Focus Group IPM for brassica

Mini-Paper 1

IPM: how to get from IPM concepts to successfully implemented IPM systems

Focus Group Authors: R. Baur[1], N. Birch[2], M. Hommes[3]

[1]Agroscope, Schloss 1, Postfach, CH-8820 Wädenswil
[2]The James Hutton Institute, Invergowrie, Dundee DD2 5DA, Scotland UK
[3]Julius Kühn-Institut, Messeweg 11/12, D-38104 Braunschweig, Germany

Introduction

During more than 50 years of development, the concept of Integrated Pest and Disease Management (IPM) has been described and summarized several times. One of the organisations which has achieved particular recognition for the development of IPM strategies is the IOBC (International Organisation for Biological and Integrated Control of noxious animals and plants (cf. **www.iobc-wprs.org**)). Several IOBC working groups, among them a working group on field vegetables, have been gathering knowledge on pest and disease control approaches that are not based on pesticides. According to the definition by IOBC (Wijnands *et al.* 2012), "The objective of IPM as a strategic approach towards crop protection is to safeguard the quality and quantity of production whilst minimizing the impact of pesticide use on human health and the environment". Similar definitions have been given elsewhere. Recently, with the Sustainable Use Directive (directive 2009/128/EC), IPM has become the standard European crop protection policy.

This contribution, after a brief description of the basics of IPM, deals with factors that might help to span the frequently-encountered gap between the often rich knowledge about agro-ecosystem functions and tools that might be useful in IPM and the successful compilation and integration of the range of measures aimed at achieving the objectives of IPM.

The basics of IPM

The basics of an IPM strategy (for example, according to the IOBC - see details in Wijnands *et al.*, 2012) are summarised below:

Prevention and/ or suppression of diseases, pests, weeds	Includes the management of all those aspects that interact with crop protection from the more basic aspects of farm layout (field size and shape, ecological infrastructures – such as flower-rich field margins), crop rotation, soil management and fertilization, cultivar choice, sowing date and density, and a range of other measures.
Justification of direct control (forecasting, monitoring, damage thresholds)	"Control" means management of the pest, disease or weed population to maintain it below the level that causes economic losses. Decisions about the necessity to apply control measures must rely on the most advanced tools and decision support systems available, such as prognostic methods, monitoring techniques and scientifically verified treatment thresholds.
Control (non-chemical, chemical)	Direct plant protection measures may be used if otherwise economically unacceptable losses cannot be avoided by indirect preventive means. Preference is given to all forms of non-chemical control measures (biological, physical etc). Pesticides may be used and integrated into the IPM strategy; however they must be carefully selected based on their properties with respect to their impact on the environment (spectrum of activity, persistence etc), ecology and human health. Detrimental effects on disease,

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	pest and weed antagonists must be avoided. Use should be optimised through application methods that minimise the amount of pesticide applied or by using monitoring or forecasting to apply treatments only when necessary, taking into account the risk for development of resistance in populations of harmful organisms. Some control methods or pesticides may be banned for a specific IPM scheme.

IPM takes an agro-ecosystems approach and the complexity of interactions within the system has to be considered. For example, crop fertilization might positively influence yield, but at the same time make crop plants more vulnerable to pest attack or disease infection. Chemical control of a pest might harm antagonists of another pest to an extent where additional control of the latter is required. Reduced weed control in *Brassica* crops might, at the later stages of crop growth, not necessarily lead to unacceptable competition for nutrients and water. However, wild cruciferous weeds might be reservoirs for pests and diseases which subsequently infect other crops and might provide micro-climatic conditions that further increase disease pressure.

Additionally, IPM cannot provide a prescriptive protocol for crop production but is more of a regionally flexible concept, a framework that needs adaptation to local environmental and economic conditions. IPM has to be seen as an approach that is based on continuous observation and improvement of the system. Therefore, farmers need to develop an approach of continued assessment of the system and an active search for system improvement. Thus, whilst IPM schemes should consist of regulations, restrictions and recommendations, they should offer enough flexibility for evolution and practicality at farm level.

Some corner stones for a successful implementation

- ***IPM Guidelines,*** such as those available from the IOBC, provide the conceptual framework and objectives for IPM and criteria for benchmarking cropping systems. They must allow enough flexibility to enable farmers to strive for solutions adapted to their own particular conditions. For example, the IOBC has established guidelines for many of the major crops, for example orchard fruits, arable crops, field vegetables, that each covers not only IPM, but a broader approach to managing the whole cropping system (Integrated production IP, for guidelines cf. http://www.iobc-wprs.org/ip_ipm/download_documents.html, Baur *et al.* 2011).
- ***Identification of key system elements*** in the given local conditions: depending on climatic, edaphic, agro-ecological and economic conditions, each growing region, or even each farm, has different key elements and key interactions that will finally determine which management strategies will be more successful than others. For example, temperature and precipitation (incl. seasonal distribution) will determine which diseases will have an impact. Field size will influence the distribution of less mobile pest insects but also of antagonists (natural enemies) within the field. Treatment thresholds may be different among different crops, since for example the susceptibility to cabbage root fly damage is much higher in swede or radish, compared with cauliflower or oilseed rape. In particular for vegetable crops, damage thresholds also differ with the market for which they are grown and the quality requirements of retailers. Since IPM measures have to be balanced and targeted to the key crop protection problems, an initial assessment of the problems and an understanding for the key interactions in the agro-ecosystem is crucial for a successful implementation of an IPM system. The IOBC uses the term "identity card" for this initial site-specific information.
- The regional ***IPM toolbox*** might, depending on crop and site-specific availability, include monitoring methods, forecasting tools, decision support systems, access to external services providing information on pest and disease status, including secondary pests. Furthermore, it is important to

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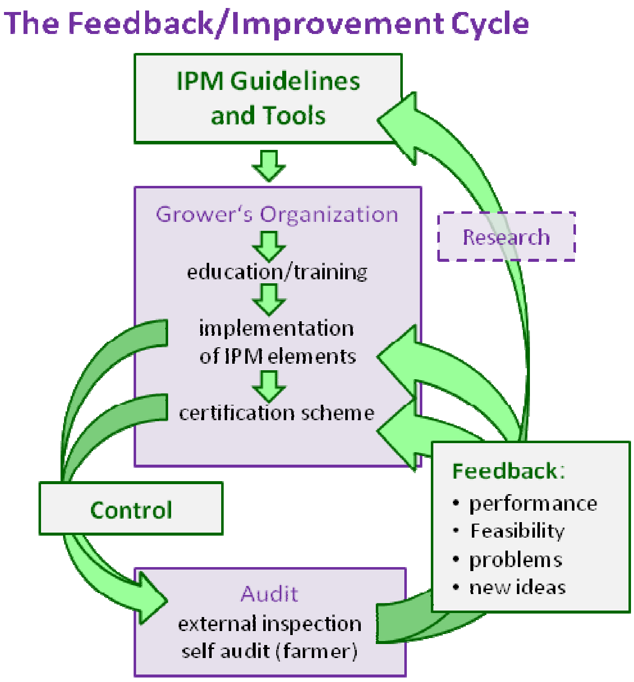
include access to a database on the effects and side effects of pesticides and knowledge about appropriate options with respect to crop rotation systems used in the region.

- ***Managing the implementation of IPM***: Successful implementation of IPM depends largely on the organizational context (Wijnands et al., 2012). Ideally, a regional or local growers' organization develops implementation procedures and inspection tools which are based on the usually more generally applicable IPM guidelines (e.g. those of a label organization or a governmental programme), including guidance for farmers. The purpose of these implementation programmes should be to specify the exact requirements and restrictions defining farmers' compliance with the programme. However, it would then be the task of the guideline holder (e.g. the label organization) to benchmark the implementation programme against their guidelines.
- **Performance assessment**: farm-level performance assessment should ideally not only determine eligibility to participate in an IPM programme and compliance with it, but should also provide feedback to growers about options for improvement. Appropriate evaluation schemes which include performance indicators, inspection schedules and a feedback process must be part of an IPM implementation programme. A self-audit, which is undertaken by the farmer as part of the evaluation process, facilitates better understanding by the farmer of shortcomings and identification of the potential for improvement (eg LEAF UK; http://www.leafuk.org/leaf/farmers/audit.eb).
- One of the core ideas of IPM is that of relying on the farmer to be a responsible, educated and motivated professional. Performance evaluation and feedback may be the start of a cycle of **continuous learning, system improvement, and systems innovation**. Therefore, IPM programmes must also establish opportunities and incentives for growers to undertake professional education and for knowledge exchange amongst themselves or with advisors and researchers. Ideally, an IPM programme will result in a community which fits in with the concept of an "operational group" according to the definition provided within the framework of the EIP.



Feedback/Improvement cycle according to Wijnands et al., 2012.

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- Successful implementation of IPM depends absolutely on ***motivation***, and thus on ***incentives***: benefits for farmers may be economic in terms of the higher profitability of their crops or reduced production costs, but may also be simply the "license to produce" and deliver into a profitable trade channel. IPM also leads to more 'stable' cropping systems with a lower overall risk of pest and disease. Nevertheless, recognition by consumers/society (possibly through labeling or positive publicity about IPM, and satisfactory professional interactions within the IPM "operational group" are also considered important motivational drivers and should be carefully established within IPM programmes.

Conclusions: more comparative systems research and knowledge exchange needed

For many crops, agricultural research has yielded a variety of measures and tools that are considered potentially useful for IPM. For example, in *Brassica* vegetables, undersowing with cover crops is described as strategy to reduce crop infestation with cabbage root fly (e.g. Finch & Kienneger, 1997; Finch & Collier, 2000). Agro-ecosystem studies have shown that the abundance of parasitoids and predators is increased by field margins with the appropriate botanical composition (e.g. Ramsden *et al.*, 2015). Supervised control of lepidopteran caterpillars using monitoring and treatments according to damage thresholds might allow reduction in the number of treatments if no other co-occurring pests determine the treatment schedule. The question arises: why do we frequently find that a large part of these well-stocked IPM toolboxes is not widely used by growers, particularly in vegetable production? The balanced use of a variety of IPM tools/measures, and their adaptation to the local situation of their crops is a challenging task for farmers. They might be reluctant to invest time and effort into a new approach as long as they perceive issues with efficiency, security and costs (in terms of additional effort). However, such information is often lacking. Even if farmers are interested in testing new IPM measures on their farms, they often lack time and expertise to establish experimental set-ups that would allow them to draw sound conclusions on costs and benefits and possible improvements. Case studies, embedded in applied research generating these data, would greatly contribute to a better understanding of the conditions and limiting factors of successful IPM implementation. Such studies, typically established within operational groups, would yield the type of knowledge urgently needed in order to speed up progress towards more IPM.

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IOBC: crop-specific guidelines for integrated production http://www.iobc-wprs.org/ip_ipm/download_documents.html.