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Overcoming Market and Technical Obstacles to Alternative Pest Management in Arable Systems

A Rural Economy and Land Use Programme research project that investigates constraints on adopting alternatives to pesticides and ways in which these barriers may be removed.

Sowing a field margin with rye grass can improve the level of biocontrol

Policy and Practice Notes

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The Rural Economy and Land Use Programme is a UK-wide research programme carrying out interdisciplinary research on the multiple challenges facing rural areas. It is funded by the Economic and Social Research Council, the Biotechnology and Biological Sciences Research Council and the Natural Environment Research Council, with additional funding from the Scottish Government and the Department for Environment, Food and Rural Affairs.

Weeds, pests and diseases cause serious damage to crops, meaning a reduction in yields and lower-quality food. As demand for food and competition for land rises, it is vital that crop losses are limited. Chemical protection has provided effective control of crop losses in the recent past; alongside chemical fertilisers and improved crop genetics, it has helped to increase crop yields dramatically over the last 60 years. However, there is now a need to develop complementary alternatives.

Why do farmers need alternatives to chemical pesticides?

Overuse of pesticides leads to pesticide resistance, and affects biodiversity and water quality. Heightened EU regulations, under directive EC 91/414, are also leading to the withdrawal of many pesticide products. Thus, complementary alternatives are needed to reduce the use of the valuable pesticides that are still available, so prolonging their useful lives, and also limiting environmental harm.

What alternatives are available?

A wide range of technologies exist that can help reduce pesticide use but few can compete on their own. Combinations are far more effective, leading to the development of Integrated Pest Management (IPM) programmes.

Techniques to help to reduce the use of pesticides include:

- cultural means – rotation of crops to reduce pests, timing of operations to minimise risk of infestation, and choosing resistant varieties.
- careful monitoring of crops to support a graduated response based on economic criteria.
- conservation biocontrol - maximising the effects of natural enemies, providing habitats that encourage these and using selective pesticides that won't reduce their numbers.
- integrated nutrient management – excessive nutrient supply encourages weeds, pests and diseases. Optimising inorganic fertiliser inputs and applying organic manures reduces excessive growth and increases pest and disease resistance.
- soil management – reducing the intensity of tillage and applying organic manures encourages beneficial soil organisms that control crop pests and improves the crop's resistance to pests and diseases.

But most farmers adopt a limited number of techniques and are not gaining the benefits of a fully integrated approach.

There are also new technologies which could be used in IPM approaches. These include non-toxic crop protection treatments such as semiochemicals that can boost natural bio-control activity and biopesticides that may be used in place of chemicals to control pest population peaks.

What is conservation biocontrol and how can it be enhanced?

Pest populations are naturally controlled by a broad range of indigenous predatory and parasitic insects, referred to as "biocontrol". Insecticides are only required when pest populations escape this process. Biocontrol can be boosted by providing appropriate semi-natural habitats that supply food and shelter for natural enemies. The relative immobility of some natural enemies means that spatial arrangement of these habitats influences the levels of biocontrol.

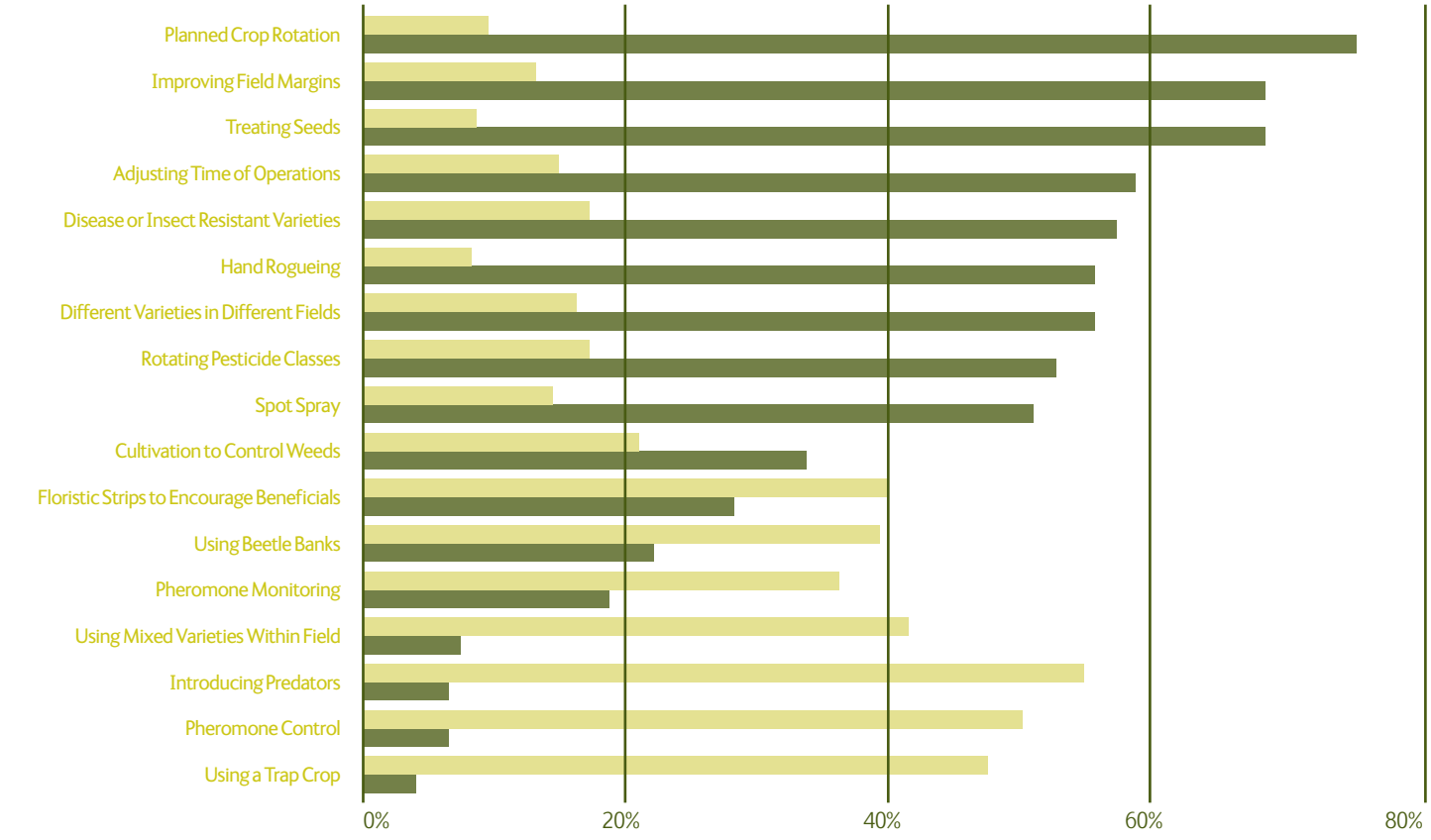
- In isolation, flying natural enemies (parasitoid wasps, hoverflies, predatory flies and rove beetles) effectively control cereal aphids. Ground based predators (mostly ground beetles and spiders) provide lower and slower levels of control.
- Natural enemy populations can be increased by providing extra semi-natural habitats.
- Flower-rich areas provide food for flying predators, and grassy margins and hedgerows improve the overwintering of ground-based predators.
- Grass margins improve the level of biocontrol. Control by flying natural enemies is highest within 250m of a grassy margin.
- Biocontrol will be achieved if habitats are present in every arable field and larger fields are divided by beetle banks.
- Biocontrol is more effective when a wide variety of natural enemies are present. More diverse semi-natural landscapes, such as differing hedge and vegetation types, promote more diverse, and effective, natural enemy populations.

Using IPM does not rule out the careful use of pesticides as a last line of defence. However, the farmer in the near future will have more choice.

– New biopesticides will provide the opportunity to manage pest population explosions in a more benign way.
– Semiochemicals will allow farmers to direct boosted biocontrol where and when required.
  - Semiochemicals are chemical signals that plants and animals use to communicate information to their own and other species.
  - Plants have natural defence systems that can be manipulated; cis-jasmone is a semiochemical that is part of this natural defence system.
  - It can be manipulated to make crops less attractive to pests while attracting generalist parasitoids of aphids. These parasitoids populate field margins so cis-jasmone should complement conservation biocontrol.
  - Other semiochemicals have the potential to attract natural enemies of pests into crops.

What range of techniques are farmers already using?

Most conventional farmers, who collectively farm the largest area of land in the UK, rely on pesticides for weed, disease and pest control. However, survey results show that many farmers are also putting in place practices and land use patterns which can help to protect their crops.



Adoption of pest control methods in a sample of 571 UK arable farms during the 2007 cropping season

Many of these practices are supported by agri-environment schemes in the UK, including the use of field margins, beetle banks and floral strips, but the promotion of IPM is not an explicit aim of agri-environment schemes and remains a missed opportunity for policy makers.

Intra Crop Bio-controllers	Chemical "Users"/ Conservers	Extra Crop Conservation Bio-controllers	Weed-Focused Farmers
Trap Crops	Pheromones	Field Margins	Cultivate Weeds
Mixed Varieties	Different Varieties	Floral Strips	Crop Rotation
Introductions	Resistant Varieties	Beetle Bank	Timing of Operations
Pheromones	Spot Spraying		Hand Rogueing
Different Varieties	Treated Seeds		
	Rotate Pesticide Classes		

IPM portfolio practices on UK arable farms: farmers fall into different types according to the practices they adopt

Which policies would support wider adoption of Integrated Pest Management?

Integrated Pest Management technologies fall into two types: the "practice-based", which depend on changes in farming practice, and therefore have "public good" characteristics, and the "product-based" which require farmers to purchase some new product in order to acquire the technology. Each needs subtly different policies to encourage farmers to adopt them.

- Supporting research that develops understanding of complementarity between practice-based and product-based approaches could ensure that commercial patent holders actively promote the IPM portfolio rather than just their own product.
- Registering plant protection products with the Chemical Registrations Directive requires information for seven risk assessment dossiers and so is costly. The biopesticide registration scheme allows exemptions from each risk assessment, negotiated on a case by case basis but this means that applicants do not have a clear idea about the final costs at the beginning of the process. For benign product groups some risk categories should be removed altogether, to ensure more products come forward.
- Agri-environmental schemes can be used to encourage further adoption of both land management practices and other crop protection technologies which use biocontrol. This can be achieved through overall habitat diversification, and through the creation of habitats that provide specific resources for pests' natural enemies.
- Schemes should be redesigned so that:
  - The promotion of biocontrol is an explicit objective.
  - Extra points are awarded for habitats that provide overwintering sites, alternative prey, or a source of pollen and nectar for pests' natural enemies.
  - Farmers are rewarded for creating diverse habitats that provide a variety of resources to promote a wider range of natural enemies.
  - Crop Protection Management Plans which place greater emphasis on IPM-focused approaches should be reintroduced. The farming industry's Voluntary Initiative on pesticides may have an important role here.
- Removing more pesticides from the market will drive the adoption of IPM strategies. The regulatory authorities and commercial contracts, between farmers, buyers and the retailers, have a role.
- Once Integrated Pest Management is widely understood, a pesticide tax could be introduced and would further promote IPM.
- Farmers need information about alternatives and support during the adoption process, including:
  - Details of the efficacy of alternative control products and how they may complement each other.
  - BASIS training programmes on pesticides that incorporate the latest research on IPM and any resulting revisions to agri-environment schemes.

Further information

The research has been carried out by researchers at The University of Kent, Imperial College, London, The Game and Wildlife Conservation Trust and Rothamsted Research.

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Useful resources:

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