From Science to Field
Maize Based Cropping Systems (MBCS) Case Study – Guide Number 2

General Recommendations for IPM Development in European Maize Based Cropping Systems: Innovative Methods and Tools

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ENDURE scientists working on the development of Integrated Pest Management (IPM) have surveyed and evaluated Maize Based Cropping Systems (MBCSs) in selected European regions (see *Maize Based Cropping Systems - Guide Number 1* for details). As a next step, they have conducted an expert-based survey on recommendations for innovative IPM tools aimed at sustainable pesticide use and risk reduction, and the results are shared here.

The introduction of innovative tools - those being developed and likely to be available to the market in the next five to10 years - into IPM strategies can significantly contribute to addressing the European Union's strategic commitment to the sustainable use of pesticides and, consequently, more environmentally sustainable MBCSs.

An expert-based survey was conducted in four European regions: a northern region comprising Denmark, the Netherlands and Poland, the central-eastern region in Hungary, the south-western region in Spain's Ebro valley, and the southern region in Italy's Po valley. This has allowed us to determine the potential negative, neutral or positive impacts that innovative IPM tools could have on MBCSs aiming at the sustainable use of pesticides, taking into account agronomic, environmental, economic and social criteria. Experts from academic institutes, advisory services, agrochemical companies, agrochemical dealers and producers participated in the process.

The survey highlighted five IPM tools with an overall positive impact. These tools have a positive impact on all four criteria mentioned above, and were identified and recommended in all four regions under consideration. The composition and sequence of crop rotations, albeit with some concerns relating to their economic impact, were also recommended for future implementation in European MBCSs. These IPM tools are presented below, together with the experts' evaluation.

Tolerant or resistant non-GM maize cultivars*

Tolerant or resistant cultivars are important components in IPM as preventive non-chemical tools. Breeding efforts have been successful in developing high-yielding maize hybrids that are resistant to stalk rot diseases (i.e. *Fusarium* spp.) or producing inbred lines with elevated resistance to European corn borer (ECB, *Ostrinia nubilalis* Hübner). The choice of such cultivars will reduce yield losses caused by diseases and pests, reduces the risk of mycotoxin contamination in grain and results in reduced pesticide use. Cultivars with increased root developing capacity and thus reduced yield loss response to damage by Western Corn Rootworm larvae (WCR, *Diabrotica virgifera virgifera* LeConte) may also be considered in the future.

* GM maize cultivars, such as insect resistant and/or herbicide or drought tolerant varieties, are not discussed here.

Early detection methods

Early information on pest presence or pressure followed by informed decision-making on pest, weed and disease management are at the heart of IPM. Our expert analysis has concluded that innovative early detection methods for pests, weeds and diseases can help prevent crop damage and yield loss by optimising the timing of management decisions while avoiding unnecessary pesticide applications. These innovative detection methods include pheromone/lure traps or acoustic detection techniques (detecting insects by species' specific sounds) for pests, robotic platforms for weed population mapping

in the field and real-time polymerase chain reaction (PCR) based detection techniques for fungal, bacterial and viral diseases. Many of the early detection methods should be incorporated and accompanied by relevant forecasting models that help farmers in their decision making.

Pest and disease forecasting models

The development and use of models for the forecasting of major pests in MBCSs, such as ECB and WCR, will improve the control decisions (including rotation in the case of WCR) and timing of insecticide applications. Redundant applications can be avoided, thus reducing both costs, the pesticide load to the environment and adverse effects on non-target arthropod species such as beneficial insects. The accurate prediction of mycotoxins produced by *Fusarium* spp. in maize or wheat grains will result in more efficient management decisions for their prevention and reduce their presence in the food chain. Farm and smaller regional scale modelling of WCR population development and build-up is another example that is under development in infested areas for future implementation.

Precision or patch spraying using GPS spray maps

Precision or patch spraying using GPS spray maps can be as effective for weed control as 'conventional' application techniques and reduces the risk of the development of herbicide resistance. Savings in herbicide usage will result in reduced pesticide load to the environment and overall pesticide costs.

Community based decisions through information sharing

Strengthening the communication links between researchers, advisory services and farmers, and improved communication among local farmers to enhance the multi-path exchange of information and technology transfer, will improve IPM decision making and provide accurate, timely and the most sustainable options for field implementation by farmers. Freely accessible web-based information systems and databases can provide a solid basis for community-based decisions through information sharing.

Composition and sequence of the crop rotation

Crop rotation is the primary non-chemical control tool in cropping systems, breaking the development of pests and diseases through the change of host and altering the habitat for weeds. Appropriate crop rotation, or even simple cropping sequences, that provide varying patterns of resource competition, allelopathic effects, soil disturbance, inhospitable soil environment (such as alfalfa) and mechanical damage result in a more diverse environment that disrupts the growth and dominance of a particular weed or the life cycle of pests and diseases that were best adapted to a monoculture. However, the survey indicated that in the central-eastern and southern regions crop rotation was judged to have a neutral economic impact. This is because the inclusion of some crops important for agronomic reasons (for pest, weed or disease control) or environmental reasons (to enhance or attract natural enemies or improve soil fertility) may not increase the net profit of the system because of the crop price and concerns about the local availability of a market for specific crops.

Our view:

> Subsidies to farmers through the introduction of agri-environmental schemes and better technology transfer processes will encourage the adoption of innovative rotation systems that have positive agronomic and environmental impacts, but also have a positive consequence on the price of the end product, making it more acceptable for the society.

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Summary

The presence of several pest, weed and disease problems that need to be confronted at the same time raises the need for Integrated Pest Management (IPM) strategies in European Maize Based Cropping Systems (MBCSs). These strategies should integrate the most efficient 'environmentally friendly' tools that maintain the proper functioning of crop production systems. This is in line with the European Union's recently published framework directive (2009/128/EC), which aims to reduce the risks and impacts of pesticide use on human health and the environment by promoting the use of IPM and of alternative approaches or techniques. The directive means innovative tools need to be introduced and applied to IPM strategies designed to reduce pesticide use. An expert-based survey was conducted in four European regions to identify the common innovative IPM tools for future implementation in MBCSs in Europe, that will: (1) provide efficient pest, weed or disease control (agronomic impact); (2) reduce the use and risk of pesticides (environmental impact); (3) result in a net profit for the systems within a time frame of 3-4 years (economic impact); and (4) be accepted by society in terms of their environmental and health impact, and safety of end product (social impact). This survey recommends five tools that meet these criteria, in addition to the composition and sequence of crop rotations (albeit with some provisos). It demonstrates that some innovative IPM tools could form the basis of large scale future IPM implementation in Europe.

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About ENDURE

ENDURE is the European Network for the Durable Exploitation of Crop Protection Strategies. ENDURE is a Network of Excellence (NoE) with two key objectives: restructuring European research and development on the use of plant protection products, and establishing ENDURE as a world leader in the development and implementation of sustainable pest control strategies through:

> Building a lasting crop protection research community
> Providing end-users with a broader range of short-term solutions
> Developing a holistic approach to sustainable pest management
> Taking stock of and informing plant protection policy changes.

Eighteen organisations in 10 European countries are committed to ENDURE for four years (2007-2010), with financial support from the European Commission's Sixth Framework Programme, priority 5: Food Quality and Security.

Website and ENDURE Information Centre:

www.endure-network.eu

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