

Site details

The trial was undertaken on calabrese (cv Greenbelt) at AREHF.

Design

The trial used a randomised block design with three replicate blocks of 8 treatments. Each plot comprised a bed 1.68m wide and 7.5m long.

Husbandry

Seed (cv Greenbelt) was sown into Hassy 228 trays and propagated at a minimum of 15°C. The trial was planted on 23 April with 3 rows per bed at 450mm spacing and 300mm spacing between plants to encourage the development of large heads.

Insecticides

Table 5 Insecticides, active ingredients (ai) and dose rates

Insecticide	ai	Amount ai in product (g/l)	Dose rate product ml/ha
Ambush c	cypermethrin	100	250
Fastac	alphacypermethrin	100	200,100 or 50
Hostathion	triazophos	420	840

The dose rate for Hostathion was that approved for caterpillar control in brassicas. Ambush C is usually applied at 250ml/ha and Fastac is approved for control of pollen beetle on oilseed rape at 200ml/ha.

Table 6   Treatments

	Treatment	Timing
1.	Untreated	-
2.	Alphacypermethrin @ 200ml/ha(N)	Single application
3.	Alphacypermethrin @ 200ml/ha	2 applications at 7 day intervals
4.	Alphacypermethrin @ 100ml/ha(½N)	2 applications at 7 day intervals
5.	Alphacypermethrin @ 50ml/ha(1/4N)	2 applications at 7 day intervals
6.	Cypermethrin @ 250ml/ha	Single application
7.	Cypermethrin @ 250ml/ha	2 applications at 7 day intervals
8.	Triazophos @ 840ml/ha	Single application

Sprays were applied on 3 and 10 July. Subsequently beetle numbers declined markedly. All treatments were repeated on 25 July although the crop was in flower. These sprays provided an additional test of the efficacy of single applications of insecticides against pollen beetle. The previous treatments were applied 13 days earlier and so were unlikely still to be influencing pest activity.

Insecticide application

Insecticides were applied with a carbon dioxide powered, precision knapsack sprayer operating at a pressure of 1.8 bar.

Assessments

Pollen beetle numbers were assessed on 4 occasions, 2 and 7 days after the first spray, 2 days after the second spray and 2 days after the third spray. In each case 10 heads were harvested per plot and placed in sealed plastic bags. Numbers of beetles in each batch of heads were then counted two days after bags were sealed.

Statistical analysis

Where appropriate, data were subjected to analyses of variance. Counts of beetle numbers were transformed to $\sqrt{(x+1)}$ values prior to analysis. Duncan's Multiple Range Test was used for mean separation.

Results

The numbers of pollen beetle recovered from 10 harvested calabrese heads on each assessment date is given in Table 7.

Table 7 The effect of single and repeat applications of insecticides on mean numbers of pollen beetle recovered from calabrese heads. (The figures in brackets are $\sqrt{(x+1)}$ transformed values).

	Assessment date			
	5.7	10.7	12.7	25.7
Untreated	2.0(1.69)	1.3(1.52b)	5.0(2.44c)	119.3(10.93c)
Alphacypermethrin N	1.7(1.61)	0 (1.00a)	1.7(1.52ab)	21.7(4.60ab)
Alphacypermethrin Nx2	0.3(1.14)	0 (1.00a)	0.3(1.14ab)	17.7(3.70a)
Alphacypermethrin 1/4Nx2	0.7(1.24)	0 (1.00a)	1.3(1.49ab)	26.7(5.19ab)
Alphacypermethrin ½Nx2	0.7(1.24)	0 (1.00a)	0.3(1.14ab)	7.7(2.84a)
Cypermethrin	0.3(1.14)	0.7(1.24ab)	1.7(1.61ab)	46.0(6.07ab)
Cypermethrin x 2	0.7(1.28)	0 (1.00a)	0 (1.00a)	43.3(6.37ab)
Triazophos	0 (1.00)	0 (1.00a)	2.3(1.73b)	73.0(8.19bc)
SED (14DF)	0.284	0.136	0.264	1.831

a, b and c are Duncan's Multiple Range Test indices. Figures followed by the same letter are not significantly different ($P<0.05$).

There was no significant difference in numbers of pollen beetle between treatments 48 hours after the first insecticides were applied. One week after treatment, however, significantly more beetles were found on untreated plants than on all other treatments except those sprayed with cypermethrin ($P<0.05$).

After repeat applications of alphacypermethrin and cypermethrin at normal and reduced rates on 10 July significantly more beetles were found in the control than in all other treatments (P<0.05). Plants treated with triazophos also had significantly more beetles than those receiving two applications of cypermethrin, (P<0.05).

Following the additional single spray treatment, on 23 July, there were again significant differences in pollen beetle numbers between treatments (P<0.05). More beetles were counted on untreated plants than on those sprayed with all insecticides except triazophos (P<0.05). Plants treated with Fastac at the normal and half rate also had fewer beetles than those to which triazophos was applied (P<0.05).

Discussion

Pollen beetle numbers were disappointingly low when calabrese plants were approaching harvest. Despite this, insecticides were generally effective in reducing pest numbers on all assessment dates except 5 July, 2 days after the first sprays. There were few significant differences between insecticides. Two sprays of cypermethrin at weekly intervals were significantly better than a single treatment of triazophos on 12 July and a single application of alphacypermethrin at the normal and half rate was better than triazophos on 25 July.

The final sprays on 23 July were applied because pollen beetle numbers had increased markedly. By this time the calabrese was in flower (no longer commercially marketable) and therefore potentially more attractive to beetles than plants approaching harvest. Insecticide treatments were therefore given a more rigorous screening against the pest on this date than when applied earlier in the month. Although there was no statistical difference in beetle numbers between the two pyrethroids, fewest were found on plants treated with alphacypermethrin. Results also suggest that the half rate of this product is more effective in deterring beetles than the full rate but that a further reduction to a quarter rate was less successful.

Conclusions

1. Pollen beetle numbers were disappointingly low when the crop was approaching harvest.

2. Pest numbers were lower in all insecticide treatments than the control on all assessment dates except 2 days after the first treatments.

3. There was little significant difference between insecticide treatments.

4. After the final treatment (when the crop was in flower), fewer beetles were recorded on plants treated with alphacypermethrin than cypermethrin. Lowest numbers were fund where half rate alphacypermethrin was used.

3. MONITORING POLLEN BEETLE MIGRATION USING YELLOW STICKY TRAPS

Materials and Methods

Site details

Yellow sticky traps were deployed at three sites AREHF, HRIK and HRISH.

Design

At AREHF and HRIK three traps were located in a vegetable crop at risk from pollen beetle attack (calabrese or cauliflower), and at the station/farm boundary adjacent to the nearest known crop of oilseed rape. At HRISH three traps were also located in a crop of cauliflowers and two at each of the north, south, east and west boundaries of the station to determine whether beetles migrated in from any particular direction. The traps (20 cm x 10 cm) were mounted on posts or canes using a bulldog clip, and set at a height of about 1 m above the crop. Each trap was spaced about 20 m from the next.

Assessments

The numbers of beetles per trap were assessed every other day. Small numbers were removed with a spatula, but where many individuals were caught the trap was replaced. Traps were in position from 24 May to 26 July at AREHF, from 15 May to 30 August at HRISH and from 29 May to 13 June and 19 July to 25 September at HRIK.

Results

Pollen beetle catches (number/trap/day) at each site are shown in Figures 1-4. Numbers at HRIK were very low throughout the two trapping periods (Figure 1). A peak of 3.1 beetles/trap/day was recorded in the crop on 29 May but catches did not exceed 1/trap/day on any other trapping occasion. Catches at AREHF were also low (Figure 2), with the peak recorded on 26 July. There was little difference in the size and timing of trap catches between the station boundary and the vegetable crop at AREHF and HRIK. At HRISH peak catches in the crop and at the north, south and west boundaries were on 19 July (Figures 3 and 4). On the eastern boundary most beetles were caught on 24 July. Peak numbers in the crop were greater than at the station boundary.

There was little difference in the total numbers of beetles trapped at the north, south, east and west boundaries of HRISH (Figure 5). Catches were however, markedly greater on all traps when the wind was from a westerly direction. At least three times as many beetles were trapped/day when the wind was westerly than any other direction (Figure 6). The second highest catches occurred when the wind was from the south followed by the north and east. The wind blew more frequently from the west than from other directions. When data was corrected to take account of the number of days when the wind was from a particular direction, greatest catches were still recorded when a westerly wind was blowing with decreasing numbers when winds blew from southerly, easterly and northerly directions (Figure 6).

Figure 1. Pollen beetle catches at HRI Kirton, 1991.

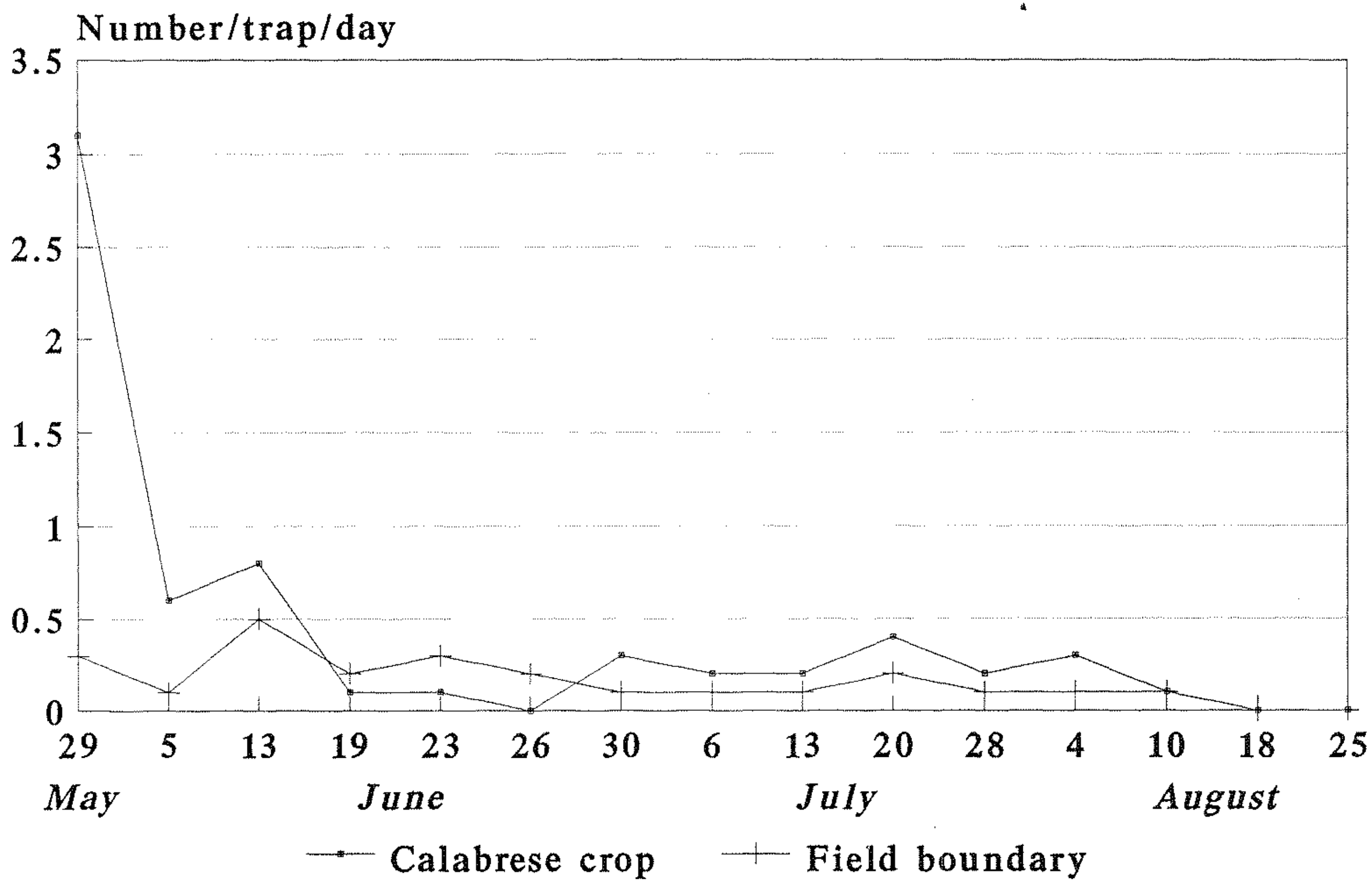

Figure 2. Pollen beetle catches at Arthur Rickwood EHF, 1991.

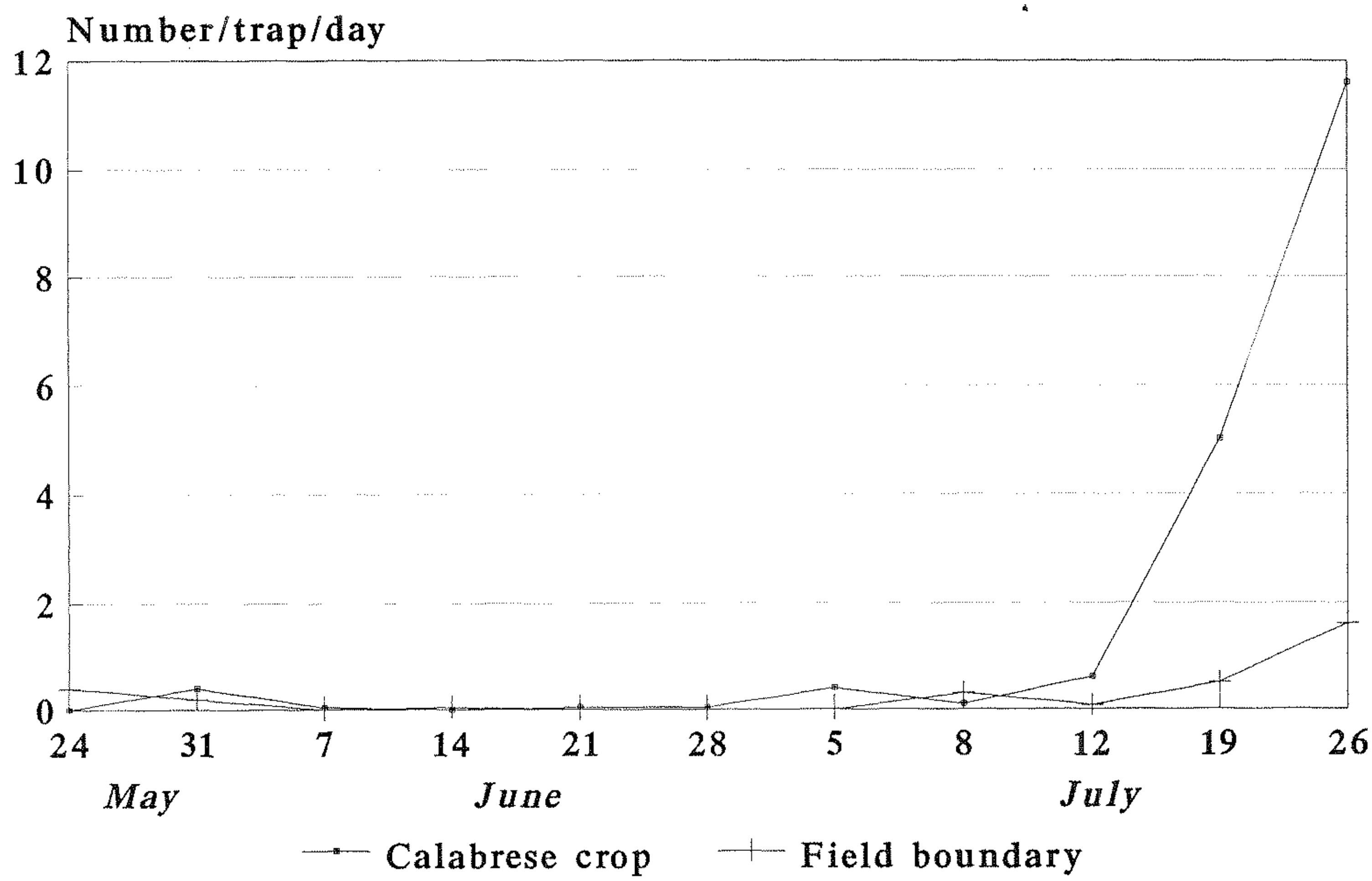

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Figure 3. Pollen beetle catches in cauliflowers at HRISH, 1991.

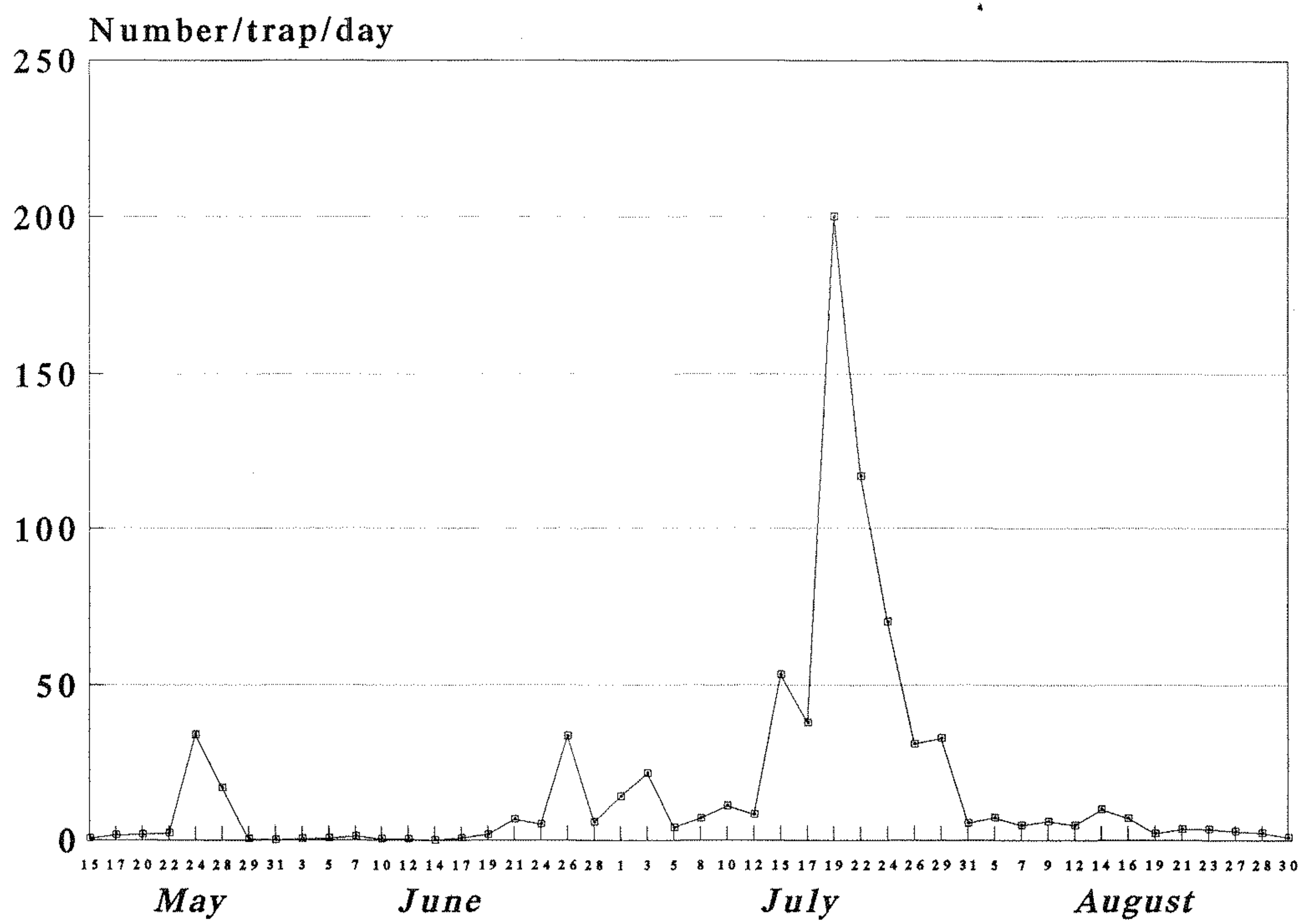


Figure 4. Pollen beetle catches at the N, E, S, and W boundaries of HRISH, 1991

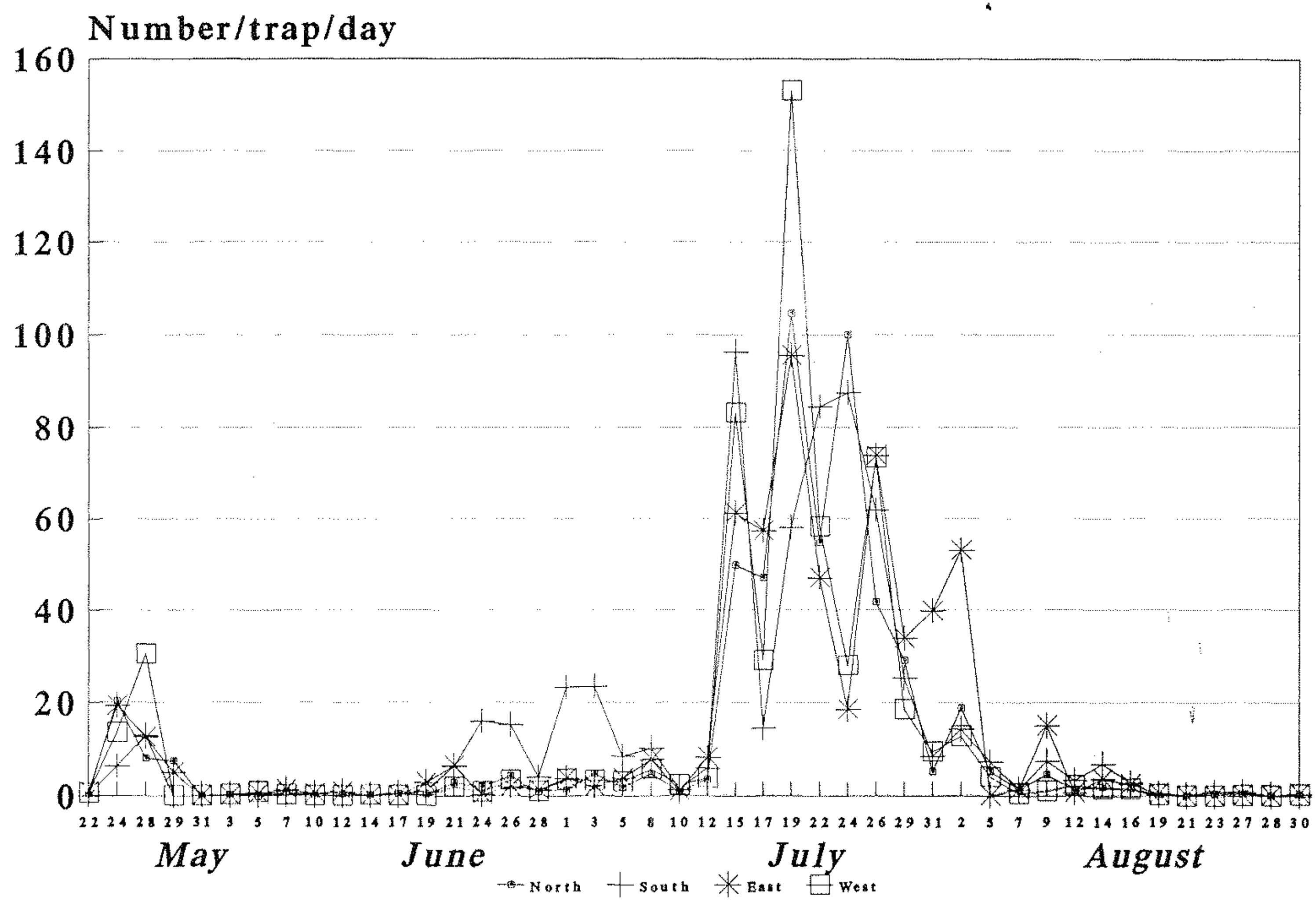


Figure 5. Total pollen beetle catch at N, E, S, & W boundaries of HRISH, 1991.

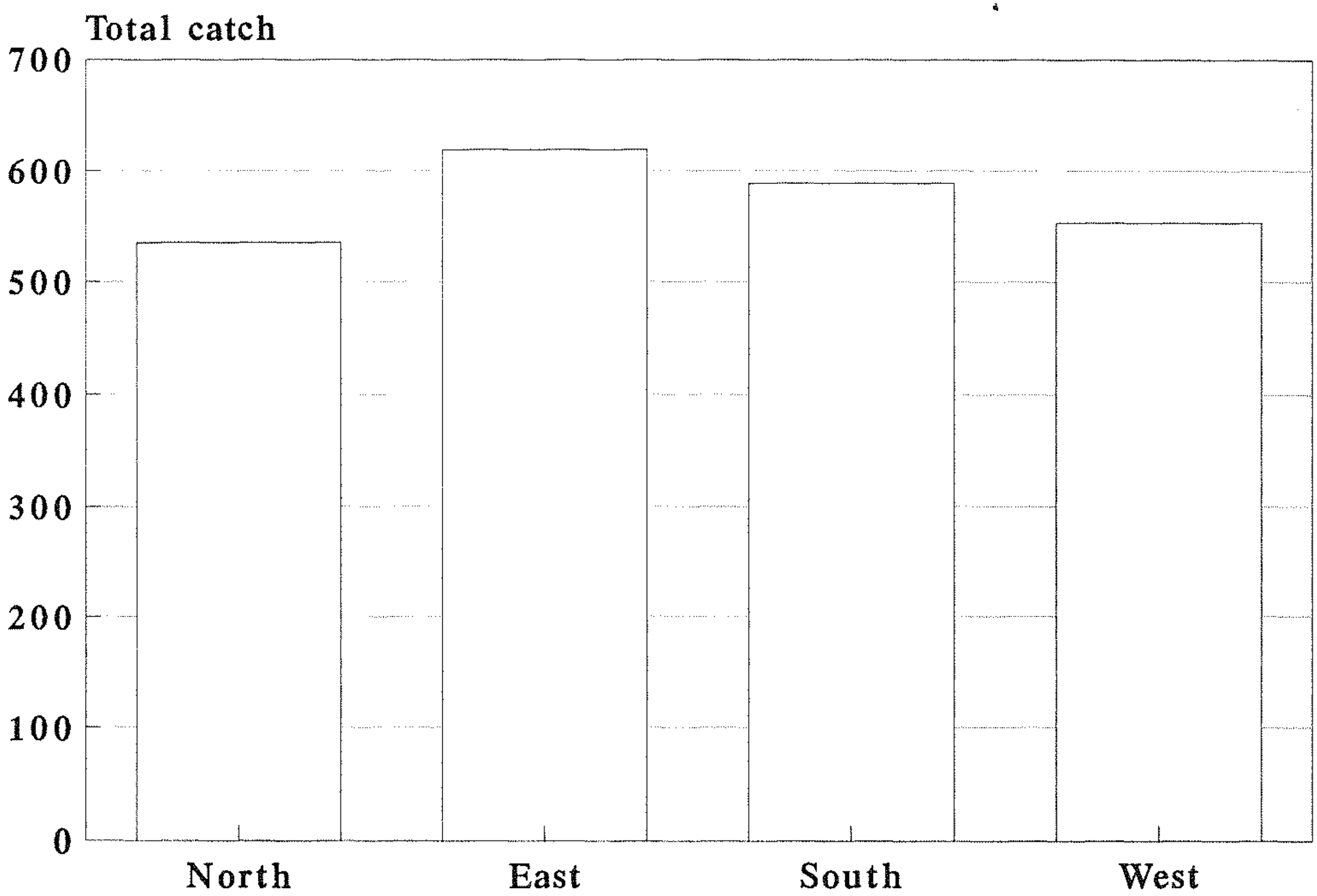
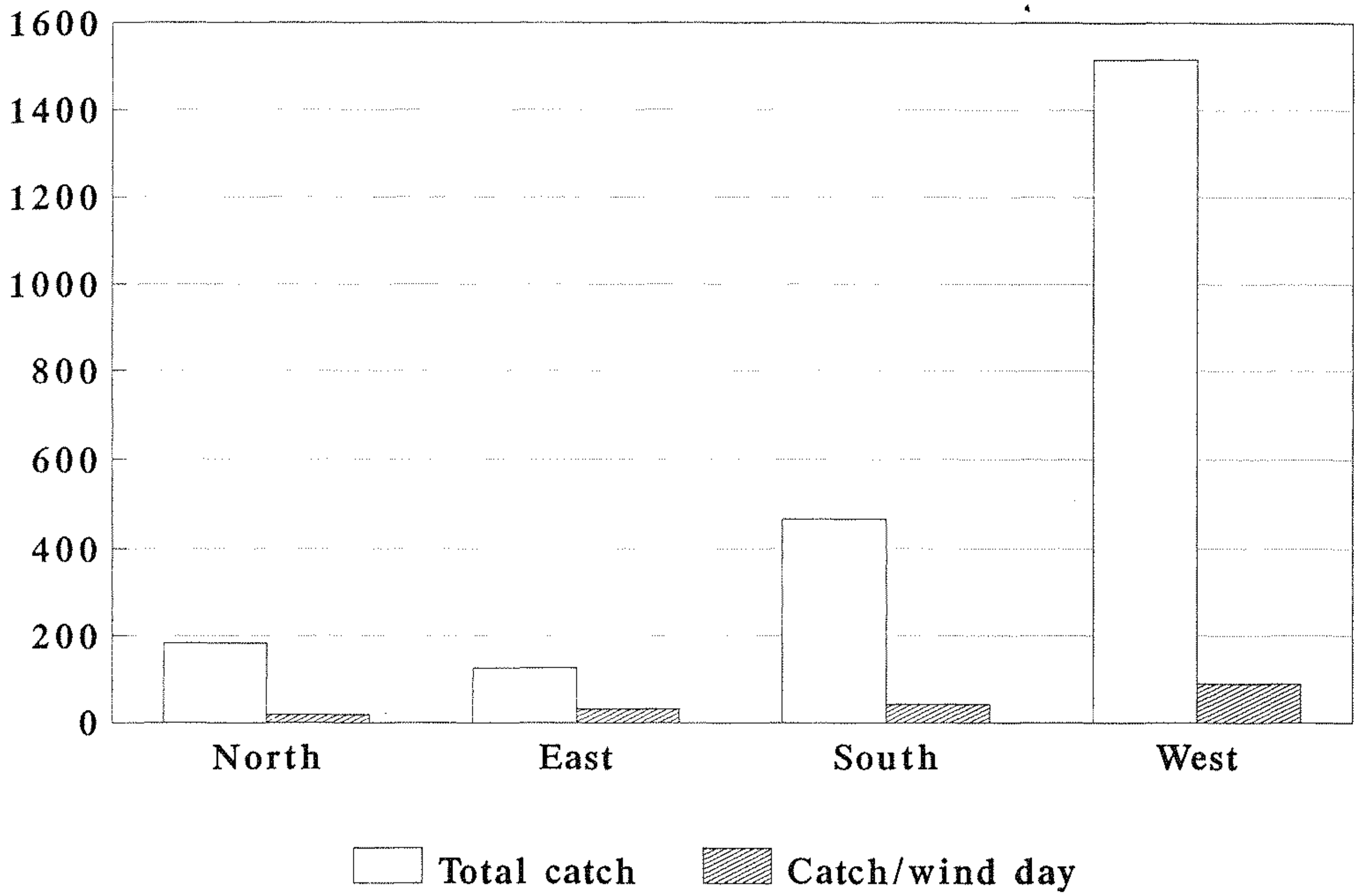


Figure 6. Effect of wind direction on pollen beetle catch, HRISH 1991.



Discussion

Yellow sticky traps were again effective at trapping pollen beetle and showed that in general numbers were much lower than in 1990. Placing traps at the station boundary did not give an early warning of pest migration as it had done in the previous season. It is possible that this is a reflection of the small catches in 1991.

If sticky traps can be used as an early warning system, results of the compass point monitoring suggests that they could be sited at any boundary. There was little difference in the total number of beetles caught on north, east, south or west traps. Catches on all traps at HRISH were however, greatest when the wind was from the west and may reflect the direction of the source of the migration.

Conclusions

1. Yellow sticky traps proved an effective means of monitoring beetle migration which was considerably smaller than in 1990.

2. Placing traps at the station boundary did not provide any early warning of pest migration.

3. There was little difference in the total catch of pollen beetles on traps at the north, east, south and west boundaries of HRISH.

4. Most beetles were caught when the wind was in a westerly direction.

General Discussion

Results confirmed the superiority of synthetic pyrethroids over organsphosphorus products for control of pollen beetle on calabrese or cauliflowers. The advantage of pyrethroids is that they may deter beetles from visiting the crop and so eliminate the problems of corpses on the harvested product.

Alphacypermethrin (as Fastac) was generally the most effective insecticide tested, particularly when applied at half the normal rate. If it is possible to predict the timing of pest migration into the crop, either by modelling or the use of sticky traps, then a spray of alphacypermethrin is potentially a low-cost alternative to crop covers, to limit the effects of beetles on crop quality. Reduced rates of insecticides are less damaging to the environment. A more rigorous test of this product in a season when populations of the beetles are much greater than in 1991 is necessary to confirm the potential shown in this years trials.

Pest monitoring failed to provide an early warning of beetle migration in contrast to findings in 1990. It is possible that this technique is effective only when numbers of the pest are large. However, yellow sticky traps in the crop are invaluable for indicating when beetles arrive and provide a useful check on the forecasting model developed by HRI Wellesbourne.

Recommendations

1. Further experiments on the efficacy of half rate alphacypermethrin to deter pollen beetles from visiting flowerhead brassicas should be undertaken in 1992 in anticipation of a large pest migration.

2. Yellow sticky traps situated in the crop should be used in conjunction with mathematical forecasting techniques. This technique would provide both a back up system in the event of a failure of the model and a check that predictions were in agreement with observations in the field.

Acknowledgements

We thank HRI Stockbridge House and Kirton for their co-operation and provision of trial or monitoring sites. We also thank all ADAS participants who assisted with this work.

Storage of data

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