TITLE OF PROJECT:	3D Farming – Making biodiversity work for the farmer
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REPORT:	Year 1 annual report 2001
REPORTING YEAR:	2001 (01/01/01 – 31/12/01)
LEAD PARTNER:	IACR – Rothamsted (Prof. Wilf Powell)
SCIENTIFIC PARTNERS:	The Game Conservancy Trust (Dr. John Holland); Central Science Laboratory (Dr. Keith Walters); Scottish Agricultural College (Drs. Stuart A'Hara & Rob Harling); Plymouth University (Dr. George Thomas)
START DATE AND DURATION:	1 April 2000; for 4 years

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PROJECT OVERALL AIM

To use field margin management techniques to increase the abundance and diversity of beneficial insects and spiders and manipulate their distribution and dispersal on farmland for the control of aphid pests.

OBJECTIVES ADDRESSED DURING THE REPORTING YEAR

- To lay out and mark insect sampling positions at all field sites.
- To define final sampling protocols for use at field sites.
- To confirm the comparative efficacy of the chosen hoverfly trap design.
- To deploy aphid sex pheromones within the crop to coincide with spring aphid immigration into the parasitoid manipulation treatment fields.
- In late summer/autumn, to deploy aphid sex pheromones in the margins of fields selected for parasitoid manipulation in the 2001/2 cropping season.
- To monitor temporal changes in carabid beetle distributions within six fields at the Cranborne site, as affected by field size and margin management.
- To investigate the local movements of selected carabid beetle species using mark-release-recapture techniques.
- To monitor changes in cereal aphid populations at increasing distances from field margins at parasitoid and hoverfly manipulation sites.
- To measure aphid parasitoid and predator populations in field margins and at increasing distances into the crop through the season at all sites.
- To conduct botanical surveys of field margins being used for parasitoid and hoverfly manipulations.
- To sort field samples and send parasitoid and hoverfly samples to Rothamsted and CSL, respectively, for identification and counting.
- To develop and test molecular techniques for detecting aphid predation by linyphiid spiders in the laboratory.
- To collect and rapidly freeze live spider samples from two field sites to evaluate these molecular techniques using field populations.

RESULTS FROM THE REPORTING YEAR

Sorting of the 2000 season field samples was completed before the start of the first full treatment season of 2001, and final sampling protocols were agreed and circulated amongst all scientific participants. Sampling grids were marked out at all sites and data on aphid flight from the Rothamsted Insect Survey suction traps were used to trigger sampling programmes to coincide with cereal and pea aphid immigration at each study site. Aphid pheromone lures were deployed within the crop, at the start of aphid immigration, in the parasitoid manipulation treatment fields at the four relevant sites. Suction nets, water traps and pitfall traps were used to sample parasitoids, hoverflies and carabid beetles, respectively, on a weekly basis in the field margins and at 10, 30 and 100m into the crop in fields at each site where margins are being managed to manipulate parasitoids and hoverflies, and in control fields. *In situ* aphid counts were done weekly at the same three distance into the crop.

Cereal aphid numbers were greater than last year but declined rapidly in the latter half of the season. Treatment effects on aphid populations occurred but these were not consistent at all sites. Hoverflies were very abundant in 2001 and were probably responsible for the principal effects on aphid numbers. It is anticipated that once the hoverfly samples have been processed, these data will provide valuable insights into the interesting differences between sites observed in the aphid counts this year. Parasitoid populations appeared to be low this year and were undoubtedly affected by the unusually high hoverfly numbers through predation of parasitised aphids. Thorough analysis of the years data awaits completion of sample sorting and identification, which is well advanced and should be completed before the start of the 2002 field season. Further field tests confirmed that the white and yellow water traps being used in the project are the most efficient design for sampling hoverflies.

A grid of 973 pitfall traps was used three times during the season, at the Cranborne site, to determine temporal changes in the spatial distribution, species composition and abundance of carabid beetle predators as affected by field size and margin management. Similar data collected in 2000 were analysed using the 'Spatial Analysis by Distance IndicEs (SADIE)' technique to identify significant patches of beetle aggregation and areas of low beetle density. This revealed significant boundary effects on beetle distributions as well as important differences between neighbouring fields that changed over time.
To supplement these data, a mark-release-recapture study was done to investigate the movement of large carabid beetles across field boundaries. Closely related *Pterostichus* species differed significantly in the extent of their cross-boundary movements.

Molecular (PCR) techniques have been successfully developed to detect the presence of cereal aphid prey within spiders. The techniques were tested using laboratory-maintained linyphiid spiders that had been fed on specific cereal aphid prey at varying periods before testing, but the techniques now need to be validated using field-collected spiders. Live spiders were collected weekly by hand from two of the field sites and deep frozen in the field immediately after collection to provide material for the validation tests.

Suitable experimental fields were selected at all field sites for use in the 2002 field season and the aphid sex pheromone lures have been deployed in the appropriate field margins for establishing overwintering parasitoid reservoirs.

CONCLUSIONS AND IMPLICATIONS FOR LEVY PAYERS

The field work this year indicated that the large numbers of hoverflies present at the study sites played a significant role in limiting cereal aphid populations and that they were making use of pollen food sources in diversified field margins to boost the number of eggs they produced.

Further details on the impact of hoverflies on aphids within the crop and the role of field margins in enhancing this impact will emerge when this years insect samples from the project study sites have been fully analysed.