

HDC Project FV 127

ANNUAL REPORT

**Dissemination of forecasts for carrot fly,
cabbage root fly and pollen beetle**

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INTRODUCTION

In an attempt to rationalise the amounts of insecticide applied during vegetable production, the HDC commissioned a study to develop systems to forecast accurately the timings of pest insect attacks on vegetable crops. Such forecasts can then be used to ensure that insecticide applications coincide with insect attacks. Three of these forecasts, for the carrot fly (*Psila rosae*), the cabbage root fly (*Delia radicum*) and pollen beetle (*Meligethes aeneus*) have now been developed. Since 1992, all the forecasts have been available free to HDC levy payers, as part of the development phase of this project.

Pest forecasts are based on the fact that insect development is related directly to temperature. Therefore, the hotter it is in a particular season, the faster an insect will pass from one generation to the next. This means that there are invariably more insect generations in the south of the British Isles than in the north. It also means that in any locality, if there are only two generations of a particular pest insect in a cool season, there could be three generations in a warm season. For reasons of this kind, it is inappropriate to apply insecticide treatments on routine calendar dates each year. Growers may be close to the best date in a few years, but in most years they will apply the insecticide either too early or too late. Such applications waste chemical and time, kill beneficial insects, contaminate the environment and contaminate the vegetable produce. In addition, badly timed applications do not kill pest insects.

Growers talk regularly about early and late seasons. Pest forecasts indicate how early or how late the season will be, so that an appropriate insecticide treatment can be timed accurately to kill the maximum numbers of the target pest insect. The forecasts are designed specifically for the control of pest insects on established crops where the protection provided by insecticides applied to the soil at sowing or planting has diminished. Insecticides applied to established crops are most effective when their applications can be timed to coincide with peak numbers of pest insects. The forecasts cannot be used to indicate whether or not there are sufficient insects within a crop to merit the application of insecticide. However, the forecasts do highlight the "insect-free" periods, when insecticides should never be applied.

The forecasts have been field tested using data collected extensively from most regions of the United Kingdom and intensively from the major vegetable growing areas. Much of this information has been collected over two seasons by ADAS colleagues,

particularly by entomologists working at Cambridge and Leeds. The forecasts for most areas of the UK coincide, almost exactly, with the activity of the insects in the field. There are difficulties with forecasting cabbage root fly attacks in south west England, south Wales and south west Lancashire because in such regions a proportion of the overwintering flies emerge later in the spring than expected. Provided such regions are pinpointed accurately, adequate forecasts can be produced. Similarly, there is a problem at present in forecasting carrot fly activity in certain parts of Lancashire. With the help of Lancashire growers and ADAS colleagues this difficulty is being resolved.

The forecasts of pest timing require daily records of the maximum and minimum air temperatures and the temperature of the soil at a depth of 6 cm (2.5 inches), the depth at which the soil-based stages of the pests spend much of their life-cycle. As temperatures at 6 cm deep are not recorded at meteorological stations, they are estimated from the 10 cm deep soil temperature recorded daily at 09.00 h. Unfortunately, the 10 cm deep soil temperature is not recorded at many weather stations in the UK. Therefore, in most localities the temperature at 6 cm deep in the soil is estimated from a deeper soil temperature.

MATERIALS AND METHODS

During 1994, forecasts of the timing of peak activity of three insect pests of vegetable crops (carrot fly, cabbage root fly, pollen beetle) were issued free, on request, to HDC levy payers. Weather data from 38 Agro-meteorological stations were used to produce regional forecasts, which were updated each week. Weather data were supplied by the Meteorological Office, ADAS, Morley Research Centre, BBSRC and HRI. Obviously the weather data for 1994 were available only up to the date on which the forecasts were sent out. Therefore, the forecasts were "projected" forwards to cover the coming week by including weather data from an earlier year. To ensure that the forecasts provided an "early" warning of peak activity, weather data from a very warm year, 1990, was used in this forward "projection".

The forecasts were used to predict the timing of insect activity in each generation, expressed on a percentage basis. For control purposes, it was considered that the start of pest activity had occurred when 10% of the insects had emerged/migrated/laid eggs and that the peak or mid-point of activity had occurred when 50% of the insects had

emerged/migrated/laid eggs.

Validation of the forecasts

During 1994 pest activity was monitored by growers and HRI staff at several sites throughout the UK. Carrot flies and pollen beetles were monitored using various numbers of orange/yellow sticky traps. Cabbage root flies were monitored using yellow water traps for the flies and by taking soil samples for the eggs. Samples were taken usually once each week and the results expressed as the number of insects sampled per week. These data were compared with the appropriate pest forecasts. Previous studies (Final Report Project FV13a) have indicated the minimum number of trapped insects required to validate a forecast. For robust validations, more than 100 flies/beetles/eggs should be sampled during each generation if the variation due to sampling is to be reduced to less than \pm one week.

RESULTS

Carrot fly forecast

The carrot fly forecast was sent to 125 levy-payers from 26 April until early October 1994 (the last included a forecast for most of October). Carrot fly activity was monitored at HRI Kirton, HRI Stockbridge House and by growers at three sites in Scotland. Comparisons of observed and forecast carrot fly activity at Kirton and in Scotland are shown in Figure 1. Peak second generation activity was approximately one month later in Scotland than at Kirton.

Cabbage root fly forecast

The cabbage root fly forecast was sent to 215 levy-payers from 26 April until mid-September. Eggs and flies were monitored at HRI Kirton, HRI Stockbridge House and by growers at several commercial sites in Lincolnshire. Comparisons of observed and forecast egg laying activity at HRI Kirton, and observed egg-laying activity at three commercial crops in Lincolnshire are shown in Figure 2. The numbers of eggs laid per plant per week varied considerably between sites, the highest numbers being recovered in the monitoring plots at Kirton. Few eggs were laid during the second generation in any of the commercial crops monitored. However, higher levels of third generation activity

were recorded.

Pollen beetle forecast

Pollen beetle forecasts were sent to 36 levy-payers from 12 June until 21 August 1994. Pollen beetle activity was monitored at HRI Kirton, HRI Wellesbourne, HRI Stockbridge House and by several growers using traps supplied by HRI Kirton.

Attacks by pollen beetles are not inevitable. Beetle migration is favoured by periods of warm, humid weather. The forecast predicts the time at which pollen beetles are ready to migrate. The numbers that eventually migrate will depend both on the size of the local beetle population and on the occurrence of suitable weather conditions.

During 1994, large numbers of pollen beetles (> 500 per trap per week) were captured at five of the nine monitoring sites. Comparisons of the observed and forecast pollen beetle activity at four sites are shown in Figure 3. The migration of pollen beetles occurred towards the end of June in Surrey and towards the end of July in Scotland.

SUMMARY

In 1994, weekly forecasts of the timing of carrot fly, cabbage root fly and pollen beetle activity were produced using data obtained weekly from 38 weather stations. Carrot fly, cabbage root fly and pollen beetle forecasts were sent to 125, 215 and 36 levy-payers respectively. In total, more than 7,000 vegetable pest forecast summary sheets were sent to growers. The large differences in weather conditions from the north to the south of the UK were reflected in the timing of activity of all three pests.

ACKNOWLEDGEMENTS

We are extremely grateful to the Meteorological Office, ADAS (National Agrometeorological Unit, Arthur Rickwood), HRI colleagues (Littlehampton, Wellesbourne, Kirton, Stockbridge House, Efford, East Malling), Brooms Barn Experimental Station and Morley Research Centre for supplying their weather data on a weekly basis and to the participating growers for sampling the insects within their fields. We are also indebted to ADAS colleagues, particularly Dr J. Blood Smyth, Mr B. Emmett, Dr S. Tones and Dr W. Parker for much useful information on pest activity.

Figure 2. Observed and forecast cabbage root fly activity at HRI Kirton in 1994 and observed activity in three commercial brassica crops in Lincolnshire.

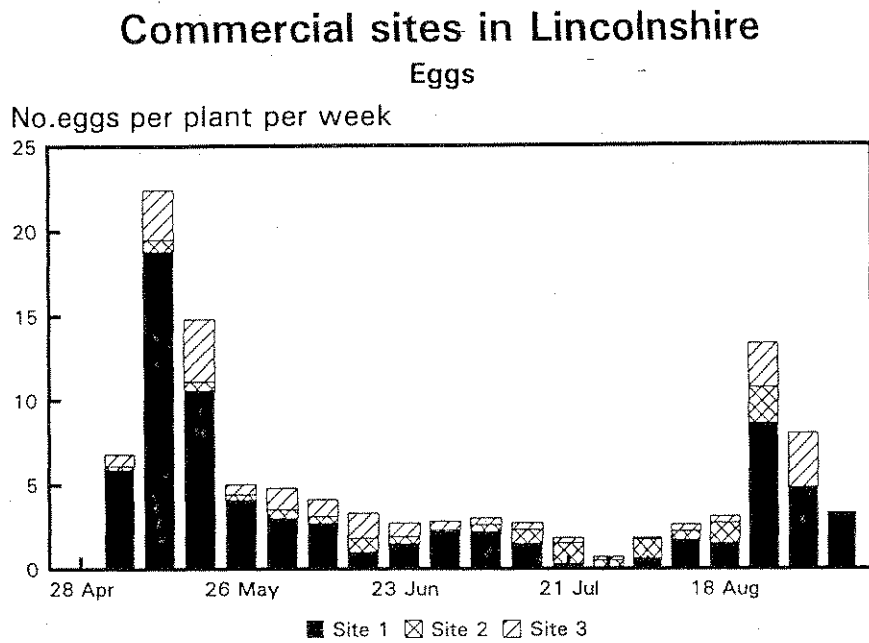
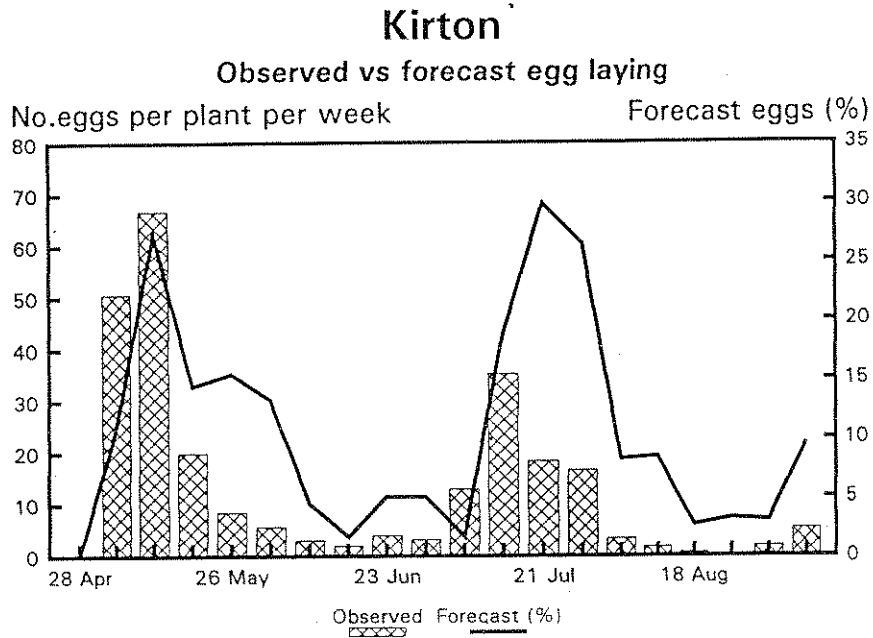


Figure 1. Observed and forecast carrot fly activity at HRI Kirton and at three sites in Scotland in 1994. Forecasts are shown only for periods when carrot fly activity was monitored.

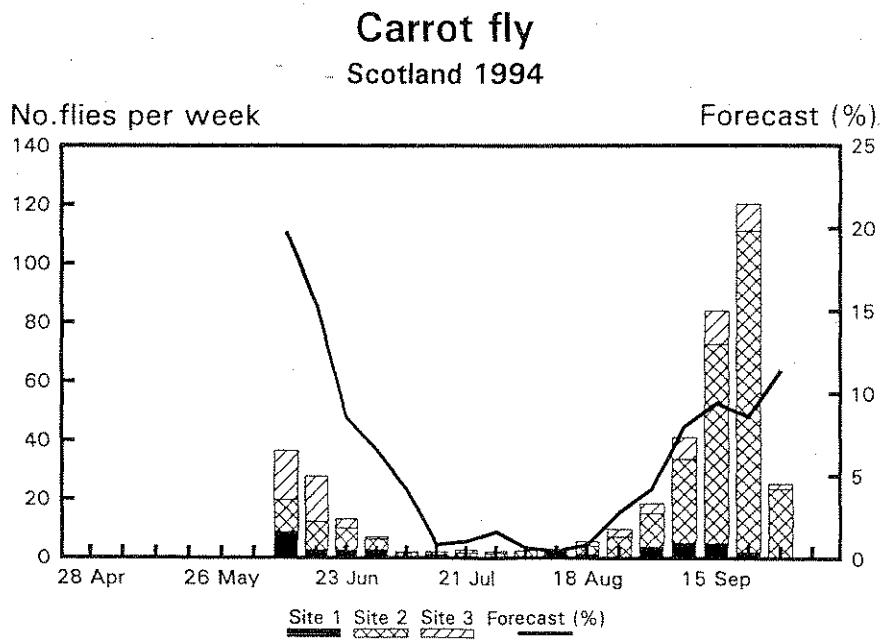
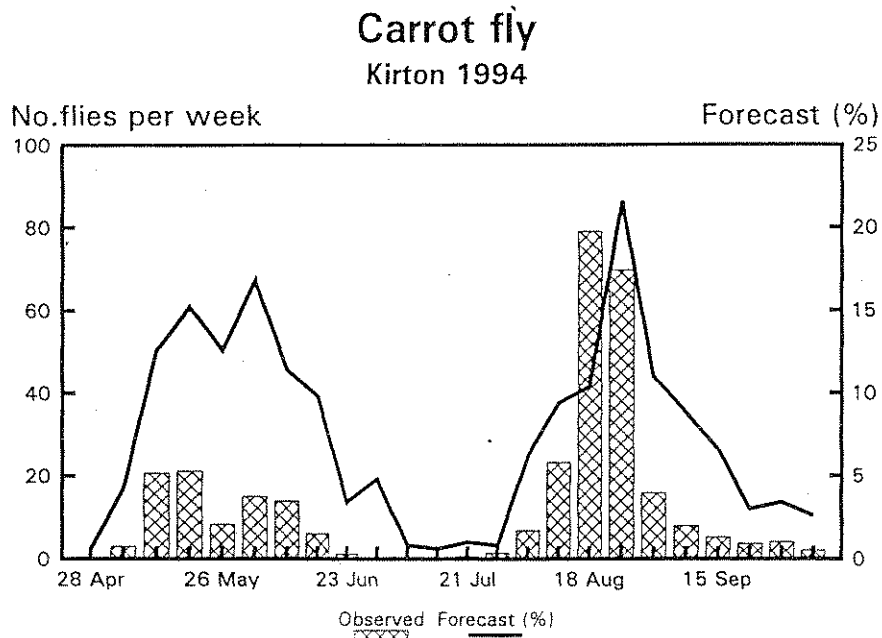


Figure 3. Observed and forecast pollen beetle activity at four sites in 1994. Forecasts are shown only for periods when pollen beetle activity was monitored.

