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PRACTICAL SECTION FOR GROWERS

Objectives

- To further validate the pea aphid model in conjunction with user groups in various geographical locations.
- To design and develop a user-friendly and intuitive interface to ensure effective and efficient implementation of the pea aphid population simulation model.
- To develop the interface in conjunction with a selected potential user group.
- To compare the effectiveness of pyrethroid insecticides in providing persistent control of aphids in vining peas.

Summary of results

Further evaluation of the pea aphid model was done at ten geographically separate sites. The model predicted aphid dynamics well at some times and less well at others. However it proved accurate in predicting when aphid infestations were likely to exceed economic injury thresholds. A prototype interface was developed and demonstrated to potential user groups.

Insecticide applications using a range of approved products were compared in a field trial for their effectiveness in providing a more persistent control of the infestation.

Practical benefits

- Prediction of rate of build-up of aphids in vining peas using a computer model.
- Reduction in unnecessary sprays to the pea crop
- Assist management decisions within an integrated crop management programme.

SCIENCE SECTION

Introduction

The pea aphid, A*cyrthosiphon pisum* Harris, is a serious pest of peas (*Pisum sativum*), in the UK. Damage occurs as a result of aphids feeding on the crop during pod setting and filling. Economic thresholds, above which, losses caused by pest damage are greater than the cost of control treatments, have been devised for vining peas. Until recently, no forecasting method was available to predict when aphid populations were likely to exceed these thresholds and hence warrant sprays, but a simulation model has been developed to predict the dynamics of aphid development and help rationalise pest management decision making.

The model describes, mathematically, the development of aphid populations within a single field. The influence of environmental conditions, particularly temperature, on aphid reproduction, development and mortality are represented.

The model has been tested successfully in two successive seasons, but further validation of its performance is necessary, especially using data collected from differing geographical sites.

Furthermore, although a prototype user-interface has been developed for the model (named PAM), it is in a format which precludes efficient use by users with limited experience of utilising large and complex simulation models. Therefore, it was essential that the graphical user-interface (GUI) be developed further to ensure that as a wide as possible user group, could utilise the system.

Efficient control of potentially damaging populations of aphids is important to maintain. There is some variability in the ability of insecticides to provide an effective reduction of infestation throughout the season. It was necessary therefore to evaluate and compare a range of approved pea aphicides in field trials.

Materials and methods

Validation

Ten sites were chosen from differing geographical locations within the main pea growing regions. At Holbeach St. Johns, detailed records of pest populations were made whereby the number of juvenile and alate and apterous adults were counted on 60 randomly selected plants within an unsprayed area of the crops at regular intervals throughout the season.

Less detailed records were made for the other nine sites whereby the number of plants infested with aphids was recorded by weekly sampling of 50 plants within an unsprayed area of the crop. At all sites, hourly temperature records were collected during the sampling period using Tiny Tag™ data loggers fitted in small, north-facing Stephenson screens at 1m above the soil level.

The appropriate weather data were imported into the model and the initial aphid population data used to seed the simulation. The model was validated by visual comparison of predicted results with observed development of aphid populations.

Graphical User Interface

To ensure maximum accessibility and usability, the GUI was developed to be implemented on a standard PC. The programming language DELPHI™ was chosen for optimal design and development.

Chemical comparison

A small plot trial was carried out in a crop of Waverex vining peas at Holbeach St. Marks, Lincolnshire. A range of approved pea aphicides were applied on a single occasion to plots 10m x 2m in a randomised block trial with four replications, using an Azo plot sprayer with 02/F110 nozzles in 200 l water/ha at 2.5 bar provided by propane.

The spray was applied at the first open flower stage (gs 203) when aphids were present on 60% of the plants. Assessments were made twice weekly by randomly selecting 20 plants within each plot and recording the presence or absence of aphids. Details of treatments, application date and assessment dates are shown in Appendix 1.

Results

Validation

At Holbeach St. Johns, where detailed assessments were carried out, field records of aphid numbers were taken from 3 July to 4 August 1997. Aphid populations rose rapidly during early July but declined gradually throughout the rest of the season and very few were present at the end of July and early August (Figure 1). The model did not simulate observed results well, tending to over estimate aphid populations at the end of the season (Figure 1). However, it would not have missed predicting a population increase which required control.

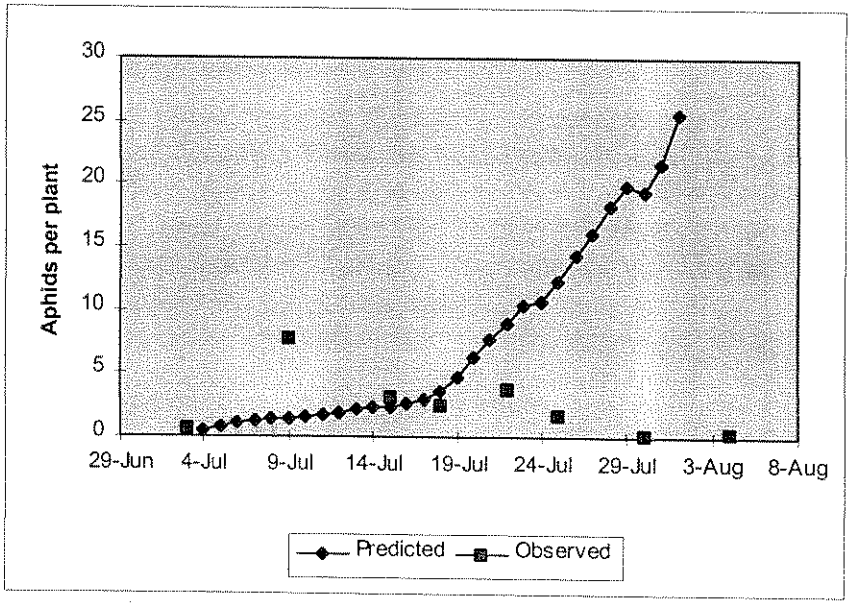


Figure 1. Predicted and observed pea aphid population dynamics at Holbeach St. John's 1997.

At AH Worth (Site 1) the model predicted aphid incidence well. Although it failed to simulate the dramatic reduction in aphid populations in late June it did predict the rapid increase in pest incidence with all plants being infested by mid-July (Figure 2). The model would have alerted the growers to the approach of a population increase leading to the need to control aphids prior to it being observed in the field.

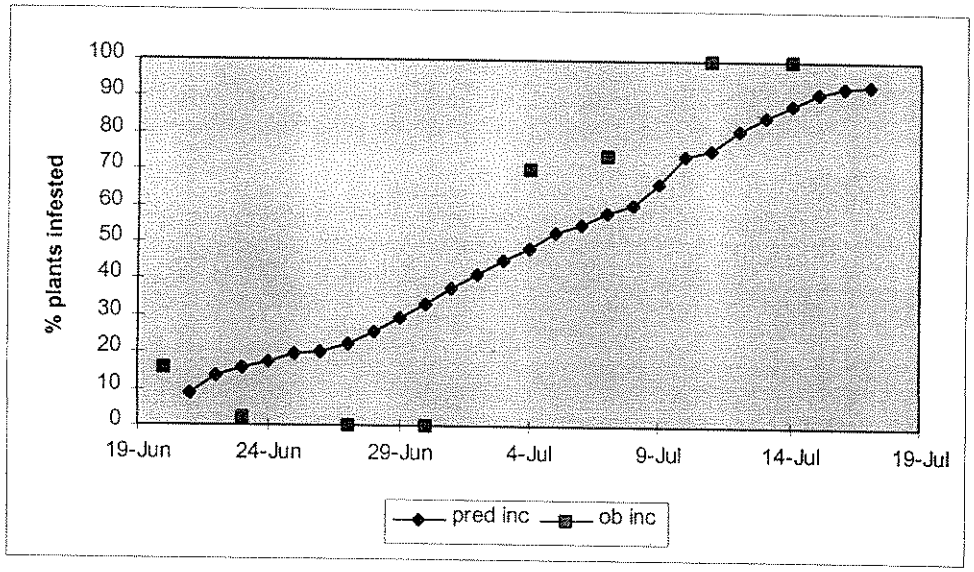


Figure 2. Predicted and observed pea aphid incidence at AH Worth (Site 1), 1997.

The model predicted the timing of the point where aphid populations were likely to exceed their economic threshold well at AH Worth (Site 2), and hence the point where chemical control was warranted. However, after this point, it predicted that the development of the aphid population would be less rapid than was observed in the field (Figure 3). The model would have alerted the growers to the approach of a population increase leading to the need to control aphids prior to it being observed in the field.

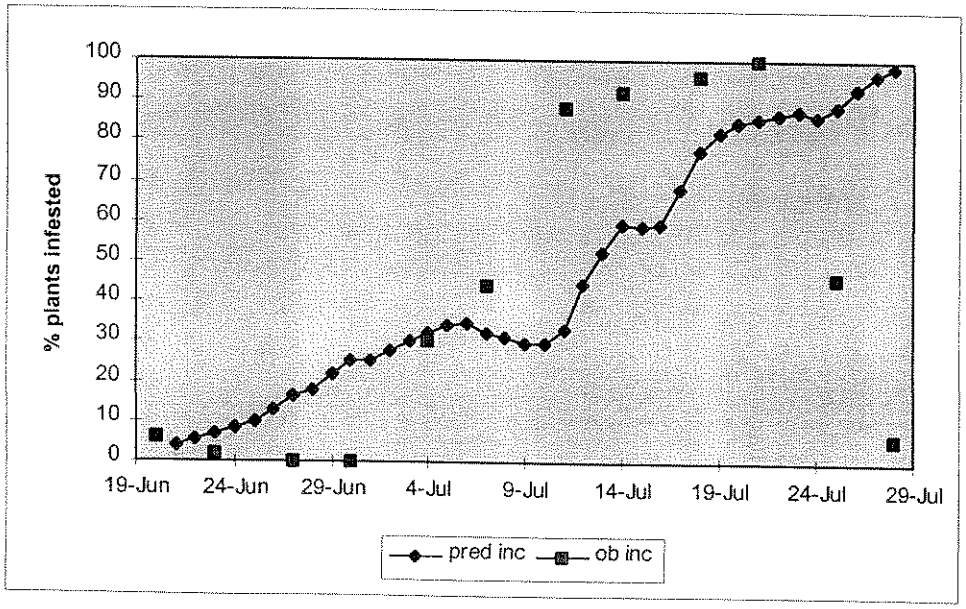


Figure 3. Predicted and observed pea aphid incidence at AH Worth (Site 2), 1997.

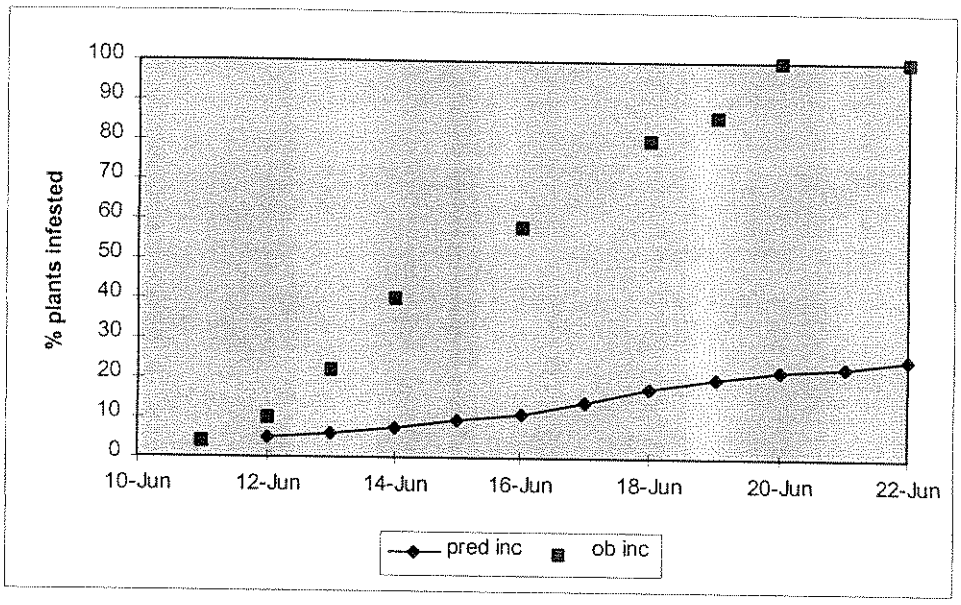


Figure 4. Predicted and observed pea aphid population dynamics at Aylsham, 1997.

The model underestimated the development of aphid populations at Aylsham (Figure 4). Observed populations increased rapidly from relatively low levels but the model predicted a slower rate of aphid increase.

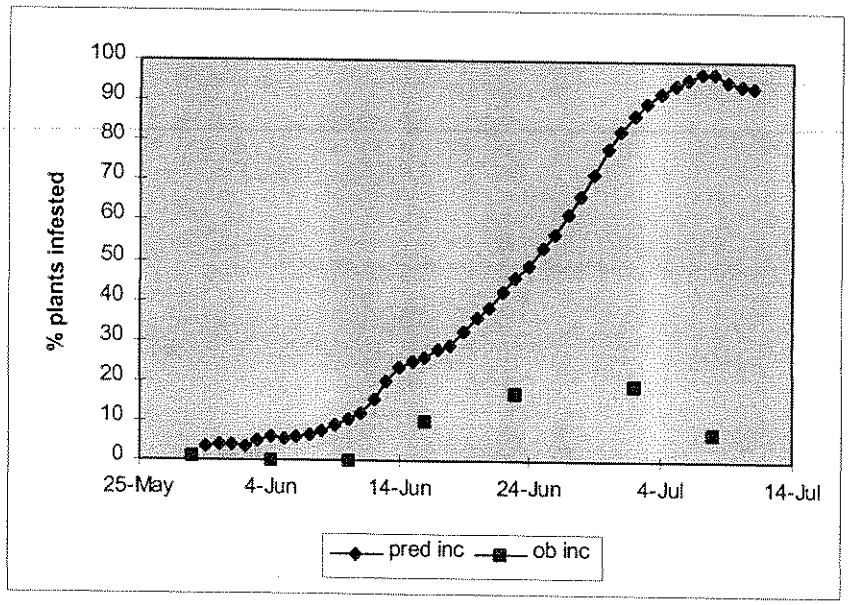


Figure 5. Predicted and observed pea aphid population dynamics at BirdsEye Walls (Site 1), 1997.

Conversely the model over estimated the development of aphid populations at BirdsEye Walls (Site 1) and although it predicted well low aphid infestations early in the season it simulated a rapid build up of aphid numbers which was not found in the field (Figure 5). The model would have alerted the growers to the approach of a population increase leading to the need to control aphids prior to it being observed in the field.

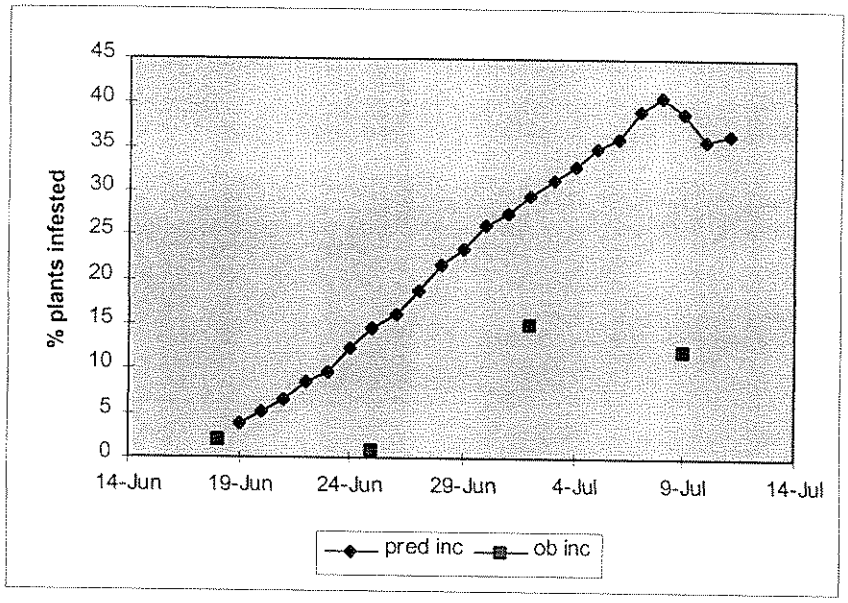


Figure 6. Predicted and observed pea aphid population dynamics at BirdsEye Walls (Site 2), 1997.

At the second BirdsEye Walls site the model again over estimated aphid populations and although numbers did increase they did not reach the levels predicted by the model (Figure 6). The model would have alerted the growers to the approach of a population increase leading to the need to control aphids prior to it being observed in the field.

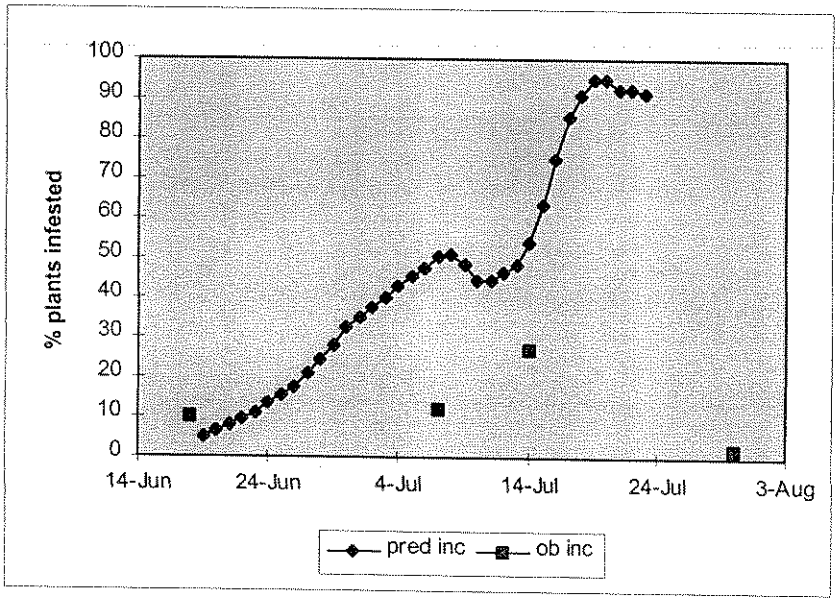


Figure 7. Predicted and observed pea aphid population dynamics at BirdsEye Walls (Site 3), 1997.

Similarly at the third BirdsEye Walls site the model over estimated aphid populations throughout the season and once again, although observed pest levels rose later in the season, they did not reach those predicted by the model (Figure 7).

At all BirdsEye Walls sites the model would have alerted the growers to the approach of a population increase leading to the need to control aphids prior to it being observed in the field, but in each case the field populations ceased to increase further when the spray threshold was reached.

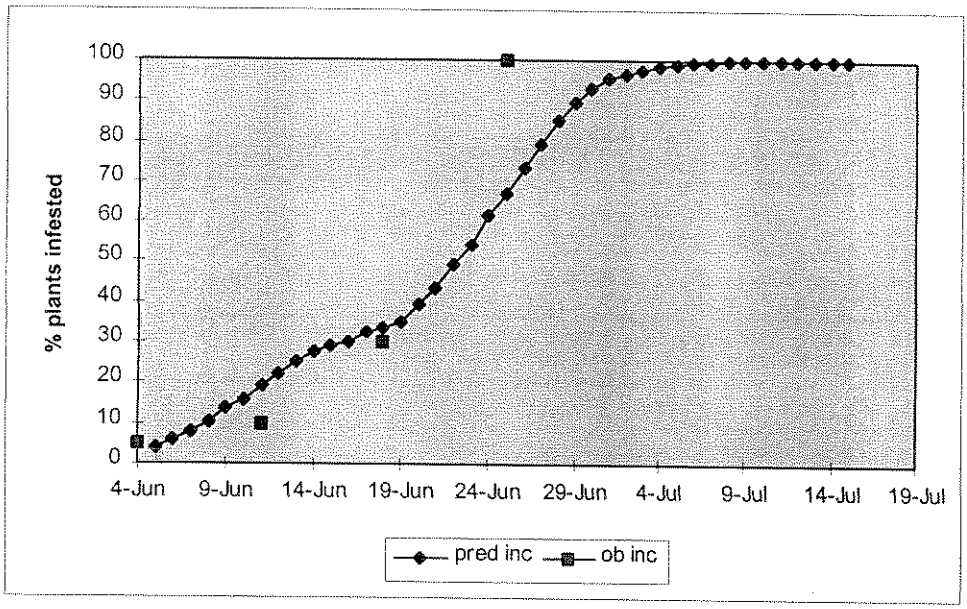


Figure 8. Predicted and observed pea aphid population dynamics at John Allen, 1997.

The model predicted the development of aphid populations at John Allen well, simulating accurately both low infestations early in the season and uniform incidence later onwards (Figure 8). The model would have accurately alerted the growers to the approach of a population increase leading to the need to control aphids prior to it being observed in the field.

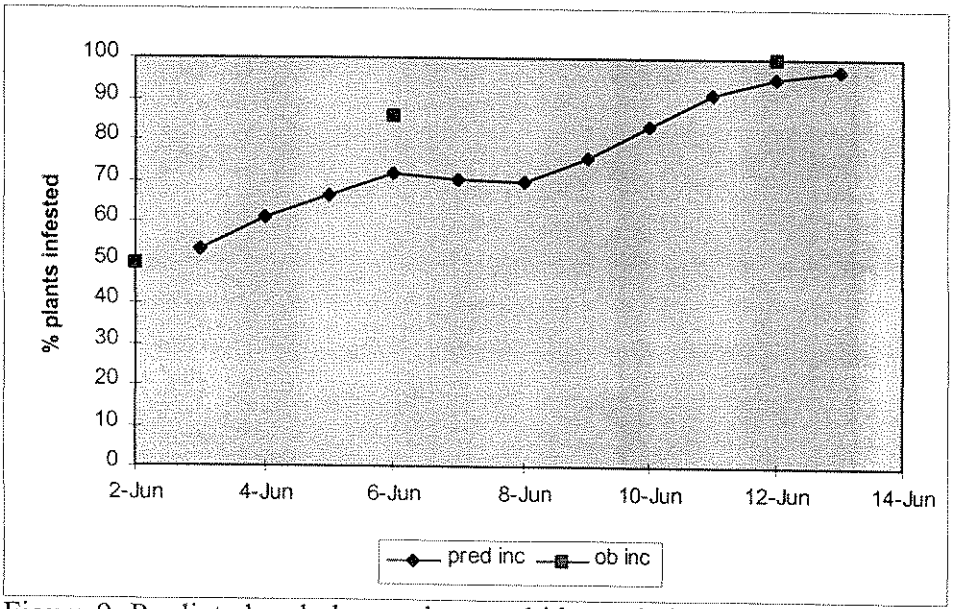


Figure 9. Predicted and observed pea aphid population dynamics at Rankin Farms (Site 1), 1997.

At Rankin Farms (Site 1) very high incidence of aphids were observed very early in the season and the model predicted well the development of aphid populations from the unusually high early levels throughout the season (Figure 9).

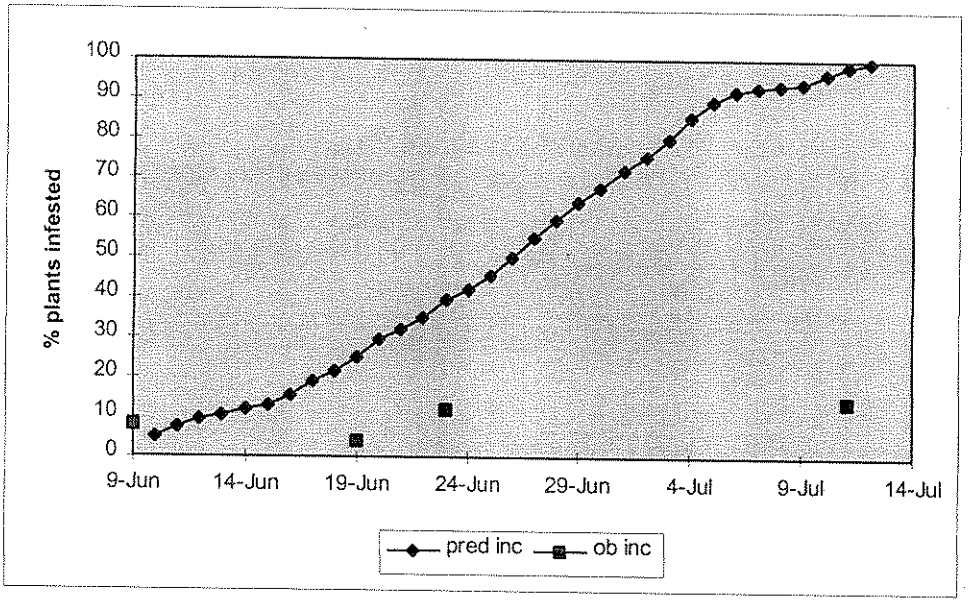


Figure 10. Predicted and observed pea aphid population dynamics at Rankin Farms (Site 2), 1997.

At the second Rankin Farms site aphids were observed at lower levels early in the season and although model predicted well the timing of development of aphid populations at that time, it over estimated pest levels observed later on (Figure 10). However, it would have alerted the growers to the approach of a population increase leading to the need to control aphids prior to it being observed in the field.

Graphical User Interface

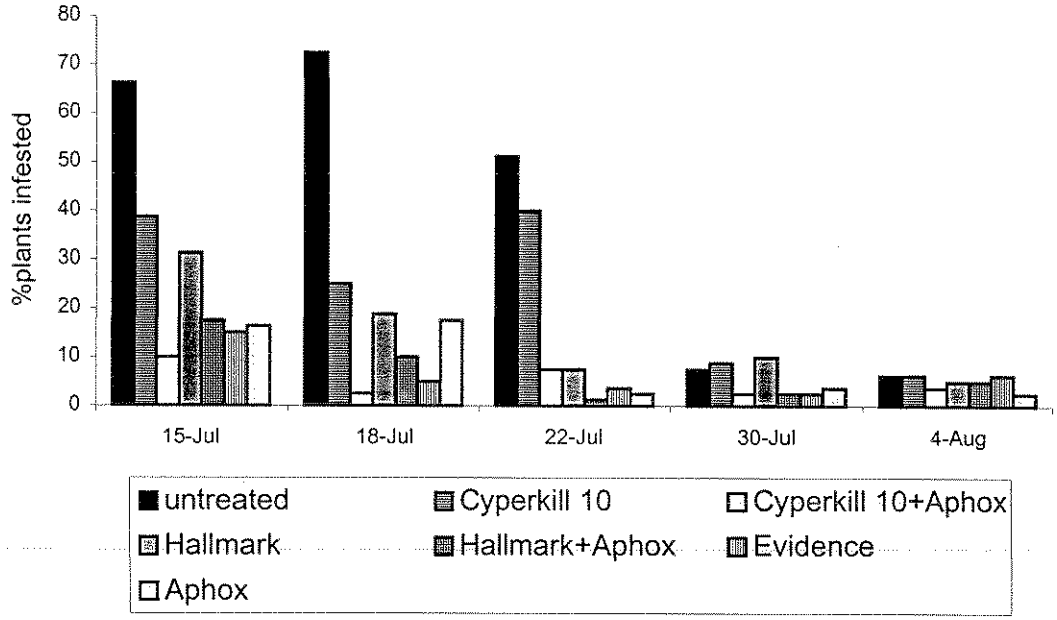
The model was converted from C into DELPHI and implemented under Windows 95 and above on a PC. Input to the model has been minimized further; users are required only to enter a data-file containing relevant temperature information, the initial sample of aphids recorded in the field, the date of when the sample was made, and the duration for the prediction. Output from the model is given both graphically (a diagram of population development) and numerically (a table of daily aphid densities). Not only are aphid levels indicated on the output but also the risk from aphid damage and suitable dates for spray treatments are presented.

The prototype model was demonstrated on two occasions to a selected user-group comprising growers, agronomists, crop managers and processor agricultural staff. Comments on the design of the interface were incorporated into the working model.

Chemical comparisons

All treatments had significantly reduced the aphid infestation three days after spraying. There was a continuing decline in the infestation up to a week later, although the mixtures of pyrethroid and carbamate provided better control than either the pyrethroids or the carbamate alone.

The older generation pyrethroid appeared to lose its efficacy 10 days after spraying, but there was then a marked decline in aphid numbers over the whole trial by the twentieth day. The results are shown in Figure 11.



Discussion

Levels of observed aphids varied between sites; low numbers were recorded at all of the three BirdsEye Walls sites and at the second Rankin Farms site, while high incidence of pests were found at the other sites with all plants in the field becoming infested with aphids.

The model predicted aphid population dynamics well at some sites and less well at others. Overall the model predicted low pest infestations early into the cropping season well but failed to predict the magnitude of the increase seen later in aphid populations. However, it is the model's ability to predict accurately the low aphid levels well that is important for optimal pest management because the threshold for the pest is only around 20% of plants infested which is likely to occur early in the season.

PAM has been developed for use by the pea growing industry and feedback from users is required so that the system will be made more widely available for further testing and development through PGRO recommended routes.

There were some obvious differences in efficacy between the approved aphicides used in the trial. This has implications on the choice of chemical when considering the need for follow up sprays if aphid numbers begin to increase towards the end of the season.

APPENDICES

APPENDIX 1

Chemical comparison trial.

Site. Holbeach St. Marks, Spalding, Lincolnshire.
Variety Waverex.

Treatments	Rate of application
1. Untreated	-
2. Cyperkill 10	250 ml/ha
3. Cyperkill 10 + Aphox	250 ml + 140 g/ha
4. Hallmark	150 ml/ha
5. Hallmark + Aphox	150 ml + 140 g/ha
6. Evidence	1000 ml/ha
7. Aphox	280 g/ha

Sprays applied 12-7-97, 26°c, 65% RH, Crop growth stage 203.

Aphid assessments: 15-7-97, 18-7-97, 22-7-97, 30-7-07 and 4-8-97.

APPENDIX 2

Chemical comparison trial - aphid infestation following treatment.

Treatment (12.7c)	assessment date:	% plants infested 15-7	18-7	22-7	30-7	4-8
Untreated		66.2	18.7	51.2	7.5	6.2
Cyperkill 10		38.7	25.0	40.0	8.8	6.2
Cyperkill 10 + Aphox		10.0	2.5	7.5	2.5	3.7
Hallmark		31.3	18.8	7.5	10.0	5.0
Hallmark + Aphox		17.5	10.0	1.3	2.5	5.0
Evidence		15.0	5.0	3.7	2.5	6.2
Aphox		16.3	17.5	2.5	3.7	2.5
LSD @ p = 0.05		14.8***	21.9***	11.7***	nsd	nsd
Coefficient of variation %		35.8	68.3	48.3	155.0	116.2

*** significant difference @ p = 0.001