HGCA

PROJECT REPORT No. OS43

ALTERNATIVE SEED TREATMENTS TO GAMMA-HCH FOR CONTROLLING CABBAGE STEM FLEA BEETLE ON OILSEED RAPE

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by

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This is the final report of a nine month project which started in August 1999.
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Abstract

Aims

The project had the overall aim of identifying potential replacement seed treatments to gamma-HCH for use on oilseed rape and was set up at short notice following the withdrawal of the treatment in summer 1999. The specific objectives were

- To test candidate seed treatments against a gamma-HCH standard and an untreated control at three sites in the Midlands, east and south of England.
- To evaluate materials in terms of both their impact on adult feeding damage and larval numbers in the plants to enable an estimation of the effect of treatment on damage and future risk of damage.
- To measure adult flea beetle activity at the sites to enable a between site comparison of the level of challenge and the persistence of control.

Conclusions

Cabbage stem flea beetle caused economic levels of damage at two of the three sites, giving the candidate seed treatments a thorough test. Of the three materials tested Bayer's UK 805 was the most effective in reducing flea beetle damage. It achieved an efficacy score of 176 relative to 100 for gamma-HCH. Other less developed products were tested at different rates. A1597 from Uniroyal achieved scores of 80, 96, 89 and 123 at the four different rates tested and fipronil from Aventis scores of 120 and 140 for two rates.

Implications for levy payers

This was a pilot study using provisionally formulated products that may differ from the final versions if developed through to commercial release. Three potential replacements for gamma-HCH seed treatment have been identified. Of these Bayer's UK805 is closest to market, approval being under consideration for approval under PSD's emergency procedures at the present. If approval is obtained in time this product may be available for use this autumn. As well as controlling attack by both species of flea beetle UK805 has been confirmed as providing a good level of aphid control and may also reduce slug damage. The other two materials are still under development but could provide useful alternatives in the future.

Summary

The project had the overall aim of identifying potential replacement seed treatments to gamma-HCH for use on oilseed rape and was set up at short notice following the withdrawal of the treatment in summer 1999. The specific objectives were

- To test candidate seed treatments against a gamma-HCH standard and an untreated control at three sites in the Midlands, east and south of England.
- To evaluate materials in terms of both their impact on adult feeding damage and larval numbers in the plants to enable an estimation of the effect of treatment on damage and future risk of damage.
- To measure adult flea beetle activity at the sites to enable a between site comparison of the level of challenge and the persistence of control.

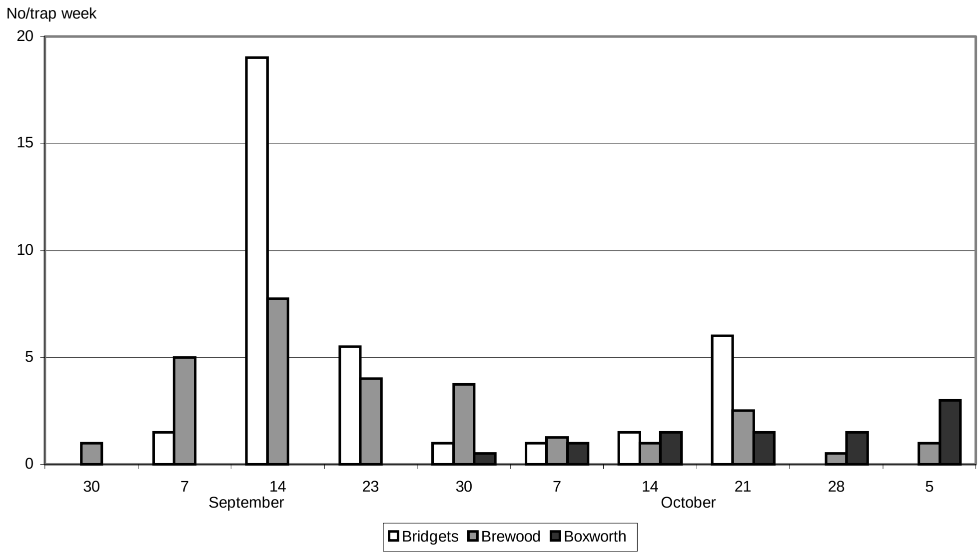
Experiments were conducted at three sites with a recent history of high numbers of cabbage stem flea beetle at Bridgets in Hampshire, Boxworth in Cambridgeshire and Brewood in Staffordshire. Seed for all treatments was provided by Uniroyal of the variety Pronto with a fungicide treatment of carboxin plus thiram (Anchor) already applied. This seed was then overdressed with insecticide seed treatments at various rates of application by Uniroyal, with coded product A1597, Bayer, with UK805, and Aventis, with fipronil.

The three sites were sown as soon as conditions allowed after the middle of August, on 23 August at Bridgets and Brewood and 2 September at Boxworth. Sowing rate was 4.5 kg/ha and the thousand seed weight 5.55g. The crops emerged quickly at Bridgets and Brewood, but at Boxworth emergence was delayed by dry seedbed conditions. Vigour was assessed visually and plant populations were counted a few days after emergence and when emergence was complete. A sample of fifty plants was removed from each plot at the end of the flea beetle feeding period and the percentage leaf area damaged by flea beetles on the cotyledons and the first true leaves was assessed. A further sample of plants was removed in late November or December and the numbers of cabbage stem flea beetle larvae in the petioles were counted. Flea beetle activity from the time of sowing to the end of October was monitored with two yellow water traps at each site.

Results

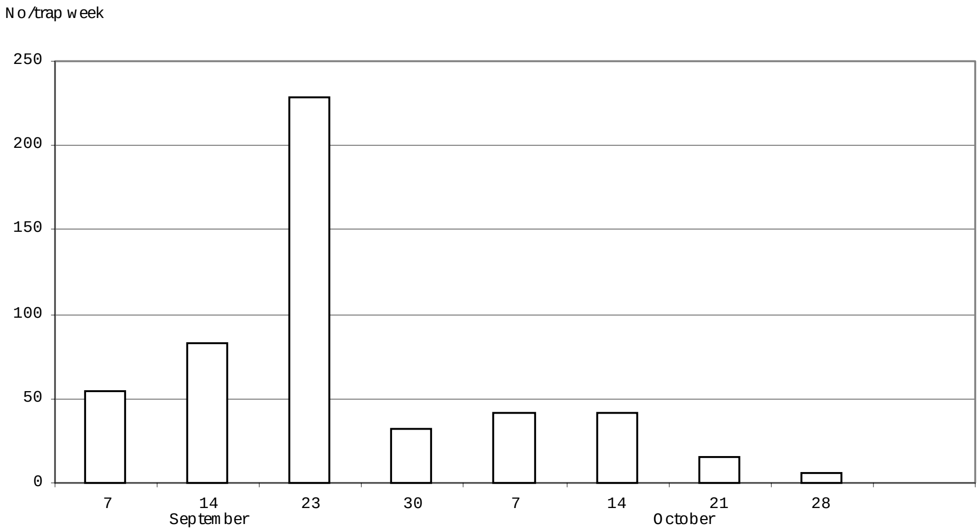
Adult cabbage stem flea beetles were caught at all three sites (Figure 1) The results show the timing of the initial migration into the crop, followed by smaller catches as they concentrate on feeding and laying eggs, followed by a blip in activity when egg laying is completed.

Figure 1. Numbers of cabbage stem flea beetle caught at the three sites.



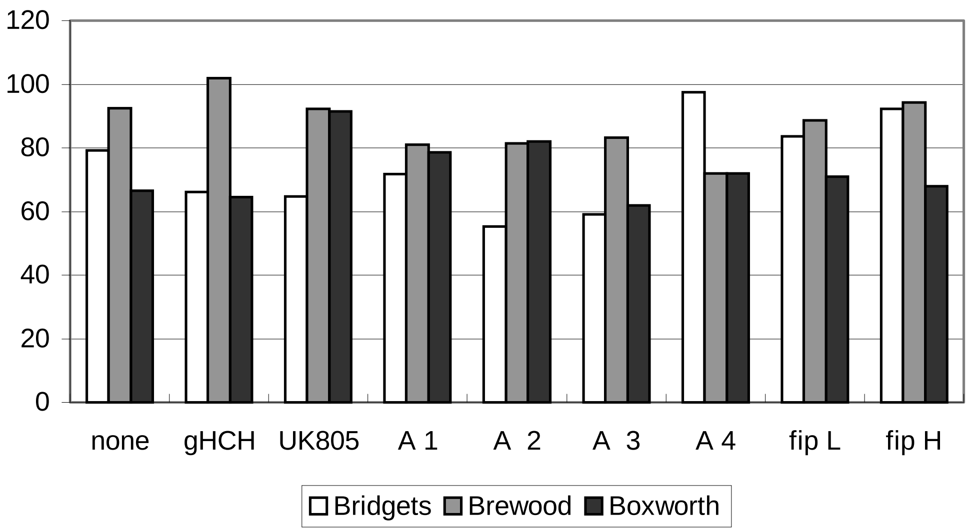
In central southern England a relative of the cabbage stem flea beetle *Psylliodes luteola* is emerging as a pest. Large numbers were caught at Bridgets (Figure 2). This flea beetle is a non-selective feeder in the autumn, damaging herbage seed and cereal crops as well as oilseed rape. The results show a progressive increase in numbers up to the 23 September, as the beetles searched for new crops on which to feed, followed by a drop in activity, once they had settled in the crop.

Figure 2. Numbers of *Psylliodes luteola* caught at Bridgets.



The vigour scores show a combination of phytotoxic effects delaying emergence and flea beetle damage, checking or killing seedlings.

Figure 3 Final plant counts (plants/m^2)



All the treatments gave some reduction in the amount of damage to the cotyledons and first true leaves equivalent to, or better than the standard gamma-HCH seed treatment.

Figure 4. Percentage reduction in damaged area to cotyledons

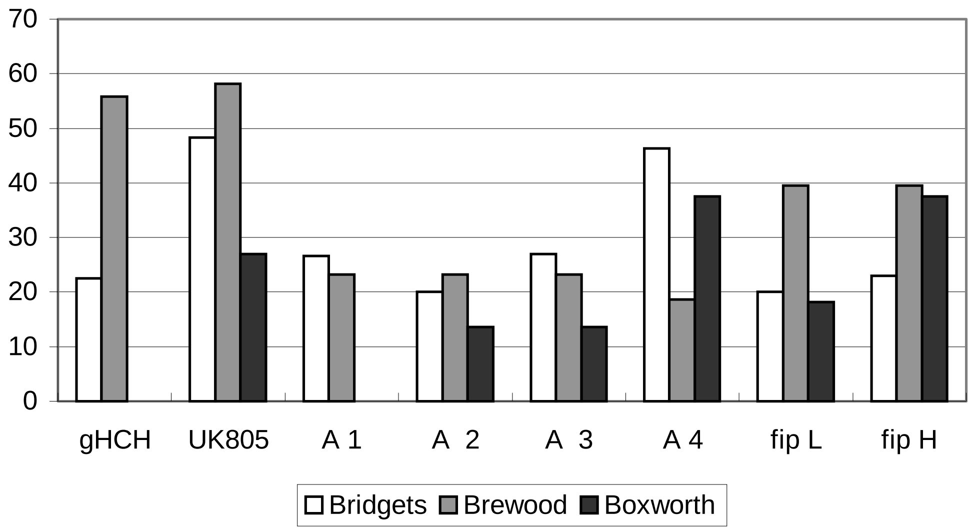
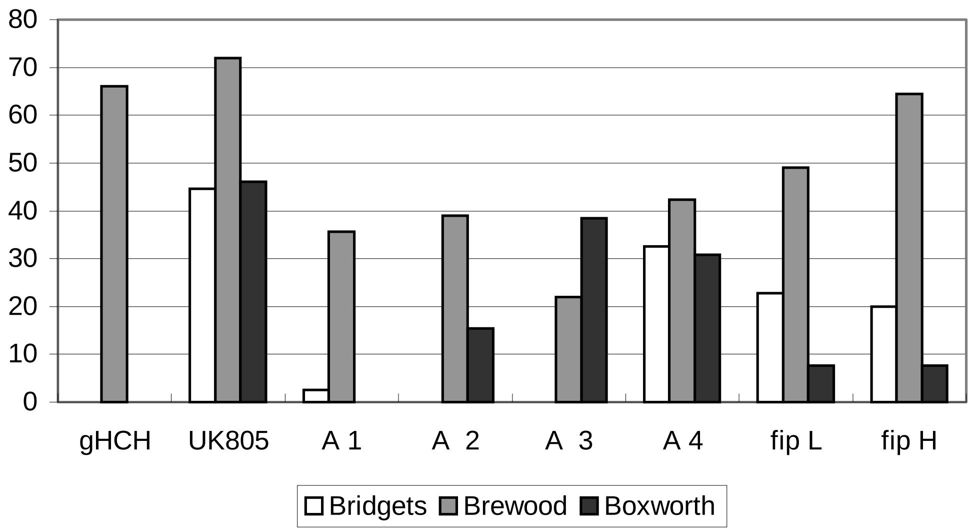
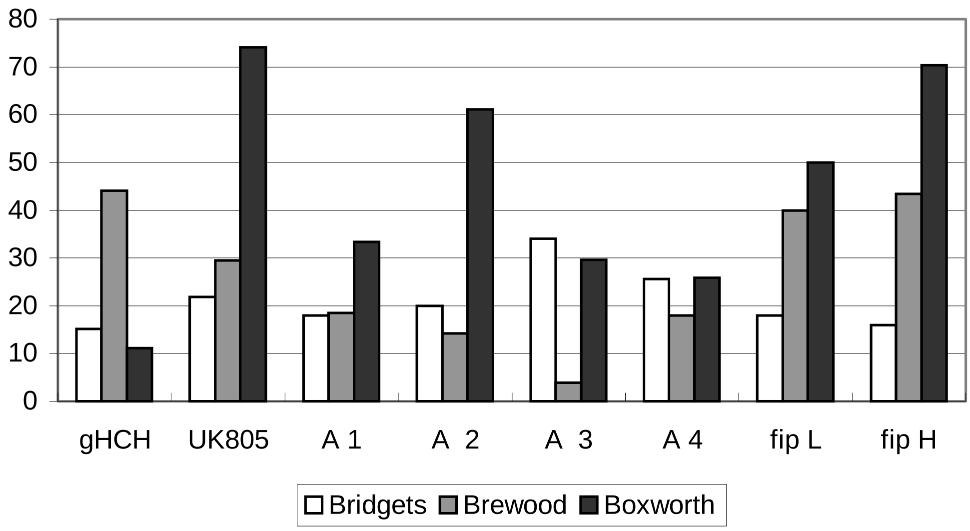


Figure 5. Percentage reduction in damaged area to first true leaves



The effect on numbers of live larvae varied, but all treatments had some effect, equivalent to the gamma-HCH standard.

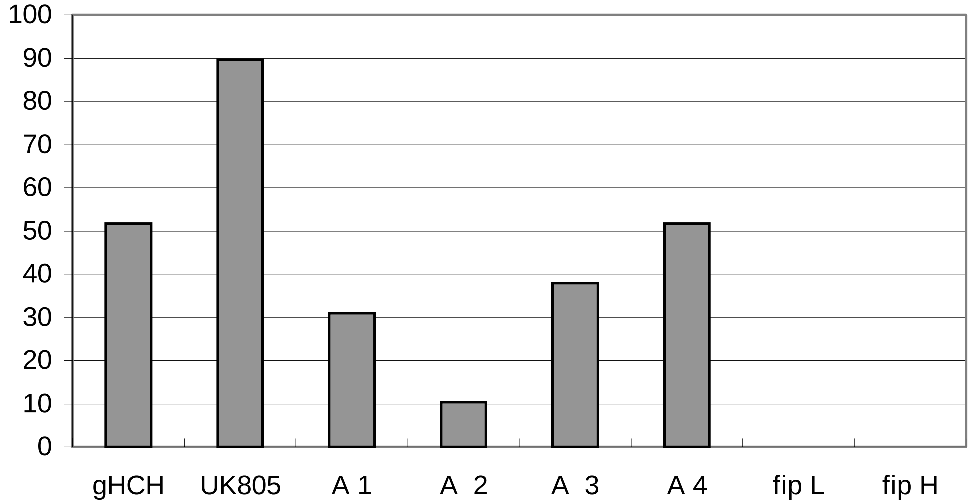
Figure 6. Percentage reduction in numbers of live larvae in the plants



A score was calculated combining the assessments of plant stand, reduction in damage to cotyledons and true leaves and reductions in numbers of larvae. This was adjusted to give a score of 100 for the standard gamma-HCH seed treatment. The comparative score for UK805 was 176; for the four rates of A1597, 80, 96, 89 and 123 and for the two rates of fipronil, 120 and 140.

Bayer's UK805 contains the aphicide imidacloprid, used in Secur and Gaucho seed treaments to control aphid virus vectors in cereals and sugar beet. Whilst these experiments were not set up to test aphid control a significant aphid infestation did develop at Brewood and the level of infestation was assessed to measure the degree of control achieved. All the treatments except fipronil had some effect with UK805 the most effective. The degree of control was equivalent to the best pyrethroid sprays in other experiments.

Figure 7. Percentage reduction in aphid infestation at Brewood.



Implications for levy payers

This was a pilot study using provisionally formulated products that may differ from the final versions if developed through to commercial release. Three potential replacements for gamma-HCH seed treatment have been identified. Of these Bayer's UK805 is closest to market, approval being under consideration for approval under PSD's emergency procedures at the present. If approval is obtained in time this product may be available for use this autumn. As well as controlling attack by both species of flea beetle UK805 has been confirmed as providing a good level of aphid control and may also reduce slug damage. The other two materials are still under development but could provide useful alternatives in the future.

Technical detail

Abstract

Candidate materials from three agrochemical companies were tested at three sites. At two of the sites, severe cabbage stem flea damage occurred, giving the insecticides a thorough test. All three candidate materials performed as well as the previous standard of gamma-HCH. At the third site, dry conditions delayed germination, and cabbage stem flea beetle damage was low, but an infestation of rape winter stem weevil developed, and will provide a test of how well the seed treatments perform against this pest. The candidate materials are at varying stages of development, one Bayer product which performed well is now being considered for approval by PSD. If passed this chemical could be available for use in 2000 or 2001.

Introduction

Cabbage stem flea beetle emerged as a significant pest of winter sown oilseed rape crops soon after their introduction. The pest spread outwards from areas of traditional brassica seed production to infest most areas of England by 1990. The early effects of adult flea beetle feeding have been reduced by seed treatments with gamma-HCH which were applied to the vast majority of crops prior to 1999, when the treatment was withdrawn due to potential risks to operators. The loss of the seed treatment has resulted in an increased need to apply a pyrehroid insecticide to control adult flea beetles, as well as a later application to control larvae. The HGCA commissioned a screening study of chemicals currently under development in the UK to stimulate and facilitate the agrochemical industry to produce and market replacement seed treatments.

Materials and methods

Seed for treatments A, B, C1-C9 was supplied and treated by Uniroyal, C5 was overtreated by Bayer and C6&7 by Aventis (Table 1).

Seed of the variety Pronto (tsw 5.55g) was sown at 4.5 kg/ha on 23 August at Bridgets and Brewood and 2 September at Boxworth before commercial crops were sown on the farms so as to maximise the level of damage. Slug pellets were applied overall after sowing to protect the crop and prevent confusion between slug and cabbage stem flea beetle damage.

Table 1. Treatments used in experiments

Code	Active ingredients	g a.i. /kg
A	carboxin + thiram (Anchor)	120 + 120
B	carboxin + thiram + gamma-HCH (Vitavax RS)	99 + 198 + 1485
C1	carboxin + thiram + A1597	120 + 120 + 350
C2	carboxin + thiram + A1597	120 + 120 + 500
C3	carboxin + thiram + A1597	120 + 120 + 650
C4	carboxin + thiram + A1597	120 + 120 + 800
C5	carboxin + thiram + imidacloprid +beta-cyfluthrin	120 + 120 +confidential
C6	carboxin + thiram + fipronil	120 + 120 +low
C7	carboxin + thiram + fipronil	120 + 120 +high

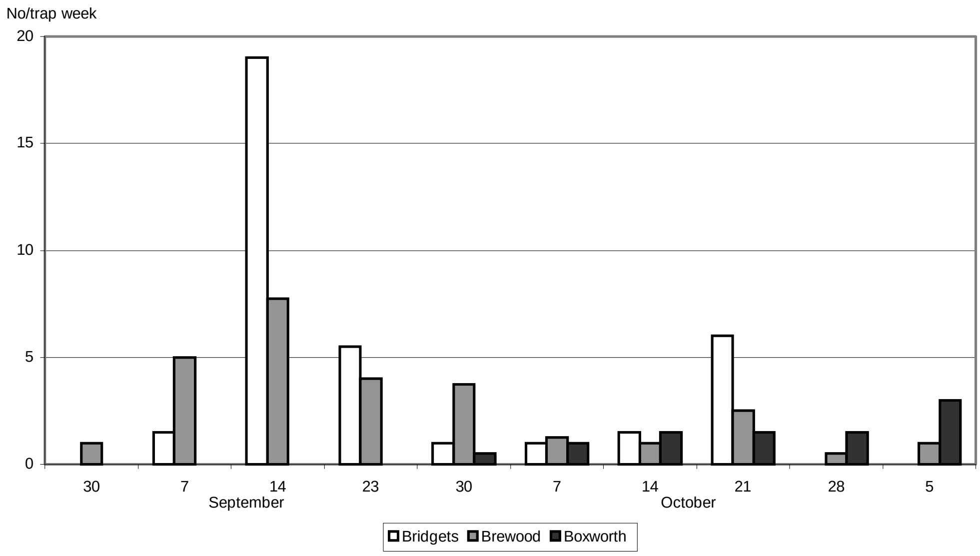
Two yellow water traps (16 cm diameter) to identify the species of flea beetles present at each site were put out at sowing and changed weekly until the first week of November. Catches were removed by sieving and preserved in alcohol for later identification. Weekly numbers of cabbage stem flea beetle and other species affecting oilseed rape were recorded separately. At the early cotyledon stage (GS 1.0) and the early second true leaf stage (GS 1.1 - 1.2) plants were counted on 5 x 1 metre paired rows per plot at random marked positions. Crop vigour was also visually assessed at both stages. Vigour was recorded on a 0 - 10 scale (0 = not emerged, 10 = even emergence, target plant population achieved, no stunting or phytotoxic effects eg cupping, marginal scorch).

Flea beetle damage was assessed on the cotyledons and first true leaves from 10 plants from each of the five marked 1.0 metre rows (50 plants per plot) at early second true leaf stage (GS 1.1 1.2). The percentage of plants attacked by flea beetles, percentage of cotyledon and first true leaf area holed, notched or windowed by flea beetles were recorded. Towards the end of November or December, five plants were removed from each of the five marked lengths of row per plot (25 plants per plot), the petioles were dissected and numbers of cabbage stem flea beetle larvae and other pests recovered were recorded. The percentage of plants infested with aphids was also noted.

Results

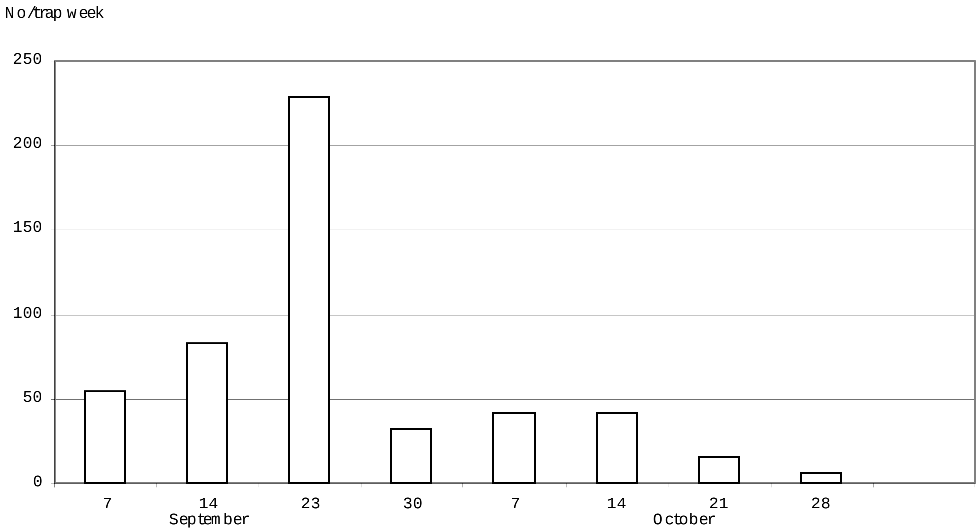
Adult cabbage stem flea beetles were caught at all three sites (Figure 1). The results show the timing of the initial migration into the crop, followed by smaller catches as they concentrate on feeding and laying eggs, followed by a blip in activity when egg laying is completed.

Figure 1. Numbers of cabbage stem flea beetle caught at the three sites.



In central southern England a relative of the cabbage stem flea beetle *Psylliodes luteola* is emerging as a pest. Large numbers were caught at Bridgets (Figure 2). This flea beetle is a non-selective feeder in the autumn, damaging herbage seed and cereal crops as well as oilseed rape. The results show a progressive increase in numbers up to the 23 September, as the beetles searched for new crops on which to feed, followed by a drop in activity, once they had settled in the crop.

Figure 2. Numbers of *Psylliodes luteola* caught at Bridgets.



The initial vigour was improved by some treatments at Boxworth, no significant differences were observed at Brewood, whilst at Bridgets some of the rates of A1597 appeared to delay emergence (Table 2). Improvements in initial plant stand were noted following some treatments at Boxworth and some reduction was noted at both Brewood and Bridgets (Table 3).

Table 2. Initial vigour assessment

Treatment	Boxworth 4 Oct	Brewood 8 Sept	Bridgets
A	2.75	4.50	5.25
B	4.00	5.25	4.25
C1	3.50	4.50	4.00
C2	3.75	4.50	2.75
C3	2.50	3.75	3.50
C4	2.00	3.50	5.00
C5	5.25	4.50	5.25
C6	3.00	4.75	5.25
C7	3.50	4.75	5.00
SED (24 df)	0.412	0.417	0.350
CV %	24.5	18.7	15.7
P	< 0.001	0.171	< 0.001

Table 3. Initial mean plants m^{-2}

Treatment	Boxworth 4 Oct	Brewood 8 Sept	Bridgets
A	74.5	91.4	80.2
B	96.0	99.8	62.0
C1	95.0	80.0	66.0
C2	100.5	79.4	55.7
C3	70.5	83.2	57.7
C4	83.5	72.8	95.5
C5	113.5	86.8	62.5
C6	99.0	86.8	77.7
C7	81.0	95.2	87.2
SED	8.46	4.05	7.63
CV %	18.7	9.4	21.3
P	0.028	0.002	0.010

The final plant stand at Boxworth was not affected by treatments, but some reductions were noted at both Brewood and Bridgets following all of the treatments, but the pattern was inconsistent, reflecting the balance between negative effects from possible phytotoxicity and the control of flea beetle damage.

Table 4. Final mean plants m^{-2}

Treatment	Boxworth 19 Oct	Brewood 15 Sept	Bridgets
A	66.5	92.4	79.2
B	64.5	102.0	66.2
C1	78.5	81.0	71.7
C2	82.0	81.4	55.2
C3	62.0	83.3	59.0
C4	72.0	72.0	97.5
C5	91.5	92.2	64.7
C6	71.0	88.6	83.7
C7	68.0	94.2	92.2
SED	6.58	4.76	8.44
CV %	18.0	10.8	22.7
P	0.079	0.007	0.016

Adult flea beetle damage to the cotyledons and first true leaves was insufficient at Boxworth to show significant differences between treatments. At Brewood and Bridgets all of the treatments reduced damage to the cotyledons (Tables 5). At Brewood all of the treatments reduced damage to the first true leaf, but at Bridgets damage was only reduced by the highest rate of A1597 and by UK805.

Table 5. % flea beetle damaged area of cotyledons

Treatment	Boxworth 19 Oct	Brewood 15 Sept	Bridgets
A	2.2	4.3	24.4
B	2.2	1.9	18.9
C1	2.5	3.3	17.9
C2	1.9	3.3	19.5
C3	1.9	3.3	17.8
C4	1.6	3.5	13.1
C5	1.6	1.8	12.6
C6	1.8	2.6	19.5
C7	1.6	2.6	18.8
SED	0.400	0.325	1.63
CV %	41.5	22.0	18.1
P	0.671	<0.001	0.001

Table 6. % flea beetle damaged area of first true leaf

Treatment	Boxworth 19 Oct	Brewood 15 Sept	Bridgets
A	1.3	11.8	32.5
B	1.3	4.0	32.8
C1	1.3	7.6	31.7
C2	1.1	7.2	36.7
C3	0.8	9.2	32.9
C4	0.9	6.8	21.9
C5	0.7	3.3	18.0
C6	1.2	6.0	25.1
C7	1.2	4.2	26.0
SED	0.29	0.96	1.48
CV %	36.9	28.6	10.3
P	0.274	< 0.001	< 0.001

Numbers of flea beetle larvae in the petioles were reduced by gamma-HCH and fipronil at Brewood, but the differences at the other sites were not significant (Table 7).

Table 7. Mean number of CSFB larvae per plant.

Treatment	Boxworth 13 Dec	Brewood 29 Nov	Bridgets
A	0.54	5.83	4.03
B	0.48	3.26	3.42
C1	0.36	4.75	3.31
C2	0.21	5.00	3.63
C3	0.38	5.60	2.66
C4	0.40	4.78	3.00
C5	0.14	4.11	3.15
C6	0.27	3.50	3.31
C7	0.16	3.30	3.39
SED	0.098	0.448	0.515
CV %	58.6	20.0	31.0
P	0.082	0.001	0.729

An attack from rape winter stem weevil larvae developed on the crop at Boxworth and the numbers of larvae in the plants were assessed. Whilst a trend for some treatments to reduce damage was noted, the results were not statistically significant (Table 8).

Table 8. Mean number of RWSW at Boxworth on 29 November

Treatment	Percent plants infested	Number of larvae per plant
A	45	1.04
B	20	0.50
C1	55	1.33
C2	44	0.70
C3	42	0.98
C4	29	0.60
C5	33	0.87
C6	37	0.84
C7	38	0.88
SED	6.3	0.245
CV %	33.1	40.3
P	0.35	0.083

A significant aphid infestation developed at Brewood and the level of infestation was assessed to measure the degree of control achieved. All the treatments except fipronil had some effect with UK805 the most effective. The degree of control was equivalent to the best pyrethroid sprays in other experiments (Table 9).

Table 9. Percentage of plants infested with aphids at Brewood, Staffs on 29 November.

Treatment	% infested
A	29.0
B	15.0
C1	20.0
C2	26.0
C3	18.0
C4	14.0
C5	3.0
C6	29.0
C7	29.0
SED	9.98
CV %	69.2
P	0.178

Discussion

This was a pilot study using provisionally formulated products that may differ from the final versions if developed through to commercial release. To allow comparison of the various effects of treatment a score was calculated combining the assessments of plant stand, reduction in damage to cotyledons and true leaves and reductions in numbers of larvae relative to the untreated control. This was adjusted to give each criterion a score of 25 for the standard gamma-HCH seed treatment, so that this treatment achieved a total score of 100. The comparative score for UK805 was 169, for the four rates of A1597, 82, 96, 89 and 122 respectively and for the two rates of fipronil, 118 and 137.

Bayer UK805 is a fully formulated product that is currently under evaluation by PSD and if approved could be on the market for autumn 2000 or 2001. A1597 and fipronil are under development and will not be marketed for a few years. UK805 would appear to have some advantages over gamma-HCH in the persistence of control and the additional benefits of aphid and, possibly, slug control. A1597 and fipronil both appeared to have potential to equal or better gamma-HCH seed treatment and could also well be worth further developing for this use.

The experiments were not taken to yield due the small size of the plots and the limited availability of chemicals and removal of plants for pest assessment. A further larger scale experiment to measure the impact of treatment on yield would be necessary to enable an economic assessment of the value of the treatments, once sufficient product is available for this purpose.