From Science to Field
Maize Based Cropping Systems (MBCS) Case Study – Guide Number 3

Innovative IPM Tools for Maize Based Cropping Systems in Northern Europe

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Innovative IPM Tools for Maize Based Cropping Systems (MBCS) in Northern Europe

In Northern Europe maize is grown mainly for silage (98% of the maize area) although the area dedicated to grain maize is increasing. It is estimated that 50% of the maize is grown in rotation with other arable crops such as cereals, potato and sugar beet, while the other 50% is grown in monoculture. Pest problems tend to be more severe in maize grown in monoculture, in particular with weeds and diseases. In conventional maize production pesticides are routinely applied to control pest problems. Herbicides constitute the majority of the pesticides used (>90%).

A number of innovative tools (defined as tools assumed to be commercially available within the next five to 10 years) could potentially reduce pesticide use and the dependence on pesticides in maize, and hence promote the implementation of Integrated Pest Management (IPM) as stipulated in Directive 2009/128/EC establishing a framework for achieving a sustainable use of pesticides.

A survey was conducted among 10 private and public advisers in the Netherlands to collect their views on the potential negative, neutral or positive agronomical, environmental, economical and social impacts of innovative IPM tools. Although the survey was restricted to the Netherlands we believe that the results of the survey are valid for other regions in Northern Europe such as Denmark, Northern Germany and Northern Poland. The survey revealed an overall positive agronomic impact of some of the tools for future MBCSs, and they are presented below.

Tolerant or resistant maize cultivars

Breeding efforts have been successful in the development of high-yielding maize hybrids that are highly resistant to stalk rot diseases (i.e. *Fusarium* spp.). The survey revealed that breeding is regarded as an important innovative tool irrespective of whether new varieties are the result of conventional breeding or genetic modification, for example *Bt* insect resistance or glyphosate tolerance. Although both technologies can provide agronomical benefits, conventional breeding was not surprisingly seen as being more acceptable to society.

Early detection methods and pest and disease forecasting models

A severe attack of *Helminthosporium* spp., a new disease in maize. © PPO-WUR, The Netherlands

Innovative early detection methods for pests, weeds and diseases, such as pheromone traps or acoustic detection techniques (detecting insects by species' specific sounds) for pests, sensor technology for weed population mapping in the field and real-time polymerase chain reaction (PCR) based detection techniques for fungal, bacterial and viral diseases, can help prevent crop damage and yield loss by optimising the timing of management decisions without conducting unnecessary pesticide applications. These technologies were considered beneficial from an agronomic point of view but the economic advantage to farmers was questioned. In contrast, pest, weed and disease forecasting models were considered beneficial from both an agronomic and economic point of view.

Decision Support Systems (DSS)

DSS will provide a tool that can determine 'when' and 'how' to conduct pest control. Applying pesticides only when economic thresholds are exceeded will reduce pesticide inputs and hence the costs of production. DSS were considered useful from an agronomic, environmental, economic and social point of view.

Precision/patch spraying using GPS maps and innovative weed control

Precision or patch spraying using GPS spray maps can be as effective for weed control as conventional application, reduce the risk of herbicide resistance and lead to savings in herbicide usage. The agronomic and environmental benefits were recognised by all the advisers, while they were more doubtful regarding the economic benefits.

'Hortibot', an example of high-tech precision spraying machinery. © Aarhus University, Denmark.

The development of innovative mechanical weed control (i.e. harrowing, finger and torsion weeding, weeding using compressed air) can provide more efficient inter and intra row weed control reducing or replacing the use of herbicides. Mechanical weed control was considered to provide environmental benefits whereas advisers were unsure whether innovative weed control methods would provide economic benefits to farmers. Precision spraying and innovative weed control methods were considered technologies highly acceptable to the general public.

Biological control and conservation biological control

Biological control, i.e. deliberate release of biological control agents into the field, and conservation biological control, i.e. conserving and enhancing the natural enemies in MBCS through measures such as provision of resources or refugia in the field, habitat manipulation and limiting pesticide use, that can balance pest populations and prevent high infestation levels, were both considered to be promising innovative tools from an agronomic point of view and environmentally and socially acceptable. From an economic point of view, conservation biological control was found more promising.

Crop rotation and cover crops

Although it may not be regarded as an innovative tool, crop rotation was regarded as one of the most important tools to prevent pest problems. Under Northern European conditions maize can be rotated with other crops without major economic impact. Cover crops are a technology already used by some farmers and the potential agronomic benefits were recognised by advisers although rated lower than the impact of crop rotation. In practice cover crops could be seen as an alternative to crop rotation.

Community based decisions through information sharing

Strengthening the communication links between researchers, extension services and farmers to enhance the multi-way exchange of information and technology transfer will improve IPM decision making and provide accurate, timely and the most sustainable option for field implementation by farmers. Advisors rated this as especially important considering environmental benefits.

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Summary

The presence of a multitude of pest problems that sometimes need to be dealt with at the same time emphasises the need for Integrated Pest Management (IPM) strategies in Maize Based Cropping Systems (MBCS). These strategies should integrate the most efficient 'environmentally friendly' tools that on the one hand conserve the ecological balance of the crop production system and, on the other hand, are economically sustainable from the farmer's point of view. This is in agreement with the objective of Framework Directive 2009/128/EC of the European Union (EU) that calls for a reduction of the risks and impacts of pesticide use on human health and the environment by promoting the use of Integrated Pest Management (IPM) and of alternative approaches or techniques. Fulfilling this objective will only be possible if innovative tools are introduced and implemented by farmers. A survey was conducted among Dutch advisers to identify innovative IPM tools for future implementation in MBCS in Northern Europe that will: (1) provide efficient pest, weed or disease control (agronomical impact); (2) reduce the use of pesticides against them (environmental impact); (3) result in a net profit of the systems within a time frame of 3-4 years (economical impact); and (4) be accepted by society in terms of their environmental and health impact, and safety of end product (social impact). The advisers were presented with a list of 18 innovative tools but found only some tools to be of interest in MBCS. These tools are presented in this leaflet.

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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:

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