Report on the BiPRO Study submitted by the ENDURE network of experts for DG Environment

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Note: This document reflects the views of the ENDURE network of excellence and is open for public circulation.

ENDURE has established a network of experts that can be called upon to provide scientific support on crop protection problems or issues. This network draws upon the competencies existing within ENDURE to respond to requests from groups involved in IPM-related policy-making or in the practical implementation of IPM. ENDURE supports the efforts initiated by the European Commission to accompany the 'Directive of the European Parliament and of the Council establishing a framework for Community action to achieve a sustainable use of pesticides' with a guidance document meant to assist Member States in the development of their National Action Plans with regards to IPM. Upon a request from DG Environment to provide comments on the 'Draft Guidance Document for establishing IPM principles - Supplement to the Final Report' (07.0307/2008/504015/ETU/B3, 23 April 2009), the ENDURE network of experts has produced the following review document.

Overall comment

ENDURE wishes to commend the authors of the BiPRO Final Report and Supplement for having produced a high-quality resource on the difficult topic of IPM implementation. These documents provide a comprehensive overview of the concept of IPM and its translation into practice. IPM itself has many different meanings, and crop protection, which draws on many disciplines and involves several sectors of economic activity, is a particularly difficult field when it comes to producing clear and applicable recommendations. In spite of this complexity, the authors have managed to start formalising the link between IPM policy and implementation, which has up to now been a scattered collection of experiences. We have found these documents to be useful in eliciting and structuring our constructive criticism. We hope that the combined efforts will produce material that Member States developing their National Action Plans can draw upon.

Our most significant comments regard:

- The systemic nature of IPM, which means that:
    - In accordance with Principle 1 on prevention and/or suppression of harmful organisms, the emphasis should be on creating the conditions that reduce the frequency and intensity of pest outbreaks
    - crop protection measures should be addressed collectively rather than in isolation, as much as possible.
- The availability of the knowledge resources needed to implement certain approaches.
- A historical bias in favour of Entomology with weed management particularly neglected.

The systemic nature of IPM

IPM creates synergies by integrating complementary methods drawing from a diverse array of approaches that include biocontrol agents, plant genetics, cultural and mechanical methods, biotechnologies, and information technologies, together with some pesticides still needed to address the most problematic pests and face critical situations. Such a diversity of solutions is also needed for sustainability purposes: the continuous use of a single method to control a given pest, be it the most favourable solution initially, will rapidly induce pest populations to evolve and overcome this method, whether a chemical one or not.

This means that the definition of IPM principles and their application require a different perspective on current farming practice, one that considers production through a systems approach. This perspective is not always fully expressed in the report. For example, in many instances reference could be made to 'cropping systems' rather than merely to 'crops'. Effective monitoring as well as guidelines would be facilitated if they were developed by cropping system rather than by crop. Many of the levers that can be manipulated to achieve robust agro-ecosystems are to be found at the cropping systems level. Similarly, the report should clearly distinguish between pest 'control' and pest 'management'. The two terms are not synonymous. 'Management' is more in line with the concept and principles of IPM which entail a broader context, and a focus shifted on prevention rather than on the wise use of direct methods for in-crop pest control.

If IPM is understood within a systems-based approach, it becomes difficult, if not impossible, to extract the effect of a single measure out of the system context. Indeed, systems theory tells us that systems have a behaviour of their own and that the sum of the effects of their components does not correspond to the systems effect. As such, it is necessary to talk about effects (success) of IPM strategies (combination and integration of tactics across an extended spatial and temporal domain) rather than tactics (individual measures chosen for a given crop and pest in a given year).

The systems approach also applies to the temporal scale, where in many cases, multi-year effects need to be taken into consideration. This has consequences, for example, on how success of the applied plant protection measures should be assessed (Principle 8). To evaluate success based on record keeping, it is important to be aware that the application of IPM, which by nature involves strategies deployed across more than one growing season, needs evaluating records across more than just one season to be able to judge effectiveness. This is particularly true for weeds, soil-borne diseases, and unpredictable insect outbreaks.

The dynamic nature of IPM implementation

ENDURE sees IPM as a continuously improving process in which innovative solutions are integrated and locally adapted as they emerge and contribute to reducing reliance on pesticides in agricultural systems. The BiPRO report appears to be based more on a yes/no logic (adopt/don't adopt). The wording in the table 5 (Annex 3) for example '*MS obliges the professional user to consider appropriate crop rotation schemes for all his crops'* seems to

indicate that farmers can consider Principle 1 and then decide not to apply it, or to apply it as a voluntary ('crop specific') effort. It would be more productive to distinguish between 'entry level' (i.e., compulsory) requirements and 'higher level' (voluntary) requirements. In this particular example, an 'entry level' requirement could be to adopt a 3-year rotation without other Solanaceae crops and a 'higher level' requirement could be to also include implementation of a specified minimum distance between potato fields in the same farm. The UK system put in place for the application of agri-environmental schemes may serve as examples of how to structure cropping-system specific guidelines: the UK 'entry level stewardship' system could correspond to IPM compulsory cropping system guidelines while the 'higher level environmental stewardship' system could correspond to IPM optional cropping system guidelines. See Natural England and DEFRA websites for details.

Availability of the knowledge resources

Research

Research is infrequently referred to in the report. The impression is created that many solutions are existent but need "only" to be implemented. This may be true in only a few cases; for the majority of crops however, much applied research is still needed. There are many references to science and MS authorities as the legitimate sources of knowledge. In many cases, neither research nor authorities will know what the best IPM measure is. It needs to be clearly emphasised that much additional information which is not yet in a 'ready-to-use' format needs to be provided to implement IPM on a common base in practice. To face the new demand, ENDURE is advocating very significant efforts to increase the range of effective and affordable IPM solutions. This requires a coordinated plan to:

- encourage public and private research on new crop protection technologies and facilitate the regulatory conditions for their availability on the market,
- support multidisciplinary research on whole systems–an emerging field—as a way to design truly innovative IPM strategies,
- develop information, education and recognition of these integrated strategies for the benefit of farmers, advisers and other actors of the food chain, including the general public,
- maintain a momentum at the European level to create synergies from national efforts.

The fact that the general principles of IPM become mandatory and crop or sector specific IPM guidelines are voluntary might become an obstacle. If farmers shall adopt true IPM principles, there is no better way than providing them with a series of cropping system-specific guidelines on how to reach this goal. Otherwise the concrete risk is that principles remain principles and are never turned into actions. However, when it comes to bridging the gap between general IPM principles and crop specific guidelines, the presumption that '*in most countries, crop specific guidelines are already available under the framework of 'integrated production (IP)' (p 30)* gives a wrong impression. In Italy, most crop-specific IP schemes included as guidelines for the regional application of EU Reg. 2078/92 and subsequent ones could be a starting point for the production of improved guidelines but are not actually useful for the implementation of IPM. In addition, existing IP schemes mainly pertain to fruit and vegetables, not arable crops.

Advisory services

Communication to professional users needs further development and should be recognised as the main vehicle by which MSs ensure IPM implementation. The assertion that "an efficient decision making system alone can lead to an effective IPM system" should be treated carefully. Efficient advisory services are present only in a limited number of EU countries: this should be one of the points in which the EU and MSs need to massively invest in the years to come to ensure IPM implementation. One way to go could be to educate specific authorised IPM advisors, which should guarantee that the basic principles were taught and could be disseminated. Advisors can work as multiplicators with groups of farmers or technicians. ENDURE partners have good experience with systems where advisors train groups of farmers in workshops (e.g. "Training for farmers after the arrival in the country of the destructive western corn rootworm (WCR)" in Hungary[1], "Course on the identification, biology and management of grass weeds" in Denmark[2]). Regarding the statement, "*For minor crops, which are not very common in some countries, it might be worth appointing an external independent advisor"*, there is no good reason to have a separate organisation of advice delivery according to major and minor crops. It should not be difficult to find experts with diverse competencies that include pest protection for minor crops. It can be recognised that many tools and methods specific to minor crops may not be available. Nevertheless, the same reference systems (web, advisory systems, etc.) for delivering such information could be used. The advisory system should be organised not by crop but by cropping system type such

[1] http://www.endure-network.eu/about_endure/all_the_news/learning_ipm_lessons_from_wcr_in_hungary
[2] http://www.endure-network.eu/about_endure/all_the_news/training_dates_for_weeds_and_wheat

as arable crops, vegetable crops, forage crops, fruit trees, vineyards, olive groves, and small fruits. The document suggests "*establishing a framework for a monitoring methodology/system*" in order to "*evaluate the efficiency of an IPM system*" by MS. The key point here is to reinforce or put into place monitoring systems run by regional agencies. This should be done by a cropping system x pest typology matrix.

Thresholds

The over-confident assumption that scientific and technical information is or will readily be available is very apparent in the discussion of Principle 3 regarding scientifically established intervention thresholds. There are several points to mention here.

One point regards the concept that "*robust and scientifically sound threshold values are essential components for decision-making*" and that sound intervention thresholds have an important role to play in IPM. While this is true, it should be realised that thresholds may not always apply, may not always be available, and may not be sufficient. The report portrays robust thresholds as critical to successful IPM. There will be many cases where this pre-requisite will not be satisfied. In this case the challenge is placed unrealistically high and provides users with a good excuse to completely forego the idea of decisions based on observation and explicit decision rules. It may be better to stress the general importance of observation and the need for sound decision rules.

Historically, IPM emerged in the area of insect pest control where the use of intervention thresholds has generated very good results. Nevertheless, the practicability of threshold-based decisions against diseases and weeds has yet to be shown. In fact, for pests such as weeds that usually appear as a community (i.e., a set of multiple species) and not as a population, there is no scientific consensus regarding the pertinence of thresholds. In the case of polycylic diseases, is is estblished that control is often much more efficient when targeted to the primary cycle, while the inoculum level is very low, than on the subsequent secondary cycles, which is contradictory with the threshold principle.

Realistically we cannot assume that robust and scientifically sound Economic Injury Levels for all major pests in all major crops will be available; this is an ideal situation that we can strive toward but that cannot be achieved. Complexity, regional and site specificities, emerging and invading pests, differing crop management practices, and – ideally – the integration of externalities make that impossible. That is why Principle 1 is in number one position; we should do our best to create the conditions that reduce the frequency and

intensity of outbreaks. Prevention and the creation of robust cropping systems are indeed the cornerstone of IPM.

Although Principle 3 (monitoring and threshold-based decisions) is true and important, it does not by itself ensure IPM. It should be noted that the idea of basing the entire decision-making process on a single criterion – the threshold – reflects an "older" view of IPM which does not necessarily satisfy Principle 1 and the need to integrate all possible measures.

Regarding some specific practices

Provisions that favour rotations and discourage continuous cropping in non-perennial crops will go a long way in favouring IPM. As a general guideline wherever feasible, alternating winter and spring-summer crops in arable rotations should be suggested as this will break the life cycle of many pests more efficiently than a rotation of the same duration with just winter crops. Similar guidelines should also be developed for vegetable cropping systems with the promotion of rotations between leaf and root crops, and discouraging crops of the same botanical family to occur frequently. Naturally, these sorts of guidelines whose underlying rationale is based on knowledge of ecological processes should also consider the economic viability of introducing new crops into a system.

Conservation tillage is mentioned as an example of adequate cultivation techniques but the relevance of conservation tillage and no-till practices to the development of IPM systems is not obvious. While it is true that reduced tillage does favour the conservation of soil organic matter and can help to reduce CO_2 emissions, it is risky to generalise its supposed benefits for crop protection. For example, Fusarium blight, one of the main causes of mycotoxins, is greatly favoured by no-till systems where maize and wheat residues remain on the soil surface all-year long. Also, no-till systems are usually associated with greater herbicide dependency. The benefits of conservation tillage need to be assessed relative to multiple sustainability criteria generating tradeoffs. No simple and general rule can be advanced.

The availability of non-chemical alternative measures certainly varies in the different production areas. But it should be mentioned that for arable crops (e.g. maize[3]) and at least pomefruit[4], many effective physical weed control methods[5] are available.

[3] http://www.endure-network.eu/content/download/3733/27111/file/GGTSPU-styx2.bba.de-17507-7777130-DAT/Integrated%20Weed%20Management%20Case%20Study%20Guide%201.pdf

Certain aspects of prevention (Principle 1) dealing with healthy planting material and detection of pathogens in substrates deserve more attention, particularly in light of new technologies. Many pathogens associated with seed become the source of disease in the subsequent year. Also weed seed as contamination wih harvest can become a major problem in the subsequent year. Certification of disease-free seed, seed potatoes, bulbs, cuttings, and new sorting technologies are very helpful in avoiding problems. Soil substrates, manure and other amendments can be screened with modern molecular multiplex technologogies to qualitatively and quantitatively assess the disease situtation. Based upon such diagnosis, better decisions can be made regarding what to grow in the subsequent growing season.

The standard of reference

To measure progress or simply efficacy, we need performance criteria and a standard as references. The need to define how to evaluate success is apparent when there is a reference to "providing satisfactory control" (Principle 4). But, although the report poses this question, it offers rather vague insights on this point. Does 'satisfactory control' refer to the control attained by chemical measures only or that attained by the best IPM strategy including wise use of chemical and non-chemical methods? Here a process of re-thinking and reassessment of methods needs to be initiated. We need to accept that over the last 50 years, chemical pesticides have been very successful at replacing all other means of management due to their capacity to quickly kill large numbers of target organisms at a relatively low apparent cost. That means that all alternative methods will probably have lower and slower control power and should therefore be combined as much as possible to achieve satisfactory management or regulation of pest populations. It also means that alternative methods may also require extra labour or are probably more expensive for professional users. It is important that the best possible level of control attained by chemical use is not considered as the standard for the definition of 'satisfactory' control. Otherwise, we would just stick to those methods that have 100% efficacy such as methyl bromide but create a biological void.

[4] https://workspaces.inra-transfert.fr/QuickPlace/endure/PageLibraryC1257324005BE62D.nsf/$defaultview/AE04AC057167ED45C12575680053D86C/$File/ENDURE_DR1.8%26DR1.9_v1.pdf?OpenElement

[5] https://workspaces.inra-transfert.fr/QuickPlace/endure/PageLibraryC1257324005BE62D.nsf/$defaultview/28F6AA83AA83AA94C12574A3003C684D/$File/ENDURE_DR1.6-validated.pdf?OpenElement

Pesticide resistance

The presented view in the guidance document on the risk of resistance development is true mainly in simplified intensive systems (e.g. continuous cropping), not if farmers make full use of preventive measures (crop rotation, use of cultivars genetically resistant to pests, etc.). Therefore, if the conditions for the implementation of 'true' IPM are met, diversification of the system will itself reduce the risk of occurrence of pesticide resistance. As such, reducing pesticide doses will not be a problem anymore.

That notwithstanding, there is no consistent evidence that reduced dosage is related to resistance development. The conclusion: "*This is more unlikely to happen in cases of compliance with label instructions. Therefore, it should be very carefully determined if dosage reductions lower than those recommended are appropriate and useful*" can be questioned. The concept of "necessary minimum" is not synonymous with the "registered (=authorized) dose" rate. This registered label dose is a maximum dose that has been justified based on many trials as part of authorisation. Often, appropriate and lower doses can be recommended specifically if information on pest level, weed size, and canopy is included in the decision making. In any case, the criterion to achieve true IPM and assess environmental effects should certainly go beyond the reduction of dose rates.

The report states "*to define 'satisfactory' one should consider decreasing rates*". The new vision of sustainable pesticide use should instead of volume or '*dose reduction'* focus on a desirable control level, which then will relate to the selection pressure (biological activity and persistence) of active ingredients and not on their doses. A striking example is that of sulfonylurea herbicides (ALS inhibitors): their doses are 100 - to 400-fold lower than older post-emergence herbicides but – due to their high biological activity and persistence – they are claimed responsible for the vast majority of occurrence of herbicide-resistant weed biotypes in the latest 15 years or so (also for anti-resistance strategies).

Regarding the management of pesticide resistance, it should also be noted that the strategy of spraying at a low pest infestation levels in order to minimize selection pressure can at times conflict with threshold-based decision rules. This dilemma may need to be addressed.

Compliance monitoring

Under "compliance monitoring", the notion that practices should be "*scientifically accepted and recommended by the MS for the region*" should be understood as something desirable but not as an unquestionable requirement. Farmers or professional users may have their own legitimate knowledge. MS authorities and science are not exclusive sources of sound technical and agroecological knowledge. We should accept that there are circumstances where a farmer's common sense does a better job than science-endorsed methods. Other assessment criteria may apply. Many practices may not be scientifically accepted and recommended by the MS but may still be in line with IPM. The general question should be: "has X cropping practice been applied taking into account crop protection?" For example, when applied to Principle 1 (Table 1), the specific question could be: "has X cropping practice been applied taking into account the prevention or suppression of harmful organisms?" rather than to systematically refer to scientific endorsement and MS recommendation. Considering that MS would need to develop cropping systems (and not crop) specific guidelines, performance indicators could be much simplified, e.g., 'Has the professional user followed the specific advice included in the MS/regional cropping system guidelines? Which measures have been taken up? Which not? Why?' Regarding Principle 2, early warning or forecasting systems may not be available in many MS or for many crops but the key question should be on whether monitoring activities occur at regular intervals. Principle 6 "*Where plant protection measures are necessary – has the professional user checked the possibility of keeping the intervention to a necessary level?*" should be understood as a principle rather than an option.

Terminology

Terms like pest management and '*integrated plant production'* should be defined otherwise interpretations could be misleading. '*Integrated plant production'* is a synonym of Integrated Crop Management (ICM). It would then be appropriate to include a brief definition of ICM[6] and to use this term and acronym consistently throughout the document.

[6] Integrated Crop Management Systems in the EU
http://ec.europa.eu/environment/agriculture/pdf/icm_executsum.pdf

List of used and additional (*) ENDURE references

Crop/Topic	Title	Source
Maize	Final report on the Maize Case Study: Key pests and options to reduce pesticides in eleven European regions	https://workspaces.inra-transfert.fr/QuickPlace/endure/PageLibraryC1257324005BE62D.nsf/$defaultview/61081F71618FCFEFC12576080035D7C2/$File/ENDURE_DR3.7%26DR1.18%26DR1.19.pdf?OpenElement
Pome fruit	Survey and analysis of the state of art of scab, brown spot and codling moth prevention and control strategies	https://workspaces.inra-transfert.fr/QuickPlace/endure/PageLibraryC1257324005BE62D.nsf/$defaultview/AE04AC057167ED45C12575680053D86C/$File/ENDURE_DR1.8%26DR1.9_v1.pdf?OpenElement
Wheat	*WHEATPEST- A simulation model for yield losses caused by wheat diseases, insects and weeds in Europe	https://workspaces.inra-transfert.fr/QuickPlace/endure/PageLibraryC12572A40039168F.nsf/$defaultview/018AE8ED1291783AC125757100338DA5/$File/Portfolio%20wheatpest.pdf?OpenElement
	*Best control practices of diseases in winter Wheat	https://workspaces.inra-transfert.fr/QuickPlace/endure/PageLibraryC1257324005BE62D.nsf/$defaultview/0DC89FD8BCFA9D17C125749E0038F352/$File/ENDURE_DR1.2_wheat%20cs%20final%20version.pdf?OpenElement
Potato	*Analysis of integrated late blight control strategies across Europe	https://workspaces.inra-transfert.fr/QuickPlace/endure/PageLibraryC1257324005BE62D.nsf/$defaultview/5609DA269DEF779CC125749100467884/$File/ENDURE_DR1.5_validated.pdf?OpenElement
Tomato	*Critical evaluation of tools for diagnosing insecticide resistance, whitefly biotypes and the levels of virus inoculums, and for assessing the risks of TYLCV epidemics and list of 1) recommendations for improving whitefly and TYLCV control and 2) key pests that should be taken into account for reducing insecticide use in tomato crops	https://workspaces.inra-transfert.fr/QuickPlace/endure/PageLibraryC1257324005BE62D.nsf/$defaultview/0ED5D8BE8A873CB1C12574B7005D74B6/$File/ENDURE_DR1.11_validated.pdf?OpenElement
Weed management	Integrated weed management (IWM) case study – report on field studies, literature review, general conclusions and recommendations and future IWM research	https://workspaces.inra-transfert.fr/QuickPlace/endure/PageLibraryC1257324005BE62D.nsf/h_80C07B6C3F3919D0C1257325002FDCCD/28F6AA83AA83AA94C12574A3003C684D/?OpenDocument
Advisory services	Training for farmers after the arrival in the country of the destructive western corn rootworm (WCR)" in Hungary	http://www.endure-network.eu/about_endure/all_the_news/learning_ipm_lessons_from_wcr_in_hungary
	Training courses in Denmark	http://www.endure-network.eu/about_endure/all_the_news/training_dates_for_weeds_and_wheat
DSS	*Review of new technologies critical to effective implementation of DSS and FMS	https://workspaces.inra-transfert.fr/QuickPlace/endure/PageLibraryC1257324005BE62D.nsf/$defaultview/3A8337CDA59DDA15C12575680052452D/$File/ENDURE_DI2.4.pdf?OpenElement
	*Proceedings of a pan-European conference on the current status and future needs for DSS	https://workspaces.inra-transfert.fr/QuickPlace/endure/PageLibraryC1257324005BE62D.nsf/$defaultview/91AAF488377AB33EC1257608002A3A7E/$File/ENDURE_DI2.3_V1.pdf?OpenElement