Project number:	FV 231 (SAPPIO LINK Project LK 0915)
Project title:	3D Farming – Making biodiversity work for the farmer
Report:	Year 2 annual report, 2002 results
Lead partner:	Rothamsted Research (Prof. Wilf Powell)
Scientific partners:	Central Science Laboratory The Game Conservancy Trust Scottish Agricultural College (Edinburgh)
Co-sponsors:	DEFRA, SEERAD, HDC, PGRO, Dow AgroSciences, Unilever, Farmcare, Tesco, United AgriProducts
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The following are members of the Consortium for LINK project LK0915.

Scientific Partners
Rothamsted Research (Prof. Wilf Powell)
Central Science Laboratory
The Game Conservancy Trust
Scottish Agricultural College (Edinburgh)

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GROWER SUMMARY

Project 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.

Key messages emerging from the project:

- Field margin diversification increases the diversity of beneficial arthropods on farmland, including aphid predators and parasitoids.
- Field margins containing wild flower/grass mixtures can help to reduce aphid densities in adjacent crops.
- Substantial reductions in aphid numbers in the crop can result from hoverfly activity in fields with appropriate wild flower margins.
- Umbellifer flowers in field margins provide the best food resources for adult hoverflies, whose larvae feed on aphids.
- Early parasitoid activity in spring/early summer limits the growth of aphid populations, facilitating natural biocontrol.
- Encouraging a range of natural enemies by means of field margin management provides the most reliable natural control system.
- Both hoverflies and parasitoids are highly mobile and can rapidly spread across crops from field margins.
- The distribution of Carabid beetles on farmland changes through both time and space and is influenced by crop type (more beetles occurred in pea crops than in cereals) and by field margins.
- Some carabid beetles move from field to field much more frequently than others.
- Set-aside strips along field margins increase the diversity of predatory beetles in the crop for at least 30m.
- A significant proportion of money spiders occurring up to at least 100m into the crop feed on aphids.

Summary of results from reporting year:

- Analysis of data collected in the last two years revealed that, although cereal aphid populations had remained below economic damage thresholds in 2000 and 2001, their dynamics through the summer were very different in the two years. In 2000 they increased slowly during the early part of the season, due to high parasitoid activity, and never showed any signs of the rapid population growth rate that normally leads to aphid outbreaks. In 2001, a cold wet spring prevented early parasitoid activity and the aphid population increased rapidly in early summer, but was prevented from reaching damaging levels by large numbers of hoverflies.
- Cereal aphid populations remained extremely low at all sites in 2002 and the project data should shed light on the main control factors responsible when this years samples are processed and the data analysed.
- Statistical analysis (ANOVA) of the aphid data from 2001 revealed a significant interaction between site and treatment. At sites with abundant hoverflies, aphid densities were significantly reduced in fields with a wild flower margin, probably due to positive effects on hoverfly predation.

- Statistical analysis (ANOVA) of the hoverfly data from 2001 revealed a highly significant effect of distance into the crop, with large numbers of adult flies emerging from well into the crop in July. The data showed that hoverflies are highly mobile and deposited eggs well into the crop. This was particularly significant in fields with a flower margin.
- Wild flowers from field margins were tested for their attractiveness to hoverflies. Umbelliferous plants such as cow parsley and hogweed were highly attractive, as were yarrow and white campion. The very abundant oxeye daisy, however, was hardly ever visited. From this work it is now possible to recommend native wild flower species for inclusion in sown margin seed mixes in order to enhance hoverfly predation of aphids in adjacent crops.
- Carabid beetle trapping data revealed an unexpected result. Much greater numbers of the carabid *Harpalus rufipes*, which is an aphid predator, were caught in fields where aphid sex pheromones had been deployed, principally to attract aphid parasitoids. Laboratory experiments will be done to confirm that this beetle is attracted by the pheromones.
- Generalist beetle and spider predators were again intensively sampled at one of the study sites, using an extensive grid of pitfall traps in six neighbouring fields. Many more predators were caught in pea fields than in cereal fields and their spatial distribution changed through the season. Weed cover was assessed at trap locations and broad-leaved weeds appeared to have a positive effect on predator numbers and diversity, especially in July. Set aside strips (24m wide) along field margins also increased the diversity of generalist predators up to at least 30m into the crop.
- Mark-recapture work showed that the abundant carabid *Pterostichus madidus* is highly mobile, readily moving between fields and crops, whereas the closely related *Pterostichus melanarius* was significantly more sedentary.
- Money spiders (Linyphiids) were again collected from cereal crops at increasing distances from field margins and tested for aphid feeding using molecular (PCR) techniques. Tests using the spiders collected from the field in 2001 successfully detected aphid remains in a significant proportion of the samples, including in those collected up to 100m away from the field margin.

Key issues to be addressed in the next year:

Field sampling of aphids and their natural enemies will continue for a third full year at 5 field sites. Studies will be extended to include more crops, including field vegetables. As more data become available from the extensive processing of field samples, statistical analyses of field data will be intensified.