

A shift in the field

Antoine Messéan, Marco Barzman, Françoise Lescourret and Pierre Ricci explain how they can build innovative crop protection strategies using a systems approach

ENDURE/PURE



To begin, can you offer an overview of the 'European network for the durable exploitation of crop protection strategies' (ENDURE) project? What are its overarching objectives?

ENDURE was initiated in 2007, based on the realisation that times of change were coming for crop protection in Europe and that facing this challenge required an unprecedented effort in research and extension that could only be achieved by sharing expertise and resources at the EU level. Previously, collaborative projects had addressed specific issues in crop protection, but the question of how to reduce reliance on pesticides in cropping systems while maintaining productivity had been debated mostly within individual countries, each one favouring its own approach.

ENDURE's main objectives were to:

- Learn from these national experiences and share their benefits at a transnational level
- Elaborate an original multidisciplinary approach to build innovative crop protection strategies along the principles of Integrated Pest Management (IPM)
- Develop common tools (databases, models, platforms) as a Resource Centre for crop protection-related research
- Stimulate IPM adoption by providing advisors with a centralised source of information and set up an EU-wide advisory network
- Offer scientific support to the implementation of the pesticide policies at EU and Member State level

For those unaware, can you describe the underlying principles of IPM?

IPM is a sustainable approach to managing pests by combining biological, cultural and

chemical tools in a way that minimises economic, environmental and health risks. The concept emerged decades ago, but it is still an appropriate framework because it can incorporate innovative methods and strategies and can be continuously adapted by farmers to their own conditions and dynamics. Basically, IPM relies on three components: control, monitoring and prevention. Pest control is best insured by a combination of complementary methods, with pesticide use as a last resort option. Control methods should be implemented only when economically justified, based on monitoring of pests, of biological regulation and of the effect of previous measures. Although too often neglected, prevention is essential. It means observing prophylactic measures, especially the use of healthy seeds and plants. But it also involves using larger temporal (ie. rotation) and spatial scales (ie. landscapes) to devise cropping systems that do not favour the build-up of weeds, pests and pathogen populations, or are resilient to their outbreaks. The ultimate goal of IPM is thus to reach production systems having a minimum requirement in control methods.

In what sense are we currently witnessing times of change for crop protection in Europe?

Crop protection relying on chemical control is at the core of current mainstream European agriculture: together with high fertiliser inputs, it allows varieties bred for greater productivity and market requirements to express their full potential in simplified cropping systems, with low labour requirements. This model, which emerged nearly half a century ago, has reached its objective of high steady plant production, providing the European population with affordable, diversified food and giving access to the world export markets. However, its deleterious effects on the environment – water, soil and air pollution, as well as loss of biodiversity – and the threats it poses to human health, are no longer accepted by our society. The model itself has reached its own limits:

the intensive use of a few pesticides causes the emergence of resistant pests at a pace that surpasses the rate at which today's agroindustry can generate novel chemicals.

The pesticide legislation adopted by the EU in 2009 will result in stricter requirements for placing new plant protection products on the market; the withdrawal of several pesticides currently in large use; many restrictions to the use of the remaining ones; and the adoption of IPM as the new standard for crop protection throughout Europe within two years. This forces all Member States to reconsider their domestic pesticide policy and the European agriculture at large to devise new crop protection strategies that will necessarily impact on the plant production schemes at the farming system level.

What progress has been made in understanding why crop protection practices differ between EU countries?

Part of the initial activity of ENDURE has been to collect and exploit the existing knowledge on reducing and optimising pesticide use. Nine case studies were carried out comparing pest problems and plant protection practices for selected crop/crop pest combinations in European countries. Besides describing the situation in different countries, the objective was to analyse why practices are different and whether optimum practices developed in one country could be adopted by others.

Furthermore, can you detail some of the major bottlenecks and knowledge gaps you have identified which are seen to impede EU agriculture?

With respect to reduction in pesticide use, the IPM conceptual framework is in existence; yet there are several impediments. There is a lack of a systems approach: limited effort has been made to exploit the interactions between individual protection methods,



or to consider the complexities of pest organisms. Regarding knowledge and tools, the potential of evolutionary biology to enhance the durability of IPM is still to be exploited, as is that of emerging technologies (eg. monitoring for diseases, precision farming). Also, IPM is not sufficiently based on sound ecological principles and should consider the new paradigm of eco-functional (ecological) intensification. Increasing the implementation capacities of IPM calls for a consideration and assessment of the various criteria of sustainability, and for reinforcing the partnership with stakeholders to co-construct IPM solutions.

The 'pesticides package' adopted by the EU in 2009 means that, in the years to come, farmers will no longer have access to the entire range of pesticides in use today. Can you summarise the viable alternative methods for crop protection that are presently available?

Most alternative methods can be classified in five categories: biological/biotechnological (use of biological control agents; mating disruption), genetic (cultivars resistant to pests and/or diseases), physical (eg. insect proof nets; soil steaming), cultural (eg. crop rotations; cover cropping; tillage to reduce herbicides) and habitat manipulation (eg. deploying plant diversity to favour insect enemies). The last category is likely to concern various scales, including the landscape.

What would you highlight as some of your key achievements to date?

In the 2007-10 period, our main organisational achievement was to lay the groundwork for a 14-member, 10-country, self-funded and permanent consortium. In terms of content, we generated a set of tools, services and information that placed us on the European map as a significant source of support for scientists, policy and farm advisors, and trainers concerned with IPM. From that period, we are also proud to have highlighted the need for a research project that could generate IPM solutions to reduce dependence on pesticides in selected major farming systems in Europe and that could be usable in the short and medium term. This initiative is now concretised in the form of the FP7 European Integrated Project, 'Pesticide Use-and-risk Reduction in European farming systems with Integrated Pest Management' (PURE).

What is the present focus of your work?

At the end of 2010, 14 ENDURE partners committed themselves to building on the achievements of the EC-funded Network of Excellence by forming a European Research Group. The focus is now on strengthening our capacity to act as a platform for the identification and launching of new initiatives in research and extension, as well as continuing to offer facilitation and tools to support research, extension and policy within the scope of IPM.

Sowing the seeds for sustainable pesticide use in Europe

Integrated Pest Management provides a sound conceptual basis upon which Europe can build effective crop protection strategies. Whilst there are undoubtedly challenges ahead, the **PURE** initiative is set to provide systems-based solutions for the main farming infrastructure in the region

THE INTRODUCTION OF pesticides and their varying synthetic forms have changed the face of crop protection and raised multiple environmental, social and economic issues for European agriculture. Agricultural pests are organisms that include plants, insects, nematodes, fungi, bacteria and rodents that decrease yields, reduce product quality, and spoil or destroy harvests. Pesticides are thus used to eliminate individual pests while also offering farmers an effective means of controlling the quality and yield of their crops. As such, pesticides have become an integrated element of many crop systems: they have become 'locked in' to various cropping routines, and have contributed to the significantly high and good quality yields achieved by Western European agriculture over the past few decades. This dependence on pesticides has resulted in an acceleration of pesticide production and use in Europe, and the cumulative and permeating effects have proven detrimental to ecosystems and dangerous to our health.

Pesticides are known to leave residues in surface and groundwater, contaminate soil, cause air pollution and reduce biodiversity. To ensure food production and competitiveness in the agricultural sector, and to protect human health and the environment, the EU adopted a legislation for the sustainable use of pesticides in 2009. Stricter regulations will be placed on the agreement and use of pesticides as part of this directive, and farmers must adopt the principles of Integrated Pest Management (IPM). IPM is a combination of pest management evaluations, decisions and controls that offers an effective and environmentally sensitive approach to pest management. In order to reduce reliance on pesticides while also maintaining productivity, innovation in research design and pest control policy is key: novel and integrated approaches are central in developing more sustainable cropping systems, and the development of a shared toolbox is necessary to assist the crop protection community. To address the EU's directive on sustainable pesticide use, the 'Pesticide Use-and-risk Reduction' (PURE) research programme has been established. PURE will run over the next four years to develop and implement IPM solutions in key European farming systems. In doing so, it will help reduce risks to human health and the environment, as well as our dependence on pesticides, and will facilitate the implementation of the EU's pesticide package.

AN INTEGRATED APPROACH

The PURE project is coordinated by Dr Françoise Lescourret and takes an integrated, multidisciplinary approach to crop protection issues. It is associated with 14 European research institutes, two extension organisations, five industries and one project management consulting company. The research will test the efficacy, practicality and relevance of IPM solutions under the agro-ecosystems and farming conditions within Europe. IPM and its associated biological control methods have a long history and offer an alternative conceptual framework to pesticide-dominated crop protection. However, the development of effective IPM solutions in Europe is impeded due to the fragmentation of crop protection research and practice: regardless of the common linkages in many of the crops, pests and pest control technologies in the EU, there are very significant differences in pesticide use patterns. France, Denmark, Germany, The Netherlands and the UK have all developed their own vision of crop protection initiatives, primarily based on the specificities of their own agriculture, history and sociological makeup.

One objective of PURE is to merge the various methods, techniques and tools in pesticide use in the EU, which will be done via the already established 'European network for the durable exploitation of crop protection strategies' (ENDURE) project. This initiative began in 2007, based on the realisation that meeting the goals of the EU directive required research, extension and a collaboration of expertise at an EU level. ENDURE thus carried out nine case studies on a range of major crop-pest issues by comparing the situation in pesticide use and pesticide reduction efforts across various European countries. The research then centred on the issue of building innovative crop protection strategies along the principles of IPM. Three systematic case studies – two on arable cropping systems and one on a perennial crop – were used as a method to address this issue in a multidisciplinary way.

To analyse why practices are different and whether optimum methods could be adopted by other countries, ENDURE collected and exploited the diverse goal setting, stakeholder involvement and the role of research and extension in different countries. A multidisciplinary, collaborative approach was central in achieving this: "The key word of



the approach is 'integration' – integration of the different interacting components of agro-ecosystem functioning in a global scheme; integration of various research disciplines to clarify this functioning and its management; and integration of different skills to prepare the research development process," explains Lescourret. The researchers involved in the ENDURE programme hypothesised systematic changes at the farming systems and food supply chain level are necessary if a significant transformation in pesticide use is to be achieved.

MAXIMISING SUSTAINABILITY

The ENDURE team listed the alternative methods for various farming systems in Europe, and analysed the related bottlenecks and conditions of adoption. Its three-system case studies were used to examine how redesigning the cropping systems and envisaging future innovations could further reduce the dependence on pesticides and improve the sustainability of major European cropping systems. The role of the new, integrated PURE project is to test these innovative cropping systems. It will do this by combining existing methods with the new tools and technologies developed in the ENDURE project, and turning them into novel IPM solutions. One notable innovation is DEXiPM; a tool that allows for an expert-based ex-ante sustainability assessment of innovative crop protection strategies, and enables an iterative process of redesigning cropping systems until sustainability has been maximised. The PURE project team will use this tool as one way of addressing the biological,

agronomical and economical diversity in Europe via six farming systems: wheat-based, maize-based, field vegetable, pomefruit, grapevine, and protected vegetable.

GAINING GROUND

PURE comes directly off the back of the ENDURE initiative in the sense that it cooperates with industries to exploit recent advances in emerging technologies, plant-pest-enemies interactions, soil and landscape ecology and pest evolution. These will be fed into the IPM solutions with innovative diagnostic and decision support systems, physical devices and bio-products, as well as strategies for ecological pest regulation and improved durability of control methods.

Plans for dissemination have remained constant throughout both projects: the various groups involved in ENDURE and PURE aim for both initiatives to become a major resource for advisors, policy makers and researchers alike. "Dissemination is one of our key objectives and also – thanks in part to the permanent nature of our network – our strength. We seek to provide information, tools and services to all scientists, policy and farm advisors, and trainers concerned with IPM," explains Scientific Officer, Dr Marco Barzman. Activities on this front include plenary sessions, interactive workshops and panel discussions. Given the close connection between ENDURE and PURE, these events will make a lasting contribution to the future of European crop protection.

INTELLIGENCE

ENDURE/PURE

EUROPEAN NETWORK FOR THE DURABLE EXPLOITATION OF CROP PROTECTION STRATEGIES

PESTICIDE USE-AND-RISK REDUCTION IN EUROPEAN FARMING SYSTEMS WITH INTEGRATED PEST MANAGEMENT

OBJECTIVES

ENDURE's mission is to provide support to extension, policy and research across Europe to ensure the development of sustainable crop protection. It supports scientists, farm advisors and policy makers by providing research tools, a freely available online information centre and a Network of Experts.

PURE will provide IPM solutions and a practical toolbox for their implementation in key European farming systems in which reduction of pesticide use and better control of pests will have major effects.

PARTNERS

ENDURE/PURE :

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FUNDING

ENDURE: EU Sixth Framework Programme (FP6)

PURE: EU Seventh Framework Programme (FP7)

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