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Executive Summary

In July 2006 the European Commission adopted a Communication "A Thematic Strategy on the sustainable use of pesticides" (COM(2006) 372 final) accompanied by a proposal for a Framework Directive on the sustainable use of pesticides (COM(2006) 373 final). After the first reading of the European Parliament in October 2007 and a Council political agreement in December 2007, the Council adopted a Common Position for a Directive establishing a framework for Community action to achieve the sustainable use of pesticides in May 2008. Most recently the European Parliament adopted its position in the second reading on 13 January 2009.

In the course of these developments, the study on the subject "Development of guidance for establishing Integrated Pest Management (IPM) principles" has been developed.

An overview of the current status of implementation and experience related to general and crop specific Integrated Pest Management key principles has been elaborated. Based on the obtained results, the eight general principles proposed in the political agreements are discussed and evaluated. In order to provide a picture as realistic and complete as possible, experts of different national and international organisations on this specific topic have been involved and their feedback has been considered for the project outcome. Several of these key stakeholders on this specific topic have already developed or discussed key elements or general principles necessary for the implementation and use of IPM. This report shows the result of the comparison of the general principles of Integrated Pest Management as proposed in the political agreements on EU level and the existing concepts and their elements developed by other organisations and stakeholders or those in use in countries of the European Union.

In addition, a precise distinction of general IPM principles related to crop specific ones has been elaborated.

As a supplement to this report a draft guidance document has been prepared which is addressed to Member States authorities. It provides support related to a better understanding of the principles, to preparatory and continuous work for MS as well as communication with professional users and compliance monitoring.

General IPM principles

In the Common Position of the Council as well as in the position of the European Parliament adopted in the second reading, eight general principles for Integrated Pest Management are currently identified related to the following topics:

(1) Measures for prevention and/or suppression of harmful organisms
(2) Tools for monitoring
(3) Threshold values as basis for decision-making
(4) Non-chemical methods to be preferred
(5) Target-specificity and minimization of side effects
(6) Reduction of use to necessary levels
(7) Application of anti-resistance strategies
(8) Records, monitoring, documentation and check of success

Apart from this categorisation of general IPM principles, a series of additional topics addressed in the context of Integrated Pest Management can be found either in already existing national practice or in IPM concepts of several international organisations. It was found that there are points strictly related to IPM and others which only deal with IPM indirectly. The latter are most often complying with the provisions of the Framework Directive on the sustainable use but do not provide necessary actions for the professional user as such.

All elements are included in the following table, with an indication of which countries or international organisations in particular mention or explain these items:

Table ES-1: IPM principles/elements mentioned in the concepts of different organisations and countries and their relationships

No.	IPM principle/ elements	Relationship with other principles (to be subsumed under/combined with/tool for achieving)	Organisation/ Member State where principle can be found	Link to IPM
(1)	Measures for prevention and/or suppression of harmful organisms		Agreement found between the EP and the Council Also found completely at IOBC, EISA and to a great extent at PAN Europe and FAO	
(2)	Tools for monitoring			
(3)	Threshold values as basis for decision-making			
(4)	Non-chemical methods to be preferred			
(5)	Target-specificity and minimization of side effects			
(6)	Reduction of use to necessary levels			
(7)	Application of anti-resistance strategies			
(8)	Records, monitoring, documentation and check of success			
(9)	Pesticide-free environment with control of ground water, soil, food and feed	Pesticide-free environment is a target value of the implementation of (5) with use of (8), not an independent principle	SE, NL and others	Not directly related to IPM
(10)	Proper spray-free buffer zones to water areas (many countries) or in general to prevent contamination of areas outside the field by spray drift (SE)	Requirement and practice for minimisation of side effects (5) and supporting function for prevention measures (1). Also required under Article 10 of the agreed text by EP and Council.	Many countries, SE tightened; EISA, IOBC	Not directly related to IPM
(11)	Manage the agro-ecosystem to decrease the build-up of pests	Might be subsumed to (1), organisation of measures; but this is a real long-term and challenging task	FAO, PAN, BG, Latin America	Yes
(12)	License system allowing buying and using products (AT and others), access only for professional users (UK)	Not a part of IPM; at best a tool/political instrument in order to reach or to second other goals, therefore part of policy tools (31). Covered by Articles 5 and 6 in the agreement reached among EP and the Council.	UK, others,	Not directly related to IPM
(13)	Aerial spraying shall not be permitted	Measure in order to achieve (5). Also considered in Article 9 in the agreement reached among EP and the Council.	Several countries, IOBC	Not directly related to IPM
(14)	Chemical soil disinfection shall not be allowed	Measure in order to achieve (4) and (5)	IOBC	Yes
(15)	Testing/supervision of spraying equipment.	Measure in order to achieve (5) and (6), also covered by Article 8 in the agreement reached among EP and the Council.	DE, DK, FI and others, IOBC, EISA	Not directly related to IPM
(16)	Safe storage and handling of pesticides and equipment	Additional and independent principle, preventing negligence, malpractice and abuse. Also covered by Articles 8 and 12 in the agreement found between the EP and the Council (see also Annex II of the agreement reached among EP and the	Several countries, EISA, IOBC	Not directly related to IPM

No.	IPM principle/ elements	Relationship with other principles (to be subsumed under/combined with/tool for achieving)	Organisation/ Member State where principle can be found	Link to IPM
		Council)		
(17)	System to recover the pesticide packaging	Supplement to (16), safe storage and handling of equipment. Also considered in Articles 8 and 12 in the agreement found between the EP and the Council (see also Annex II of the agreement reached among EP and the Council)	BE	Not directly related to IPM
(18)	Specific training scheme for farmers dedicated to IPM, (certificates for users mandatory); further IPM specific advice systems	Additional and independent principle. However, also considered in Articles 5 and 6 in the agreement reached among EP and the Council.	FI, AT and others, Latin America; EISA, PAN, IOBC, FAO; improvement required by several countries	Yes
(19)	Setting of national targets/plans of success for soil, groundwater, environment and biodiversity	Belonging to (8) for the national perspective – operational targets and goals are a prerequisite for checking success.	NL and others	Not directly related to IPM
(20)	Adaptation of target plans, e.g. every 5 years	To be combined with (19) and therefore (8) – targets are a prerequisite for checking success. Considered in Article 4 in the agreement reached among EP and the Council	Many countries	Not directly related to IPM
(21)	Research and development of new IPM measures	Additional and independent principle	Especially NL and FR	Yes
(22)	Intensive dissemination	Element of training measures, to be combined with (18). Considered in Article 4 in the agreement reached among EP and the Council	especially NL	Yes
(23)	Conserving and improving biodiversity on the farm	Could be subsumed under (1)	BG	Yes
(24)	Crop protection management plan	Indefinite superordinated concept comprising other principles already mentioned, therefore no separate principle. Also considered by Articles 4 and 13 (crop specific guidelines) in the Agreement reached among EP and the Council	EISA, USA, PAN	Not directly related to IPM
(25)	Avoidance of surplus chemicals, adequate disposal of surplus mix or tank washings, containers etc.	Measure in order to reach (9) and therefore finally (5)	IOBC, EISA	Not directly related to IPM
(26)	Targeted MRL	Principle similar but weaker than (9), therefore also to be subsumed under (5) and (8). Covered by a separate EU-Directive	EISA, IOBC, DK	Not directly related to IPM
(27)	Emergency action plan	Obligatory part of good practice and of any production processes, therefore no genuine part of IPM. Also considered by Articles 4 and 13 (crop specific guidelines) in the agreement reached among EP and the Council	EISA	Not directly related to IPM
(28)	Environmental protection during mixing and filling	Should be part of good practice, no genuinely essential component of IPM. Also considered by Articles 8 and 12 in the agreement found between the EP and the Council and in detail already specified in Annex II of the agreement reached among EP and the Council	EISA	Not directly related to IPM
(29)	Observing pre-harvest intervals	Part of Good Plant Protection Practice, not IPM-specific. Considered by Article 4 in the agreement reached among EP and the Council	PAN, EISA	Not directly related to IPM
(30)	Designing a balanced soil structure, farming structure and species in order to support the reproduction of beneficial organisms	One possible measure related to (1) which is further developable	PAN	Yes
(31)	Supporting policy tools	additional and independent principle	PAN, FAO, several	Not directly related

No.	IPM principle/ elements	Relationship with other principles (to be subsumed under/combined with/tool for achieving)	Organisation/ Member State where principle can be found	Link to IPM
	including economic instruments e.g. pesticide tax, subsidies, but also financial and insurance tools for IPM farmers		countries	to IPM
(32)	Registration and permission	Element of good practice, no specific IPM principle. Also considered by Articles 5 and 6 in the agreement reached among EP and the Council.	IOBC	Not directly related to IPM
(33)	Compliance with statutory conditions	General instruction covered in detail by other principles and good plant protection practice.	IOBC	Not directly related to IPM
(34)	Spray windows (small untreated areas)	As a recording and monitoring instrument to check the effect of spraying versus untreated field covered by (8) and (1).	IOBC	Yes
(35)	Focus on important causes and mechanisms of action	One important approach and focus point within research and development (21). Might also be considered in crop specific guidelines as a universal principle (Article 13 in the agreement reached among EP and the Council)	FAO	Yes

In total, nearly 30 elements – in addition to the 8 principles available in the political agreements – could be identified as mentioned in already existing material on IPM; however, several of them are already covered by corresponding principles or are already considered within general articles of the draft Framework Directive, since they are not exclusively related to IPM but to plant protection in general.

Especially this aspect – that elements of existing approaches could often be linked with general paragraphs in legislation – seems to be an indication of the different ways plant protection is addressed. It could be observed up to now that most countries/organisations tackle IPM not at a level of defined principles to be applied by the professional user – this means precisely defined necessary actions for the user – but at a higher level, addressing policy makers – more specifically, this means the provision of to do's in order to achieve a sustainable use of pesticides.

Evaluation of the proposals made by the EP and the Council

It could be shown that the eight principles under discussion can be regarded as a minimum approach; it is essential that all elements are applied in an integrated way, which means that – in an efficient IPM system – none of the principles can be used as a stand-alone tool; only the combination and application of all principles will lead to success.

Even if not addressed in the IPM-related legislation, there are several aspects which are important for Commission Services and which have been stressed by several Member States experts, namely that it is of importance to:

- carry out continuous training activities for professional users
- make funds available for advisors, both qualified and independent

- raise awareness for IPM at Community level; marketing must be promoted in order to increase the value of IPM products; information regarding the advantages and benefits obtained by IPM programmes for the environment, farmers and consumers must be provided to customers.
- carry out and support research in this field, funds for research and experimentation must be made available
- have sufficient personnel available in the countries to enable effective IPM
- have funds for monitoring, forecasting and warning available
- find way to guarantee funds for farmers adopting IPM measures

These points cover very important prerequisites for the further implementation of IPM.

Crop specific IPM elements

Based on several criteria, the following crops have been selected for further investigation relating to crop specific IPM elements:

- Common wheat (cereals)
- Maize (cereals)
- Rapeseed (oilseed)
- Potato
- Tomato (vegetables) → field growing and protected growing
- Vine → "viticulture"
- Apples (crop trees)

Available material in EU MS and international organisations has been evaluated and it was recognised that most often crop-specific guidelines are included in the framework of Integrated Production of which IPM is just one element. Focusing exclusively on IPM, it could be shown that all elements mentioned in the guidelines of EU Member States or international organisations are concretisations of the eight general principles mentioned above. Any additional elements – for example, related to harvest or to fruit treatment – are related to the Integrated Production scheme and not primarily to IPM.

Contents

1 Background and objectives

Integrated Pest Management in agricultural practise can be traced back to the middle of the last century and aimed at a reduction of pesticides in pest control to minimise environmental pollution as well as financial costs and to maximise the farmer's profit.

The first IPM working group in Europe was founded in 1959. Formerly known as the "Working Group for Integrated Plant Production in Orchards" it is nowadays called the "International Organisation for Biological and Integrated Control for Noxious Animals and Plants" (IOBC). The IOBC established several working groups in Eastern and Western Europe in the seventies and eighties to promote IPM. Whereas the organisation's strategy aimed to limit pesticide usage and ecological impact in Western Europe, it focused on alternatives because of the lack of pesticides in Eastern Europe. In 2006, 20 working/study groups in Western and 16 in Eastern Europe were attending to the topic of IPM. In the Agenda 21 (Rio de Janeiro, 1992) Integrated Pest Management is regarded as an "optimal solution".

The FAO defines IPM as: "A pest management system that, in the context of the associated environment and the population dynamics of pest species, utilizes all suitable techniques and methods in as compatible a manner as possible and maintains the pest populations at levels below those causing economic injury."

In the European Union, IPM is defined through Directive 91/414/EEC: "The rational application of a combination of biological, biotechnical, chemical, cultural or plant-breeding measures, whereby the use of plant protection products is limited to the strict minimum necessary to maintain the pest population at levels below those causing economically unacceptable damage or loss". The system approach and necessary minimum levels of pesticide usage are central points.

Directive 91/414/EEC encourages Member States to take the principles of IPM into account. However, generally binding IPM principles and rules on how IPM should be implemented still do not exist at the European Union level. In 2006, the EU authorities published a "Thematic Strategy on the Sustainable Use of Pesticides" and put forward new draft legislative documents relating to plant protection for discussion.

These include:

a) A new "Regulation Concerning the Placing of Plant Protection Products on the Market" which shall ultimately replace Directive 91/414/EEC

The proposed Regulation would replace the existing legislation on the placing on the market of plant protection products (Council Directive 91/414/EEC), thoroughly revising the procedures for the safety evaluation of active substances and plant protection products. However, it keeps the two steps procedure of the Directive:

– Approval of active substances at EU level

– Authorisation by Member States of plant protection products containing approved substances.

For simplification, it would also repeal Council Directive 79/117/EEC prohibiting the placing on the market and use of plant protection products containing certain active substances. The main aim of the proposal is to maintain a high level of protection for humans, animals and the environment; to reduce the administrative burdens of the present approval and authorisation procedures and to achieve a higher level of harmonization.

This proposal should be seen as part of a package together with the Thematic Strategy on the Sustainable Use of Pesticides and the proposal for a Framework Directive, which fills a legal gap in the use phase of pesticides, as well as a proposal for a Regulation on the collection of statistics regarding the placing on the market and the use of plant protection products.

In January 2009, the European Parliament adopted a legislative resolution amending the Council's common position for adopting a regulation of the European Parliament and of the Council on the placing of plant protection products on the market and repealing Council Directives 79/117/EEC and 91/414/EEC.

The text is the result of negotiations between the Council, the EP and the Commission. All amendments are mainly of a technical nature and are in line with and strengthen the key principles of the initial proposal.

The Commission just recently accepted all the amendments voted by the EP.

b) A "Directive Establishing a Framework for Community Action to Achieve a Sustainable Use of Pesticides"

An essential element of this Directive is the idea that the Member States should develop "national action plans" during the next few years. These national action plans should include targets, measures and timetables to reduce pesticide risks and hazards and dependence on pesticides. It also specifies that Member States shall ensure by 1 January 2014 at the latest that all professional users implement the general standards of IPM. Consequently, it strongly demands that Member States not only consider, but also implement the IPM principles. The Directive also provides that, based on these principles, the Member States shall be encouraged to develop "crop-specific guidelines for IPM", the practical implementation of which shall be voluntary.

Up to now, work on this dossier made substantial progress. After the first reading of the European Parliament in October 2007 and a political agreement reached by the Council in December 2007, the Council adopted a Common Position for a Directive of establishing a framework for Community action to achieve the sustainable use of pesticides in May 2008.

Few changes have been introduced recently as draft recommendations for the second reading by the European Parliament on 5 November 2008.

With regard to the status of IPM in various countries, most national plant protection acts incorporate IPM as a general model or aim. Policy makers generally use IPM as an orientation mark and consider it as a strategy that should be supported, but not necessarily as a mandatory standard.

Definitions focus on ecological principles and techniques which prevent pests from reaching the economic injury level. For this they apply multiple tactics, including cultural, biological and chemical ones. Although sustainable agricultural production through IPM is discussed worldwide, up to now no uniform definition has been generated. Nearly every nation composed its own regulation. The USA in particular created nearly 70 definitions framing IPM. Worldwide, more than 100 definitions in total exist.

In Europe, IPM is considered to be a standard procedure in perennial crops but not in annual or rotational cropping systems. However, unlike organic farming, integrated production systems have not yet achieved significant added value for the products at the farm level. This is one of the main problems slowing down the implementation of IPM and IP in practice.

It another particularity in Europe is that principles of Good Plant Protection Practice (GPPP) were introduced as “basic legal standards”, the requirements of which are not as strict as the IPM standards, but should ensure proper use of pesticides by farmers. This distinction is also addressed in detail in this report, since some misconception with regard to GPPP versus IPM might dilute the general high standards of IPM.

c) A new “Regulation concerning statistics on plant protection products”

There is a need that this new regulation is based on consistency and coherence with the two other legislative initiatives mentioned above. This proposal on the use of plant protection products will apply to agricultural use only. But the discussion about this draft is less advanced than both of the other documents. The objective of this new regulation will be to collect data on the use of plant protection products that will be needed to calculate risk indicators under the Framework Directive.

d) A revision of the Machinery Directive

To complete inspection requirements under the Framework Directive with environmental protection requirements to be fulfilled by machinery used for pesticide application when placed on the market, a Commission proposal for revision of the Machinery Directive has been adopted and is currently examined by the co-legislators in co-decision.

In the course of these developments, the European Commission has contracted a study on the subject “Development of guidance for establishing Integrated Pest Management (IPM) principles” (07.0307/2008/504015/ETU/B3).

In the following, the draft final report is presented comprising a discussion on existing approaches to general IPM criteria as well as to crop specific IPM elements followed by an evaluation of the approach

proposed in the draft "Directive Establishing a Framework for Community Action to Achieve a Sustainable Use of Pesticides."

In addition to this report, a draft guidance document is elaborated, which shall support Member States' authorities in the implementation of the IPM-related parts of the Framework Directive. It explains the intention and scope of the eight general principles and provides information on tools that need to be set up by Member States before professional users can apply the principles. Furthermore, it provides guidance as to which aspects should be considered for compliance monitoring.

2 Requirements relating to the "Directive Establishing a Framework for Community Action to Achieve a Sustainable Use of Pesticides"

On 14 July 2006, the Commission submitted a proposal for a Framework Directive on the sustainable use of pesticides to the European Parliament and the Council for adoption by co-decision procedure as laid down in Article 251 of the EC Treaty. The content of this proposal is shown in Annex B. Therein no specific general principles of IPM were indicated.

The Economic and Social Committee gave its opinion on 14 March 2007. The Committee of the Regions adopted its opinion on 13 February 2007.
Half a year later, the European Parliament agreed on a legislative resolution following the first reading. Therein, it was suggested to adapt the former proposal as shown in Annex B (adaptations are highlighted in bold).
Already at this time, general IPM criteria had been suggested; the Council reached a political agreement on the proposal on 17 December 2007 and adopted its Common Position on 19 May 2008. Therein, all of the previously-mentioned eight general principles are once again included; however, principle 1 differs slightly in some details.
Most recently, the European Parliament adopted its position in the second reading on 13 January 2009.

There are two main sections in the currently available version of the Framework Directive focusing on the issue of IPM. Article 14 addresses general requirements relating to IPM whereas in Annex III general IPM principles are listed.

In order to go into more detail, Article 14 requires the following actions to be taken by Member States:

1. Member States shall **take all necessary measures to promote low pesticide-input pest management**, giving wherever possible priority to non-chemical methods, so that professional users of pesticides switch to practices and products with the lowest risk to human health and the environment among those available for the same pest problem. **Low pesticide-input pest management includes Integrated Pest Management** as well as organic farming according to Council Regulation (EC) No 834/2007 of 28 June 2007 on organic production and labelling of organic products.

2. Member States **shall establish or support the establishment of necessary conditions for the implementation of Integrated Pest Management**. In particular, they shall ensure that professional users have at their disposal information and tools for pest monitoring and decision-making, as well as advisory services on integrated pest management.

3. By 30 June 2013, Member States shall report to the Commission on the implementation of paragraphs 1 and 2 and, in particular, whether the necessary conditions for implementation of integrated pest management are in place.

4. In their National Action Plan referred to in Article 4, Member States shall describe how they will **ensure that the general principles of Integrated Pest Management as set out in Annex III[1] are implemented by all professional users by 1 January 2014**.

   Measures designed to amend non-essential elements of this Directive relating to amending Annex III in order to take account of scientific and technical progress shall be adopted in accordance with the regulatory procedure with the scrutiny referred to in Article 21(2).

5. Member States shall establish appropriate **incentives to encourage professional users to implement crop or sector specific guidelines for integrated pest management on a voluntary basis**. Public authorities and/or organisations representing particular professional users may draw up such guidelines. Member States shall refer to those guidelines that they consider pertinent and appropriate in their National Action Plans drawn up in accordance with Article 4.

ANNEX III
General principles of Integrated Pest Management

1. The prevention and/or suppression of harmful organisms should be achieved or supported among other options especially by:
– crop rotation,
– use of adequate cultivation techniques (e.g. stale seedbed technique, sowing dates and densities, under-sowing, conservation tillage, pruning and direct sowing), – use, where appropriate, of resistant/tolerant cultivars and standard/certified seed and planting material,
– use of balanced fertilisation, liming and irrigation/drainage practices,
– preventing the spreading of harmful organisms by hygiene measures (e.g. by regular cleansing of machinery and equipment),
– protection and enhancement of important beneficial organisms, e.g. by adequate plant protection measures or the utilisation of ecological infrastructures inside and outside production sites.
2. Harmful organisms must be monitored by adequate methods and tools, where available. Such adequate tools should include observations in the field as well as scientifically sound warning, forecasting and early diagnosis systems, where feasible, as well as the use of advice from professionally qualified advisors.
3. Based on the results of the monitoring, the professional user has to decide whether and when to apply plant protection measures. Robust and scientifically sound threshold values are essential components for decision making. For harmful organisms, threshold levels defined for the region, specific areas, crops and particular climatic conditions must be taken into account before treatments, where feasible.
4. Sustainable biological, physical and other non-chemical methods must be preferred to chemical methods if they provide satisfactory pest control.
5. The pesticides applied shall be as specific as possible for the target and shall have the least side effects on human health, non-target organisms and the environment.
6. The professional user should keep the use of pesticides and other forms of intervention to levels that are necessary, e.g. by reduced doses, reduced application frequency or partial applications,

[1] of the Framework Directive

considering that the level of risk in vegetation is acceptable and they do not increase the risk for development of resistance in populations of harmful organisms.

7. Where the risk of resistance against a plant protection measure is known and where the level of harmful organisms requires repeated application of pesticides to the crops, available anti-resistance strategies should be applied to maintain the effectiveness of the products. This may include the use of multiple pesticides with different modes of action.
8. Based on the records on the use of pesticides and on the monitoring of harmful organisms, the professional user should check the success of the applied plant protection measures.

3 Methodology and data collection

In the course of this study, general and crop-specific IPM principles have been analysed separately in order to later allow mandatory – in case of the general principles, or, in the case of crop-specific principles – voluntary implementation in future legislation. However, the initial approach – to collect information on already existing approaches, has been similar for both aspects.

3.1 General IPM principles

In order to realise the task of "developing general principles of IPM" it seems obvious to collect existing schemes of IPM as well as GPPP in order to select key elements that should be part of a list of ambitious but realistic general IPM principles. The task has to be concluded by considering and evaluating monitoring-possibilities in order to derive with well justified recommendations for key elements of general IPM principles.

In order to obtain a precise picture of the already-existing IPM approaches, the data collection in the first phase of the project has been conducted by several methods. Investigation within relevant literature and from the World Wide Web, as well as the inclusion of relevant institutions/experts has been used for a survey. Relevant experts have been contacted with a brief questionnaire (see Annex A) in order to create a basis for further discussions. It became clear that it is not only important to know which approaches exist, but also to obtain a picture of several details thereof. For example, it is important to know what concerned people think about the existing measures, to know their criticisms as well as their preferences, and their experience with monitoring possibilities of IPM elements.

A focus has been laid upon IPM approaches in the EU27 Member States. Accepted definitions from international organisations – IOBC, FAO and stakeholder organisations – PAN Europe and EISA- have been identified as relevant. But also outside the EU, IPM systems have been developed and broad knowledge is available. In order to obtain a maximum list of possible approaches, already-applied approaches within the European Union have been identified. Approaches used worldwide, such as by the United States Environmental Protection Agency and in Canada (Urban Pest Management Council of Canada; CropLife Canada), have been taken into consideration. IPM practised at an international level shows several interpretations, and the implementations in agricultural technique differ very much. In the course of the project, a focus was to bring different approaches together, to assess their usefulness and applicability for a possible improvement of the currently proposed legislation.

The starting point for the analyses of existing IPM concepts were those concepts available at those international organisations leading in this field. These can serve as prototypes or standards for national implementations. The existing approaches were in a first round analysed against the eight general IPM principles which are a result of discussion in the Council and the European Parliament.

Thus, each individual item has been compared to identify

- whether an item has a corresponding principle in the positions of European Parliament or the European Council,
- whether an item stands in close relationship with other principles, as explained in the third column of Table 3 (i.e. it either can be subsumed as one partial aspect of another principle or interpreted as a tool or policy – not directly linked to IPM – that can be applied in order to reach or helping to achieve another superordinated principle),
- or whether an item indeed addresses an additional new field, (i.e. it is independent from the existing ones).

The same approach has been performed for schemes in countries outside Europe, namely the United States, Canada and some Latin American countries, and for the results already gathered for Member States of the European Union through the answers of the questionnaires received from suitable experts.

In order to simplify the approach used, all identified principles have been numbered in the same order (corresponding to the numbering in Table 3. Not all countries/organisations cover all possible principles – in such cases, the numbers of such missing principles are not further mentioned for this country/organisation. Only the relevant numbers accompanied by a brief description are presented for each country/organisation).

In order to be able to select possible key elements from existing approaches to be taken into consideration for ambitious but feasible general IPM principles, a series of evaluation criteria has been considered for the identified elements in a subsequent step. This has been done from two perspectives: on the one hand, from the perspective of the professional user and on the other, from the perspective of the authorities. As evaluation criteria, the following aspects have been used:

- Usability
- Acceptance
- Implementability
- Enforceability
- Feasibility
- Costs
- Efficiency

These evaluation criteria can be regarded as aspects to be considered when discussing whether an element shall be regarded as a key element and therefore should be further discussed to be used as a general IPM principle. For example, it has been considered whether an element is estimated to be accepted in the majority of countries or whether the element has a realistic cost benefit ratio.
The identification of elements in existing approaches has revealed that not all aspects are covered by existing approaches but that they also contain additional elements. In the following, it has been carefully assessed as to whether important and/or necessary additional elements could be added to the list of general IPM criteria. This aspect – the possible need for additional elements – is discussed in chapter 5.2.

3.2 Crop specific IPM elements

The approach for the development of crop specific IPM criteria is similar to the procedure for general IPM criteria. Existing guidelines have been analysed for elements that can be used to identify key elements to be included in appropriate crop specific IPM criteria.

As a first step, a selection of the most important crops for the examination of crop-specific IPM criteria has been carried out on the basis of a set of quantity related criteria (with respect to production and use of plant protection products) and taking into account several further aspects such as geographic distribution, representation of different crop categories, crop rotation systems, greenhouse growing and considering the availability of project resources and of existing crop specific guidelines.

Taking these aspects into account a selection of main crops cultivated in Europe has been made in close coordination with the Commission Services for the further examination of crop specific IPM criteria (see Chapter 7.1).

In order to obtain valuable input, national experts have been contacted. However, the feedback in this regard was not satisfying and very often translations had to be arranged. Therefore, already elaborated reports and studies relating to crop specific guidelines have now also been considered for the evaluation.

It should be noted that there is a growing need for food, feedstuff, fibre and energy on a worldwide scale, and thus agricultural productivity and efficiency must be enhanced rather than cut back. Specific IPM schemes must adapt to this demand and farmers need to be allowed to use all available tools in a responsible manner, i.e. to follow the holistic concept of Integrated Farming, in order to respond to this challenge. This is not only important for the economic status of the European Union, but this is part of a more sustainable approach to food production demanded by European citizens – providing affordable food, of high quality and grown with consideration to the environment. This approach can be achieved through integrated farming and through the integration of IPM principles, as long as farmers are acting according to site and situation and apply these principles where possible while maintaining a reasonable productivity level.

4 Distinction between IPM and Good Plant Protection Practice

This chapter addresses the differences and similarities between and among IPM and Good Plant Protection Practice (GPPP). Parts of this chapter are also included in the draft guidance document which is a supplement to this report. It seems essential to undertake actions to make professional users as well as national authorities aware of what IPM means and what is "just" GPPP. It was recognised during the performance of this study several times that many people still have no precise understanding of the differences.

One of the key points as to why a differentiation is extremely necessary is that GPPP is already mandatory CAP, while the application of general IPM principles is proposed to become mandatory as of 2014, which would render them ineligible for agri-environmental payments after 2014. The situation is slightly different for crop-specific IPM elements which should remain voluntary and are therefore eligible for agri-environmental payments even after 2014. For the differentiation of general and crop-specific IPM elements please refer to chapter 0.

While the term "Integrated Pest Management" (IPM) is a 50-year-old concept designed as a response to the increasing usage of chemical pesticides (Stern et al., 1959), the term "Good Plant Protection Practice" (GPPP) was first used in Europe in the 1980s.
GPPP demands strict compliance with legal regulations on pesticide use, but IPM is the holistic plant protection strategy including particular requirements.
Unfortunately, from the beginning, definitions and publications could not ensure unambiguous distinction between GPPP and IPM. This results in different definitions of both, but also in blurred boundaries between GPPP as the minimum accepted plant protection practice and IPM as the model or highest quality of practical plant protection. These problems remain up to the present time.

GPPP

Because IPM proved to be a complicated and sophisticated strategy that was difficult to adopt, experts – particularly those in Europe – proposed a simpler basic strategy which is focused on the proper use of pesticides and can be adopted by all users, calling it Good Plant Protection Practice (GPPP). Unfortunately, there is no unified worldwide definition of GPPP even today.
The definition used in EU definition in the Regulation concerning the placing of plant protection products on the market (2009):

"Practice whereby the treatments with plant protection products applied to a given crop, in conformity with the conditions of their authorised uses, are selected, dosed and timed to ensure optimum efficacy with the minimum quantity necessary, taking due account of local conditions and of the possibilities for cultural and biological control."

Following this definition GPP can be briefly defined as follows: *GPPP is the good professional practice in plant protection in compliance with the legal requirements.* Its focus is on the compliance regarding the use of authorised pesticides, the use of tested plant protection equipment and the qualification and training of users.
The requirements are established in:

- Use of authorised pesticides and in authorised fields of use (crop/pest combination),
- Use according to instructions given on the pesticide label and to defined conditions,
- Use of certified pesticide application equipment,
- Compliance with requirements regarding buffer zones,
- Implementation by licensed users only

While most countries limit GPPP to pesticide use, other countries, such as Germany, apply GPPP to all aspects of plant protection and include some simple rules on using preventive cultural control measures and biological methods provided that these are defined as practicable and reasonable methods to be adopted by all farmers.
Another question is whether GPPP should apply only to conventional farming or also to organic farming. Different policies exist in Europe. In Germany, for example, GPPP is treated as a basic strategy for both conventional and organic farming.
As a basic plant protection strategy, GPPP demands strict compliance with legal regulations on pesticide use and can also include measures and tools which are
- Safe from a scientific point of view,
- Recognised as suitable, appropriate and necessary in practice,
- Recommended by official extension services and
- Widely known to users.

GPPP reflects the necessary minimum standard of plant protection to be achieved. Plant protection is performed in dynamic biological systems and under specific economic conditions influenced by a large number of variables. The knowledge and experiences of farmers and new results from research, in particular, on optimal timing and efficient use of pesticides, modifies the plant protection and use of pesticides.
Some experts on GPPP propose more stringent requirements than those stipulated in the legal regulations on pesticide use and recommendations. However, further-reaching demands and restrictions are not the rule in documents of GPPP.

The EPPO has developed and published “Principles of GPPP” and crop-specific GPPP documents for the following crops:
Potatoes, lettuce under protected cultivation, *allium* crops, rodent control for crop protection and on farms, hops, vegetable brassicas, rape (canola), strawberry, wheat, barley, beet, ornamentals under protected cultivation, peas, tobacco, farm grassland, maize (corn), pome fruits, rye, mushrooms, sunflower, umbelliferous crops, grapes, oats, leguminous forage crops and *ribes* and *rubus* crops (Anonymous, 2002).
These documents represent the collection of European knowledge on pests and pest management in these crops, however, they include aspects of IPM as well. Therefore, the EPPO’s GPPP papers are not strict guidelines or requirements, but they delineate the range of plant protection problems and possible and feasible measures in each crop.

In some countries, GPPP is included in the concept of Good Agricultural Practice. In other countries, the term Good Plant Protection is never used, e.g. in the U.S., or replaced by other similar terms describing a basic standard, i.e. Code of Conduct, for plant protection (see U.K.).

Integrated Pest Management

While GPPP focuses on the strict compliance with legal regulations on pesticide use and gives some additional recommendations, IPM is the advanced plant protection strategy with strong requirements specified in guidelines.
IPM and the corresponding principles have been described in a number of publications. They document the ambitious concept of integrated plant protection, which clearly stands out from the present requirements of GPPP. IPM is regarded as a model for practical plant protection worldwide as it was included in national and EU legal documents and in Agenda 21 of the 1992 UN Conference on Development and the Environment. IPM is characterised by the following principles:

- Complex approach in harmony with the objectives of integrated plant production and particular emphasis on the sustainability of plant production,
- Embracement of ecological requirements and effects, in particular, the promotion of natural mechanisms of control
- Targeted and economical use of pesticides to reduce their dosage to the minimum while utilising the full potentials of preventive and non-chemical measures.
- Knowledge-intensive system with wise decision-making,
- Openness to new ideas, scientific findings and technological advances.

Unfortunately, there are more than one hundred definitions in official papers worldwide. Currently, the most widely used definitions worldwide and in Europe are the following:

"*A system of variegated, economically, ecologically and toxicologically acceptable methods of keeping harmful organisms below the economic damage threshold, chiefly by making deliberate use of natural control factors and regulatory mechanisms*" (FAO, 1964).
This definition was also used by the IOBC.

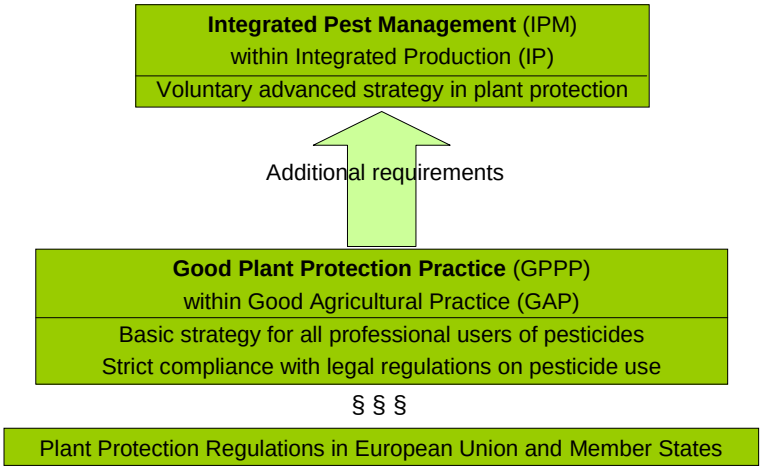
"*The targeted use of a combination of biological, biotechnological, chemical, physical, cultivation-related and plant breeding measures, applying pesticides only to the minimum extent necessary to keep infestation with harmful organisms so low that no economic or direct damage or loss is incurred*"(91/414/EEC).

The new EU definition in Regulation concerning the placing of plant protection products on the market (2009) based on the new FAO definition contains the same basic idea but is broader and more complex:

"*Careful consideration of all available pest control techniques and subsequent integration of appropriate measures that discourage the development of pest populations and keep plant protection products and other interventions to levels that are economically justified and reduce or minimise risks to human health and the environment. IPM emphasises the growth of a healthy crop with the least possible disruption to agro-ecosystems and encourages natural pest control mechanisms.*"

Specific IPM standards, for example related to use of cultural, biological and other non-chemical measures, go beyond baseline requirements. They therefore provide a service to the society, while usually entailing additional costs and loss of income for farmers. Financial public support for farmers applying these practices is therefore justified, via for instance agri-environmental programmes.
Distinction

The following scheme demonstrates the relationships between GPPP and IPM.



The following table shows how various elements are addressed in GPPP and in IPM. This helps to see clearly the differences between the two systems.

Table 1 IPM – GPPP differences and similarities

	Good Plant Protection Practice	Integrated Pest Management
Compliance with legal regulations	Strict compliance with legal regulations with respect to additional recommendations	Strict compliance with legal regulations and additional requirements in terms of a more sustainable farming and superior quality
Prevention and Suppression of harmful organisms		
- **Crop rotation**	Recommendations	Requirements, e.g. 3-field rotation in arable cropping
- **Cultivation techniques**	Common practise	Appropriate practise has to be used
- **Resistant varieties**	Use of site-related appropriate varieties	Use of resistant varieties when feasible
- **Fertilisation, irrigation**	Common practice	Best practice has to be used
- **Hygiene measures**	Common practice	Best practice has to be used
- **Enhancement of beneficial organisms**	No particular measures of natural pest control	Consideration and use of natural control, Pest suppressing effects of beneficial organisms are included in action thresholds, use of selective pesticides, enhancement of natural pest control by field margins and other structural elements
Monitoring	Observation of fields for infestation	Pest monitoring according to information of advisory services or monitoring plan, use of available forecasting tools
Threshold values	Use of threshold values are not required, decision-making after simple evaluation of infestation, including experience and if possible advisory service information	Decision-making after field monitoring using action thresholds and appropriate forecasting and decision making systems
Non-chemical methods	No requirements for using non-chemical methods	Giving preference to non-chemical methods if feasible
Target specificity and side-effects	Use of authorised and appropriate pesticides according to legal requirements	Use of authorised pesticides most appropriate for IPM and least side-effects
Necessary minimum	Users should make efforts to use pesticide on necessary minimum	Users have to keep pesticide use to levels that are necessary (as much as needed and as low as possible) by reduced doses, reduced application frequency and partial applications
Documentation	Documentation of field-related pesticide use Control by enforcement services	Documentation of field-related infestation situations and pesticide use Control by certified control services

Example

In order to sum up the chapter, an example is given in the following, showing which facts a farmer has to consider and what actions must he carry out to be in compliance with GPPP or with IPM?

Please note, the examples as well as the used measures given can vary according to regions, crops and pests. The selection of measures always depend on the present regional conditions e.g. characteristics of soil, macro and micro climatic conditions, water supply, topographic structures, cultivated plants including cash crops or cops of lower priority (economical reasons) e.g. intermediate crops or fodder plants, occurrence of harmful organisms repeatedly or rarely, infestation density and the pressure arising from it. Thus, the measures within the examples cannot easily be adopted and no strict recipes for pest management can be given.

The considered target organisms are aphids as virus vectors on winter barley. The following examples are both set in the central and northern regions of Europe.

To achieve compliance with the **GPPP** approach:

Depending on the various regional conditions, winter barley is drilled in the autumn months September to October. A common disease in winter barley is the barley yellow dwarf virus (BYDV) infestation which is transmitted by vectors such as the bird cherry-oat aphid *Rhopalosiphum padi*, grain aphid *Sitobion (Macrosiphum) avenae,* rose-grain aphid *Metopolophium dirhodum*, corn leaf aphid *Rhopalosiphum maidis,* in autumn and in early spring. The farmer has sufficient knowledge about the disease symptoms and the aphid species causing the disease.
Deriving from his own experiences and because of the early sowing date (e.g. 12 September), the farmer decides to implement a preventative measure intending to hinder a BYDV-infestation. Thus, the farmer chooses to use a seed dressing with systemic insecticide closely covering the seed. For instance in Germany, the seed dressing possessing the trade name Manta Plus (4572-00/Bay) containing the active substances Fuberidazol, Imazalil, Imidacloprid and Triadimenol is used. The full concentration as indicated by the instructions for use is applied, and certified equipment is used.
In October, the regional early warning system informs about the increasing flight intensity of winged aphids. Following the recommendations of this service, the farmer sprays the cereal plants in order to prevent further distribution of virus infested aphids as vectors. He chooses an efficient and cost effective insecticide respecting the legal admission and approval for aphids as vectors as well, for example the insecticide “Karate mit Zeon Technologie” (active substance lambda-cyhalothrin). He uses the full application rate as indicated on the instructions for use and applies certified spraying equipment. In preparation of the measure, the operator takes temperature and wind conditions into account and meets the regulations regarding buffer zones. After the treatment, he dilutes the residual mixture for spraying in a ratio 1:10 and dispenses the solution equally upon the same field.
If traces of surviving aphids are noticed, especially after mild winters, some farmers again apply pesticides against aphids as virus vectors in early spring (April).

To achieve compliance with the **IPM** approach

Bearing the eight general IPM principles and the requirements arising from this complex approach in mind, the farmer considers several preventative measures besides the chemical vector control. Therefore, the farmer has sufficient knowledge about the increasing threat of barley yellow dwarf virus (BYDV) infestation when conditions of relatively high mean daily temperature in September and October combined with low precipitation enhance the aphid infestation. Consequently, the farmer does not drill before 20 September, which is the critical date for winter barley sowing in Central Europe, as a preventative measure.

The farmer is provided with information about recent scientific research findings. For example aphids prefer loose or sparsely grown fields to densely grown ones when shifting from field to field. Thus, the farmer does not implement thin sowing. He is informed about the fact that aphids persist on residual plant material. Consequently, he makes sure that prior to sowing stubble, self-sown cereal is consistently removed from the field. What is more, the farmer selects an appropriate field without adjacent late-ripening maize or fallow meadow land in order to prevent the immigration of winged aphids (alate) into the barley fields. He contacts an independent advisor in order to obtain information about new findings regarding tolerant barley varieties or those less susceptible to BYDV infestation.

In order to enhance the biodiversity with special regard to beneficial organisms, the farmer maintains or promotes ecological structures within field margins. For instance, by erecting stone heaps or leaving dead wood in the margin where possible.

In October, the regional early warning system informs about the increasing flight intensity of winged aphids. Consequently, the farmer scrutinizes all cereal fields following the monitoring routine provided by the state authority, at intervals of three to four days. During the monitoring, both pest and beneficial organisms were counted. As the counts showed, the abundance of aphids is above 25% of all examined cereal plants, whereas beneficial organisms are not emerging in high enough densities to impose a controlling effect on the aphids. Resulting from his own checks and under consideration of the action threshold provided by state advisory service, which is 15 % of all examined cereal plants, the farmer decides to spray the crop. In order to prevent economic losses and further distribution of the virus vectors, he chooses an efficient and cost effective pesticide respecting the legal admission and approval for aphids as vectors as well. For example, in Germany the farmer uses the pesticide “Karate mit Zeon Technologie” employing the active substance lambda-cyhalothrin. He uses the full application rate as indicated on the instructions for use intending to reduce the risk of resistance development. The farmer applies certified spraying equipment. In preparation of the treatment, the operator takes temperature and wind conditions into account and meets the regulations regarding buffer zones. Afterwards, he dilutes the residual mixture for spraying in a ratio of 1:10 and dispenses the solution equally upon the same field. Immediately after the treatment, the operator writes down the results of the monitoring and the details of the pesticide application as well. Two weeks after the measure, he checks the success in the field and documents the results.

In early spring (April) the farmer again monitors the barley fields. In order to protect and enhance the pest suppressing impact of beneficial organisms, he avoids pesticide applications.

5 Status of general IPM principles in EU MS and outside of the EU

Note: The numbering of individual principles or elements in this chapter refers to the numbering used in Table 3.

5.1 Existing approaches

As explained in chapter 2, eight general principles are currently under discussion in the European Commission, the Council and the Parliament. These principles comprise the following issues:

(1) Measures for prevention and/or suppression of harmful organisms

(2) Tools for monitoring

(3) Threshold values as a basis for decision-making

(4) Non-chemical methods to be preferred

(5) Target-specificity and minimization of side effects

(6) Reduction of use to necessary levels

(7) Application of anti-resistance strategies

(8) Records, monitoring, documentation and check of success

Apart from these categories for general IPM principles, a series of additional topics addressed in the context of Integrated Pest Management can be found either in already existing national practice or in IPM concepts of several international organisations. The following chapters provide an overview of such existing concepts and practises.

5.1.1 IPM definitions, concepts and implementations of international organisations

In the following, the concepts and positions of these international organisations are arranged and described in a way that offer substantial and leading work on the development of Integrated Pest Management. Aspects belonging to further items not reflected within the eight principles mentioned in the agreement found between the EP and the Council are labelled as additional items. The description can then serve as a foundation for identifying those key elements that are common and substantial to all these concepts and those that seem to be missing in the agreement found between the EP and the Council but available in most of the other existing approaches.

International Organisation for Biological and Integrated Control of Noxious Animals and Plants (IOBC)

The West Palaearctic Regional Section (WPRS) of the IOBC instituted a commission “Guidelines for integrated Production”, serving in the first instance as quality criteria for consumers’ food. Objectives and principles of Integrated Production evolving during the 1980s have been compiled, analysed and

formulated by IOBC panels of experts in 1992, first published in 1993 and updated twice, lastly in the 3rd Edition in 2004.[2]

Integrated Pest Management is embedded in the IOBC concept of Integrated Production as one of eleven main principles described in Technical Guideline II; Principle 8 of Integrated Production explicitly states that IPM is the basis for decision making in crop protection.

It should be highlighted that the clear distinction of preventive (indirect) plant protection measures and control (direct) plant protection measures used by the IOBC is not reflected in the same way within the general principles of Integrated Pest Management of the agreement reached between the EP and the Council.

All principles (1) to (8) of the agreement found between the EP and the Council can be found again in the IOBC criteria. Furthermore, several IPM regulations suggested by IOBC go into much more detail and cannot be directly attributed to the principles (1) to (8) – these aspects are therefore put on record as additional items in Table 3. This assignment structure will be used in the following, also for the IPM concepts of other organisations as well as countries.

In the following, all aspects addressed are described – each under the appropriate heading used in Table 3.

(1) Measures for prevention and/or suppression of harmful organisms

Indirect plant protection by prevention of key pests, diseases and pests should be achieved or supported especially by choice of appropriate resistant/tolerant cultivars, optimum crop rotation, adequate cultivation techniques, balanced fertilisation and irrigation practices, protection and enhancement of important natural enemies by adequate plant protection measures, utilisation of ecological infrastructures inside and outside production sites to enhance a supportive biological control.

(2) Tools for monitoring

Pests, diseases and weeds shall be monitored with adequate methods and tools to determine whether and when to apply direct pest control measures. Scientifically sound warning, forecasting and early diagnosis systems should be utilised for decisions, official forecasts of pest and disease risks shall be taken into consideration where available.

(3) Threshold values as a basis for decision making

Robust and scientifically sound threshold values are essential components for decision making, also on a regional basis and considering differences in varietal susceptibility. Spraying during certain weather conditions is not recommended; (i.e. above maximum wind velocity, 5 m/s), maximum temperature (25°C) and below minimum relative humidity (50%).

(4) Non-chemical methods to be preferred

[2] See Boller et al. (2004). The chapter on plant (crop) protection to be explained in detail is Chapter 8 of the Technical Guideline II, described in pp. 24-28.

Preventive (indirect) plant protection measures shall be considered and applied to their fullest extent before intervention with control (direct) measures take place. Biological, biotechnical and physical methods shall be preferred to chemical methods if they can provide satisfactory control. Weed management shall be achieved by non-chemical methods as far as possible.

(5) Target-specificity and minimization of side effects

When direct plant protection methods have to be applied, priority shall be given to measures which have the minimum impact on human health, non-target organisms and the environment. The product applied must be appropriate for the target as indicated on the product label, or for officially approved off-label uses. The impact on the environment shall be minimised by calculating dose per hectare required for a given phenological crop stage; existing models to calculate canopy volume and leaf surface shall be used.

(6) Reduction of use to necessary levels

The application shall be limited to the lowest possible area (e.g. band spraying, spot treatments); the use of best application techniques to minimize drift and loss is recommended. The purchase and use of spraying equipment producing the least drift and pesticide loss is encouraged.

(7) Application of anti-resistance strategies

Where risk of resistance is known and where repeated application of plant protection products in the crops is required, regional organisations shall provide clear recommendations or mandatory requests for an anti-resistance strategy.

(8) Records, monitoring, documentation and check of success

Documented evidence is required on the mode of application according to label instructions, and that the application has been accurately calculated, prepared and recorded. The official pre-harvest intervals shall be recorded for all applications. The safe disposal of obsolete pesticides shall also be recorded.

Further aspects addressed:

(10) Proper spray-free buffer zones to water areas or in general to prevent contamination of areas outside the field by wind drift

Adequate buffer zones between treated crop areas and sensitive off-crop areas (surface water, springs, and ecological infrastructures) shall be observed.

(13) Aerial spraying shall not be permitted

The use of aircraft shall be forbidden, except where other access to the plot is impossible due to exceptional weather conditions or topography.

(14) Chemical soil disinfection shall not be allowed

The use of chemicals for soil disinfection is not allowed.

(15) Testing/supervision of spraying equipment

The spray equipment shall be kept in a good state, which shall be verified annually and its functioning verified before each treatment. Technical service of equipment, especially manometers and nozzles, shall be carried out by an authorised service at least every four years.

(16) Safe storage and handling of pesticides and equipment

The basic requirements of good agricultural practice for storage, safe handling and disposal of pesticides, operation and maintenance of spray equipment shall be fulfilled and outlined in regional IP guidelines. The IOBC suggests detailed guidelines for safety facilities and handling, safe application and storage of pesticides.

(18) Training of farmers, mandatory certificates for users; further advice systems

All sprayer operators shall have appropriate training and, where relevant, a certificate of competence. During the training, they shall be supervised by a certificate holder.

(25) Disposal of surplus chemicals, crop washings, containers etc.

The IOBC suggests detailed regulations for the disposal of a potential surplus mix, of obsolete pesticides, tank washings and empty containers. Empty containers shall be disabled against re-use.

(26) Targeted MRL

Legislation and food market requirements concerning pesticide residue analyses shall be fulfilled.

(29) Observing pre-harvest intervals

The official pre-harvest intervals shall be followed and if possible extended in order to minimise pesticide residues. In situations with continuous harvesting, systems shall be in place to ensure fail-safe compliance.

(32) Registration and permission

All plant protection products applied must be officially registered or permitted, either by the appropriate governmental organisation in the country of application and final destination, or with reference to the FAO code of conduct on the distribution and use of pesticides.

(33) Compliance with statutory conditions

All pesticide applications shall comply with the statutory conditions regarding the specific crop and maximum permitted dose, number of treatments and intervals, as indicated on the product label or authorised off-label uses. Reduced dosages beyond the maximum are possible.

(34) Spray windows (small untreated areas)

Small untreated areas (spray windows) shall be maintained in each crop and each major plot, except for some highly dangerous/contagious/invasive arthropod pests, diseases and weeds.

European Initiative for Sustainable Development in Agriculture (EISA)

In September 2006 EISA adopted its Integrated Farming Framework as their definition and characterisation of Integrated Farming as a holistic, whole farm concept and as a guideline to sustainable development in European agriculture.

This European Integrated Farming Framework consists of eleven main chapters, of which Chapter 8 deals with Crop Protection; therein all elements of Integrated Pest Management are listed and described.[3] The description of crop protection within Integrated Farming goes into much detail; the criteria and requirements of Chapter VIII (Crop protection) consist of 31 items, grouped into the four parts on "General considerations", "Decision-making process", "Crop protection measures on farm/application" and "Evaluation". For each item, a guideline is formulated; several items are illustrated with explanations. For all items, also demonstration and documentation activities are suggested. The items are further categorized into "must" (obligatory requirement), "should" and "consider". In the same way as for the IOBC principles, all items of the EISA principles have been sorted and attributed to the principle categories of Table 3.

(1) Measures for prevention and/or suppression of harmful organisms

A crop mosaic should be realised, this means to distribute different crops around the farm and avoid large blocks of single species; this should be accompanied by a crop rotation plan. Sprayers have to be cleaned regularly. Prevention and management decisions for IPM (weed, pest and disease management) also include using trap crops and predator host plants to increase natural control and resistant varieties as the preferred strategy.

(2) Tools for monitoring

Decision support systems should be applied for making decisions on crop protection practices in order to minimise environmental impacts. Pest, disease and weed levels and thresholds shall be monitored and recorded, and this information should be used in the decision process.

(3) Threshold values as basis for decision making

Developments of threshold values shall be checked and adopted when appropriate. The threshold concept shall be applied that aims to target economically damaging parts of populations in crops.

(4) Non-chemical methods to be preferred

This concept appears not to be addressed in the available EISA guidelines.

(5) Target-specificity and minimization of side effects

It is aimed to minimise undesired effects of any method of crop protection to non-target organisms. Appropriate products, rate and timing for site and soil condition should be chosen.

(6) Reduction of use to necessary levels

Crop protection products shall be used only in the areas in which they are required. Post harvest treatments shall only be used when necessary, and all measures shall be recorded.

[3] See EISA (2006). Chapter VIII (Crop protection) can be found on pp. 58-69.

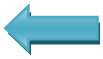
(7) Application of anti-resistance strategies

Strategies shall be applied to avoid pest resistance to herbicides, fungicides, and insecticides.

(8) Records, monitoring, documentation and check of success

The justification of all crop protection measures shall be implemented and recorded. All measures with regard to post harvest treatments shall also be recorded. An evaluation shall be carried out with the intention of assessing the results and effectiveness of measures taken. In order to establish a crop protection management plan of the following year, current practices and results shall be evaluated. The plan shall be reviewed and updated if necessary.

Further aspects addressed:



(10) Proper spray-free buffer zones to water areas or in general to prevent contamination of areas outside the field by wind drift

Appropriate actions shall be taken to avoid adverse effects to hedges, water-courses and other vegetated field boundaries as well as obligatory field margins. Attempts should be made to minimise machinery movement on the field boundaries.

(15) Testing/supervision of spraying equipment

Sprayers should be tested regularly by a nationally recognised scheme and records kept of the test.

(16) Safe storage and handling of pesticides and equipment

All crop protection products must be securely and separately stored and handled according to regulations and label instructions, including the wearing of protective clothing. This also applies to empty containers and surplus products before disposal.

(18) Training of farmers, mandatory certificates for users; further advice systems

Persons in charge of crop protection decisions should receive training on the identification of pests, weeds, diseases and crop disorders. This includes continuous learning, willingness to improve systems and skills. Managers and operators shall also be continually trained, including the proper choice and use of any crop protection measures. Registered and fully qualified agricultural advisors should give recommendations for situation-specific advice.

(24) Crop protection management plan

A crop protection management plan shall be developed addressing the farm's crop protection policy in detail.

(25) Disposal of surplus chemicals, crop washings, containers etc.

The crop protection management plan shall include the disposal of crop washings, empty containers and surplus crop protection products. Leftover spray mix shall be disposed of in a manner suitable to avoid harm to human health and the environment.

(26) Targeted MRL

The maximum residue levels should follow label instructions including pre-harvest intervals and codes of good agricultural practice and should be documented in the crop protection management plan.

(27) Emergency action plan

An action plan should be in place to deal with emergencies, accidents, poisoning, spillage, miscalculations, improper handling and use.

(28) Environmental protection during mixing and filling

Measures shall be taken to avoid spillage and contamination during mixing and filling. Ideally, areas for filling and mixing should be contained.

(29) Observing pre-harvest intervals

Pre-harvest intervals must be observed when using crop protection products; products shall not be applied too early or too late, harvest shall not take place within the pre-harvest interval.

Pesticide Action Network Europe (PAN Europe)

As one of the five regional centres of the international Pesticide Action Network of non-governmental organisations and individuals founded in 1982 in Malaysia, PAN Europe has worked out positions on Integrated Pest Management and Good Agricultural Practice since the 1990s. PAN Europe welcomed the setting of standards by the European supermarkets incorporated in EUREP, but regarded these standards as only a first step in a process striving for an ambitious environmental level of protection that should be further elaborated.

As a conclusion of six case studies performed recently in various European countries, PAN Europe concludes among others that "it is vital that Member States agree a common definition of Integrated Pest Management (IPM)..."[4]

PAN Europe emphasizes the hierarchy as they understand it, with regard to the new terms and concepts in agriculture.

Table 2 shows the components of Integrated Farming Systems and their special focus; the lower term in each case being the 'narrower' area as part of the respective more holistic higher term.

Table 2 **Integrated Farming Systems and their components**

Term/component	Focus on
(1) Integrated Farming Systems (IFS) (interchangeably used: Integrated Agriculture; Integrated Production (IP)	Whole farm approach, crops and livestock; each individual enterprise being integrated with the others to produce benefits through mutual interactions
(2) Integrated Crop Management (ICM)	Management of crops, including aspects such as selection of crop varieties, crop rotation,

[4] Neumeister et al. (2007), p. 5.

Term/component	Focus on
	cultivation pauses, mixed cropping
(3) Integrated Pest Management (IPM)	Pest Management: Pest spectrum within individual (perennial) crops

Source: according to Neumeister et al. (2007), p. 6, referring to Agra CEAS Consulting (2002).

However, PAN Europe emphasizes that "so far, there are no agreed definitions of these terms at EU level, which is not helpful for policy makers"[5] (up until the first attempt to provide an EU-wide definition of IPM in the proposed Thematic Strategy on the Sustainable Use of Pesticides in 2006). A lack of minimum standards has also been criticized. PAN Europe explicitly welcomes the proposal to use the definition of IPM by the Food and Agriculture Organisation (FAO)[6].

According to the most recent information of PAN Europe, updating the IPM/ICM definition and the key elements elaborated in 2000, the key elements of Integrated Pest Management and Integrated Crop Management consist currently of 18 items. However, some of them can be interpreted as policy tools including economic instruments supporting other instruments. Therefore, since these instruments do not have the same quality as the "original" IPM principles, they are not put on record separately but together as one item "supporting policy instruments".

(1) Measures for prevention and/or suppression of harmful organisms

A crop rotation frequency shall enhance a balanced population of soil organisms and prevent the outbreak of soil-bound pests. Best available pest-resistant crop varieties shall be used. Refugia shall be made available for natural enemies of pests and for the prevention of pesticide- resistant pests.

(2) Tools for monitoring

The use of pesticides shall be based on the information of the presence of pests, such as scouting, sensors and online services. An effective information and monitoring system on pesticide use and residues in close relation to all stakeholders (sellers, users, citizens as consumers) shall be established.

(4) Non-chemical methods to be preferred

In principle, the use of mechanical weeding is to be preferred or other non-chemical methods such as the use of heat. Exceptions shall be allowed in cases of bad weather conditions. Priority shall be given to the use of 'green' bio-pesticides and pest-preventive substances.

(5) Target-specificity and minimization of side effects

Only selective pesticides shall be used that do not harm beneficial organisms.

[5] Neumeister et al. (2007), p. 6.
[6] See Neumeister et al. (2007), pp. 7f.

Further aspects addressed:

(11) Manage the agro-ecosystem to suppress the build-up of pests

This includes an economical nutrient management on the basis of the information of already present nutrients in the soil and of the soil structure; the dosage shall only depend on the crop.

(18) Training of farmers, mandatory certificates for users, further advice systems

An independent advisory and training system is suggested, based on a participatory approach. This should be backed by a database containing global knowledge on best available techniques, practices, cultivars and varieties.

(24) Crop protection management plan

An optimum crop distance and crop management shall be applied to prevent growth of fungi. In this key element, as written down by PAN Europe, the application only refers to fungi.

(30) Soil and farming structure, design and species

The soil structure shall be optimised in order to be suitable for serving as an adequate buffering system for agriculture. The same holds for the farming design, structure and species that should be well balanced.

(31) Supporting policy tools including economic instruments

PAN Europe suggests further policy tools summarised as follows: A consistent control and "polluter pays" principle shall be applied. Appropriate financial and insurance tools shall be available fixing stability for farmers applying IPM and ICM. A fair financing of all costs connected to pesticide use from authorization, use, training and monitoring shall be covered by beneficiaries, the producers and sellers. A support by European Union subsidies shall be motivated, and three levels of continuous implementation are suggested. This shall also include a marketing system via certification and labelling as products with fewer pesticide residues, with the same qualitative requirements for imported goods.

Food and Agricultural Organization of the United Nations (FAO) / Global IPM Facility

The Global IPM Facility, established by FAO, UNDP, UNEP, and the World Bank, based on the FAO Headquarters in Rome, Plant Production and Protection Division, promotes Integrated Pest Management through awareness-raising support to the development of field programmes and policy reform. The principles of the FAO, especially the Global IPM Facility in co-operation with the World Bank, documented in a most recent version in an internal document, are classified in the same way as for the other organisations in the following. One point especially emphasized by FAO is that the overall goal shall be a primary economic one, considering the social costs and benefits of production, i.e. the net farm profits plus the short and long term risks to health and environment (external costs) or on profits of other economic subjects (other hidden private costs). Therefore, external damage due to various options of chemical pesticide use or non-chemical measures have to be estimated (e.g. using monitoring) and taken into account for an optimum decision.

(1) Measures for prevention and/or suppression of harmful organisms

One focus of FAO is on cultural practices aimed at keeping the crop healthy. Varieties shall be selected that are resistant or tolerant to pests. A package of measures for growing a healthy crop consists of site and crop selection, seed bed sanitation and attention to soil, nutrient and water management.

(2) Tools for monitoring

Decisions for pesticide applications shall be based on field monitoring of pest incidence. However, monitoring shall also be focused on the environmental and health effects of pesticides to understand and quantify the indirect costs of pesticides. In order not to under-estimate the costs of pesticides, an accurate assessment of such costs is vital for an optimum decision-making on pest management interventions.

(3) Threshold values as a basis for decision making

Only when field monitoring shows that a pest population has reached a level that is likely to cause significant economic damage, shall pesticides be applied.

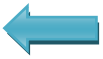
(4) Non-chemical methods to be preferred

Application of external inputs may for instance include biological control measures (pest predators, parasites, parasitoids or pathogens), labour to remove the pest manually, physical barriers, mechanical devices, pest attracting lures, pheromones, pest traps, biological or chemical pesticides. The use of pesticides can be a preferred option if economically viable non-chemical pest control techniques are not available or fail to control the pest.

(5) Target-specificity and minimization of side effects

Decisions to apply external inputs as supplementary controls shall be made locally and site-specific. Selection of products and application techniques should aim to minimize adverse effects on non-target species, people and the environment.

Further aspects addressed:



(11) Manage the agro-ecosystem to suppress the build-up of pests

For this agro-ecosystem management, agronomic techniques can be used to make the field and the crop inhospitable to the insect pest species and hospitable to their natural enemies, and to prevent conditions that are favourable to the build up of weeds and diseases.

(18) Training of farmers, mandatory certificates for users; further advice systems

Within the concept of Integrated Pest Management, the FAO stresses the so-called Farmer Field School – this is a form of adult education utilizing the fact that farmers can learn optimally from field observation and experimentation. It was developed to help farmers tailor their Integrated Pest Management (IPM) practices to diverse and dynamic ecological conditions.[7] In this way, the IPM Farmer Field School combines the approach to pest management and to farmer education. This

[7] See the study of Van den Berg (2004).

educational approach shall guarantee that apart from the (immediate) impacts, a long-term developmental impact shall be achieved.[8]

(31) Supporting policy tools including economic instruments

Mainstreaming integrated pest management requires a conducive policy environment. In order to support and facilitate the implementation of integrated pest management and to address factors that might unduly foster pesticide use, an accompanying policy reform may be required.

(35) Focus on important causes and mechanisms of action

The FAO emphasizes that root causes of the pest problem have to be found and addressed, e.g. an optimal integrated pest management starts with an analysis of the pest problem, i.e. questions such as where does it come from, how does it develop, what is the pest cycle, which factors accelerate or inhibit the development of the pest, and which potential natural control mechanisms are available. Understanding these questions provides a sound basis for the development of a pest management strategy. Another mechanism of action is the impact of plant damage on yields. Since many plants show an ability to recover from or compensate for plant damage, visual damage to the plant up to certain levels can be sustained and does not necessarily result in reduced yields.

5.1.2 Approaches of Integrated Pest Management in countries outside of Europe

A special view is given on the American continent since their development in this field has been trend-setting in several aspects. It becomes evident that the North American continent, described in the following for the United States, shows a different approach towards Integrated Pest Management, compared to Latin America, especially due to their different historical and political conditions and restrictions. Therefore, the following sub-chapter is separated into these two regions.

North America

- **The United States of America**

The following principles refer chiefly to the work of the United States Environmental Protection Agency (US-EPA). The US-EPA defines and explains Integrated Pest Management as “an effective and environmentally sensitive approach to pest management that relies on a combination of common-sense practices. IPM programmes use current, comprehensive information on the life cycles of pests and their interaction with the environment”.[9] IPM is therefore the coordinated use of pest and environmental information with available pest control methods to prevent unacceptable levels of pest damage by the most economical means and with the least possible hazard to people, property, and the environment.

[8] See examples of immediate and developmental impacts in Table 1 of Van den Berg (2004)
[9] US-EPA (2008).

The US-EPA describes the work of IPM programmes as a series of evaluations, decisions and controls of pest management. For practical application, the structure of a four-tiered approach is recommended, consisting of the setting of action thresholds, the monitoring and identifying of pests, measures of prevention and measures of control. The four steps of this approach and their components can easily be attributed to the general principles of Integrated Pest Management, as indicated in the following.

(1) Measures for prevention and/or suppression of harmful organisms

For agricultural crops, applying crop management measures includes the use of cultural methods; this can especially mean crop rotation, selection of pest-resistant varieties and planting of pest-free rootstock.

(2) Tools for monitoring

Programmes are applied to monitor pests and identify them accurately and distinguish them from innocuous and beneficial organisms; this serves as a basis for appropriate control decisions.

(3) Threshold values as a basis for decision making

Before taking pest control actions, an action threshold is set, at which it is specified by indicators (pest populations and environmental conditions) that pest control action must be taken. The critical level at which pests become an economic threat can guide future pest control decisions.

(4) Non-chemical methods to be preferred

Measures of prevention shall be preferred to measures of control. In cases where preventive methods are no longer available or effective, IPM programmes can evaluate proper control methods for effectiveness and risk. First choice of control methods should be mechanical control such as trapping or mechanical weeding.

(5) Target-specificity and minimization of side effects

Appropriate control decisions can be made in conjunction with action thresholds; monitoring and identification can remove the possibility of needless or wrongly applied pesticide use.

(6) Reduction of use to necessary levels

Effective and cost-efficient control methods with no or little risk to people or to the environment shall be preferred in the following ranking:

- First choice are effective, less risky pest controls (highly targeted chemicals such as pheromones to disrupt pest mating, or mechanical control such as trapping or mechanical weeding)
- If these less risky methods are not working, additional pest control methods such as targeted spraying of pesticides
- Broadcast spraying of non-specific pesticides is regarded as a last resort

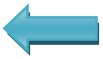
(7) Application of anti-resistance strategies

Selection of pest-resistant varieties are mentioned as measures for prevention, but beyond that they are not further addressed in the US-EPA guidelines.

(8) Records, monitoring, documentation and check of success

Monitoring for pests is mentioned, but further records or check of success is not addressed in US-EPA guidelines.

Further aspects addressed:



(24) Crop protection management plan

IPM Programmes, especially in the field of prevention measures, shall function as a framework for managing crops, lawns or indoor spaces to prevent pests from becoming a threat.

It becomes obvious that the eight IPM principles are at least mentioned, however, some of them (5, 7 and 8) only marginally. From the description and explanation of the US-EPA, it also becomes obvious that the principles are closely linked to each other.

What is also emphasized by US-EPA and other organisations within the United States dealing with IPM, such as the IPM Institute of North America, is that the IPM approach is officially applied (above the focus of general IPM approaches as applied within Europe) not only to agricultural settings but also to several other areas of economic activity, such as the home, garden and workplace. Especially, there are several programmes of Integrated Pest Management in schools with the goal of protecting children there from pests and pesticides.

Latin America

In Latin America, various models of agriculture are observed, concerned with production for industries and export, and production for the regional market. Prevailing economic policies in Latin America encourage the production of export and/or commercial crops, primarily in large-scale monocultures. The major recipients of pesticides were large-scale production systems producing sugar cane, cotton, maize, soybeans, rice, citrus and tomatoes, especially in Brazil, Colombia, Argentina and Mexico. Predictably, the emphasis of the chemical-intensive agricultural export model has intensified ecologically-based critical conditions and has lead to serious environmental and health consequences.

Despite the above trends, there are interesting and well documented cases of alternative pest management approaches scattered throughout the region that have result in sustainable crop production. These are traditional crop protection practices (indigenous IPM systems) developed by indigenous farmers using traditional knowledge and local resources and modern IPM systems developed by innovative researchers involved in the search for more sustainable methods of food production.

Despite many scientific advances, it is still arguable whether ecological principles have actually had an impact on the practice of IPM. In most cases, IPM has come to mean Intelligent Pesticide Management, which aims at scouting crops to monitor pest densities in order to take action – usually an insecticide application – when they threaten economic viability (the economic threshold; ET).

As long as the simplified structure of monocultures is maintained, pest problems will continue because of the process of ecological simplification that has been set in motion. Alternative IPM projects allow beneficial fauna to re-establish itself and to recover, and a more desirable level of biodiversity within agro-ecosystems and can thus reduce pest calamities.

The array of both proven and promising IPM technologies developed by innovative researchers and indigenous farmers offer considerable potential for reducing agrochemical use and improving agricultural sustainability. The challenge will now be how to incorporate local knowledge and skills as well as innovative IPM research into the research agenda of national and international organizations. The other challenge will be how to mobilise such organizations in order to help scale-up such initiatives as we have described here, making a wider eco-regional impact possible. At the political level, it is clear that a true reduction and/or elimination of pesticide use in the agro-export sector will require major political reforms that deal with the reasons why farmers turn to chemicals.

- **Cuba**

Since trade relations with the socialist bloc collapsed in 1990, pesticide imports to the island have dropped by more than 60 percent. Because of this, the Cuban government adopted an IPM policy which focused on biological control in its search for techniques that would enable biologically sophisticated management of agro-ecosystems. Key components of their strategy are the Centres for the Production of Entomophagae and Entomopathogens (CREEs), where the centralised, “artesanal” production of biocontrol agents takes place. By the end of 1992, 218 CREEs had been built throughout Cuba and were providing services to the state, cooperatives, and individual farmers.

5.1.3 Approaches of Integrated Pest Management in EU Member States

In the following, the IPM approaches performed in most of the EU Member States are described and attributed. The sources of information have been the returned questionnaires of the experts, additional interview contacts with scientists and, as a substantial supplement, the contributions to an EU expert meeting on national plans and programmes for the reduction of risks associated with the use of plant protection products.[10] A balanced representation of all geographic regions of the European Union is ensured.

[10] The information brought together at this expert meeting organised by the Julius-Kühn-Institut, the subcontractor of this project team, is available at the website http://www.jki.bund.de/nn_814194/EN/Home/ReductionofPlantProtection/ReductionofPlantProtection__node.html__nnn=true

Austria (AT)

In Austria there are several activities and measures to reduce the risks of plant protection products, both at national and at regional levels. The environmental aspect has gained increased importance in the last two decades. Acts and regulations containing very strict and restrictive provisions have been passed. Austria relies on a measure-mix, i.e. numerous measures and provisions from various legal fields, supported by additional measures with financial compensation; this approach is regarded as very successful and broadly accepted by farmers and society. Most of the measures and targets set up in the national action plan are already implemented in Austria or in the phase of being implemented.

(1) Measures for prevention and/or suppression of harmful organisms

The Austrian Agri-environmental programme is one of the most comprehensive and differentiated programmes of all Member States with a catalogue of more than 30 different measures carried out on the whole territory of Austria.

(2) Tools for monitoring

Forecasting systems are given financial support.

(4) Non-chemical methods to be preferred

Several integrated production measures are provided, according to comparative assessment of measures and the principle of substitution.

(5) Target-specificity and minimization of side effects

Plant protection equipment that reduces spray drift is obligatory.

Further general IPM aspects:

(10) Proper spray-free buffer zones to water areas or in general to prevent contamination of areas outside the field by wind drift

Buffer zones to surface water included as an additional risk mitigation measure within the Plant Protection Products Act.

(15) Testing/supervision of spraying equipment

Plant protection equipment already in use is inspected; grants are provided for an inspection of sprayers.

(18) Training of farmers, mandatory certificates for users; further advice systems

The Chemical Act also comprises training requirements for the farmers and license systems allowing buying and using of such products. Advisory services dealing with integrated pest management are promoted.

(31) Supporting policy tools including economic instruments

A number of incentives were created, in particular in the form of subsidies, aiming at specifying and optimizing the application and minimizing the risks of plant protection products, for example financial

support for forecasting systems and grants for the inspection of sprayers are given. Farmers opting for one or several measures of the Austrian agri-environmental programme complete a contract for several years and commit themselves to fulfil the specific requirements. Income losses due to a decline in production and increase in additional production costs due to these measures are compensated for. Such a balance of legally binding instruments and additional instruments is regarded as necessary to guarantee both the survival of farmers and further risk reduction of plant protection products.

Belgium (BE)

During the last 15 years several efforts were made in Belgium by federal and regional authorities to manage the risk and control the use of pesticides and biocides, such as a decision by the Flemish government and a ministerial decision in 1996 on the regulation of production methods for integrated pome fruits, the registration of control organisms and a guideline for integrated fruit production where IPM is generalised for apple and pear production for instance. Measures have been implemented on the basis of an intensive participation of stakeholders with information, consultation and dialogue initiatives.

(2) Tools for monitoring

Monitoring of pesticide use has been realised since 1998. Further development of a pesticide use monitoring system in agriculture is undertaken in order to obtain a sufficiently representative data set. A system of risk, mass and frequency indicators has been developed to work with.

(5) Target-specificity and minimization of side effects

The use of pesticides in sensitive areas and water catchment areas is restricted.

(6) Reduction of use to necessary levels

Some pesticide application dosages have been limited and the authorised dosage implemented in the authorisation of PPPs.

Further aspects addressed:

(9) Pesticide-free environment with control of ground water, soil, food and feed

Controls of residues in food are carried out. The regions have also implemented the monitoring of ground and surface water quality. Actions have been developed in order to monitor consumer exposure to pesticides and biocides.

(10) Proper spray-free buffer zones to water areas or in general to prevent contamination of areas outside the field by wind drift

Restrictions of pesticide authorisation involve protection measures of water bodies in order to introduce appropriate buffer zones.

(13) Aerial spraying shall not be permitted

Aerial spraying of pesticides is severely controlled but possible upon authorisation.

(16) Safe storage and handling of pesticides and equipment

Compulsory controls have been organised since 1995 for the application machinery, controls are also carried out for the pesticide storage area.

(17) System to recover pesticide packaging

A system to recover pesticide packaging and remnants has been implemented under the control of regions since 1997.

(18) Training of farmers, mandatory certificates for users; further advice systems

Professional applicators of toxic or very toxic pesticides are obliged to possess a certificate of knowledge (license). A website "Phytoweb" was developed in order to provide all useful information and legislation for professionals and amateurs. Advisory services are supported. Information, training and demonstrations for professionals and awareness-raising programmes for both professionals and amateurs are organised. In particular, information on the activities of the programme for the reduction of pesticides and biocides is ensured.

(19) Setting of national targets/plans of success for soil, groundwater, environment and biodiversity

The objective of the programme for the reduction of pesticides and biocides (PRPB) adopted in 2005 is to reduce by 2010 the risks from pesticide and biocide uses to 50% of the values for 2001; for agricultural use, the objective was lowered to 25% due to efforts already realised.

(31) Supporting policy tools including economic instruments

Private initiatives for labelling and certification systems are supported.

Bulgaria (BG)

Under Article 8, paragraph 2 of the Plant Protection Act, an ordinance was issued in August 2007 about the conditions and the order for integrated production of plants and plant productions and their designation by the minister of agriculture and food, and published in the official journal of the republic of Bulgaria, issue 66/2007. Measures have been in use since 15 February 2008. Therefore, the implementation of Integrated Pest Management in Bulgaria has not yet progressed very far up to now.

(4) Non-chemical methods to be preferred

Pesticides shall be substituted by natural mechanisms for regulating pest in agricultural crops.

(5) Target-specificity and minimization of side effects

Additional costs and adverse impacts on the environment and on human health shall be reduced by moderating the use of pesticides.

Further aspects addressed:

(11) Manage the agro-ecosystem to suppress the build-up of pests

Sustainable agro-ecosystems shall be maintained, and biodiversity in the farm shall be conserved and improved

(18) Training of farmers, mandatory certificates for users; further advice systems

Universities of agriculture and research institutes demonstrate readiness to implement the training, the national service for plant protection of the ministry of agriculture and food can give guidance.

(23) Conserving and improving biodiversity on the farm

This explicitly-mentioned key element of conserving and improving biodiversity on the farm can be regarded as part of the agro-ecosystem management.

Denmark (DK)

The Danish government aims at ensuring active and restrictive regulation of pesticides. The comprehensive analyses of the committee on assessing the overall consequences of a partial or total phasing-out of pesticide use (Bichel committee) serve as the basis and point of departure of a pesticide plan.

(1) Measures for prevention and/or suppression of harmful organisms

Detailed rules on cleaning of spraying equipment on hard-surfaced areas are laid down.

(2) Tools for monitoring

Distribution of decision-support systems to a larger number of farmers is on the way. The decision support system Crop Protection Online is widely used by advisors and as a learning tool for students but often has not reached farmers. Although the system has been validated in many field trials and has shown reliable results, the number of end-users among farmers has been relatively low, with approximately 1000 farmers during the last 10 years up to 2006.[11]

(8) Records, monitoring, documentation and check of success

On a national (not farmer) level, an evaluation of treatment frequency is carried out each year in order to monitor target performance trends, considering annual variations. In connection with calculations of such a treatment frequency index, a status report about the achievement of the overall strategy is prepared.

[11] According to Jørgensen et al. (2007) http://www3.interscience.wiley.com/journal/118486134/abstract

Further aspects addressed:

(10) Proper spray-free buffer zones to water areas or in general to prevent contamination of areas outside the field by wind drift

8,000 hectares of land along targeted watercourses and lakes have been laid out as spray-free buffer zones. Since the establishment of buffer zones can limit the content of pesticide residues in the aquatic environment, the aim is to increase the total area of buffer zones to cover around 25,000 hectares by the end of 2009. Annual status reports concern the establishment of buffer zones, and possible ways of converting farm subsidies to expedite the establishment of buffer zones will be examined.

(16) Safe storage and handling of pesticides and equipment

Detailed rules on filling of spraying agents or the use of personal protective equipment are laid down. An information campaign for private garden owners also concentrates in particular on guaranteeing a correct handling of spraying agents.

(18) Training of farmers, certificates for users mandatory; further advice systems

A catalogue targeting growers has been prepared in co-operation with researchers, growers and consultants that concerns how to reduce pesticide consumption in horticulture and fruit growing to the widest possible extent. The government has also initiated an information campaign aiming at private garden owners, also concentrating on incorrect dosage and handling of spraying agents and on alternatives to pesticides. A hotline has been established whereby garden owners receive guidance and tips on how to deal with weed problems, fungal diseases etc. with no or minimal use of pesticides.

(19) Setting of national targets/plans of success for soil, groundwater, environment and biodiversity

In 2010, an evaluation of target performance and measures applied will be carried out.

(20) Adaptation of target plans, e.g. every five years

Provided there is no change in the assumptions and being technologically possible, the government will discuss a possible reduction in the treatment frequency index.

(26) Targeted MRL

Maximum limit values for pesticide residues in food have been established. The government supports setting a maximum limit value at the limit of determination level for substances not covered by the EU maximum residue levels in the proposed regulation. This includes about 60 pesticides. The Danish MRLs are found on: http://www.retsinfo.dk/_LINK_0/0&ACCN/B20030018405. (only in Danish)

(31) Supporting policy tools including economic instruments

A subsidy scheme for environmentally friendly farming will be established. Under this scheme, subsidies will be granted to acreage belonging to farms not authorised for organic farming but cultivated in accordance with the guidelines used on organic farms. The set-aside scheme also provides for the possibility of compensation payments to farmers in connection with the establishment of buffer zones.

Estonia (EE)

The status of implementation described suggests making no clear distinction between integrated pest management and good plant protection practice.

(8) Records, monitoring, documentation and check of success

There used to be a pest monitoring system covering the whole country. Currently, pests are regularly monitored only locally in some regions. It is intended that the pest monitoring system should be re-introduced all over the country.

Finland (FI)

There is no legal status of IPM in Finland at the moment. Crop specific guidelines on balanced crop protection, in use since the year 2000, reach more than 90% of the farmers, and their content is regarded as very close to integrated pest management. In general in Finland, due to the Northern cold climate and the short growing season, the pressure of pests and disease and thus the basic need for chemical crop protection is identified as rather low, compared to the average situation in the European Union. This is one reason why there was not such a need for a more active use reduction policy up to now.

IPM principles are used in greenhouse vegetable production by over 90% of the growers. Apple growers have adopted their own version of IPM, including monitoring of the key pests and lower insecticide doses.

The implementation of IPM in greenhouse floriculture, but also for several outdoor crops, it is regarded as difficult without continuous public support for several years.

(1) Measures for prevention and/or suppression of harmful organisms

Emphasis has been placed on crop rotation.

(2) Tools for monitoring

Monitoring of key pests and lower pesticide doses exists, especially for apple growers. For some high value crops, forecasting systems and monitoring services are available, but generally the need for better forecasting tools and new research results has been noted. Monitoring services are regarded as time-consuming and expensive, especially due to the long distances between fields. Risk indicators are calculated yearly by the Finnish Environmental Institute SYKE (Suomen ympäristökeskus) based among others on the sales amount of plant protection products.

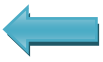
(3) Threshold values as a basis for decision making

Thresholds for control measures have been developed, but more information is needed on threshold values, they should be developed further, based on local data, since the growing season and crop growth differs from that in more southern regions.

(7) Application of anti-resistance strategies

Risk of pesticide resistance is high because the availability of different kinds of pesticides in Finland is low and actions are therefore limited; more information on pesticide resistance and mode of action under the special climate conditions is needed for farmers, especially for outdoor crops.

Further aspects addressed:



(9) Pesticide-free environment with control of ground water, soil, food and feed

The impact of pesticides on water quality is well monitored, and the use of pesticides has been strongly regulated in environmentally sensitive areas (e.g. ground water, near-surface water). Precautionary principles have been used because of the special northern climatic conditions. Environmental restrictions cover for example the use of products harmful to bees on flowering crops or in the neighbourhood of beehives.

(10) Proper spray-free buffer zones to water areas or in general to prevent contamination of areas outside the field by wind drift

Environmental restrictions include prohibition of the use of a product along water courses closer than 10, 15 or 25m, depending on the aquatic toxicity of the product, a restriction of use in consecutive years in the same field or limited times during the growing seasons, and restrictions of use in ground water areas or on areas with certain soil types.

(15) Testing/supervision of spraying equipment

All agricultural spraying equipment has to be tested regularly every five years.

(16) Safe storage and handling of pesticides and equipment

The label text printed on each plant protection product has to be approved by Evira. The text covers the name of the product, amount and name of active substances, risk and safety phrases, safety equipment, use instructions and necessary restrictions of use, as needed e.g. for protecting the environment.

(18) Training of farmers, mandatory certificates for users; further advice systems

Integrated pest management guidance for vegetables, also serving as a quality requirement for vegetables and for fruit production has been available and in use since 2007 as a part of specific quality management systems. Advisory services are available, as well as a training module on crop protection in the agro-environmental scheme. Training in greenhouse production, based on IPM principles is also available, but room for improvement is identified. Booklets for 24 different crops have been jointly produced (balanced crop protection on wheat, barley, potatoes, etc.), mainly covering the general IPM criteria. Farmers have been obliged to buy the booklets for the crops they grow. This project “Balanced crop protection” formed the basis for the training from 2000 to 2006. Farmers have to attend training every five years; the environmental training for farmers covers other issues as well as the use of pesticides. When approving a very hazardous (toxic and harmful) plant protection product, Evira can decide that the product may only be sold to persons holding a special

certificate for which the user has to pass an examination. In general however, emphasis has mostly been placed on training and advising on a voluntary basis.

(32) Registration and permission

An approval system is in operation in which the products are evaluated and approved before they can be sold and used.

France (FR)

The government in France has decided to implement an interministerial plan for reducing the risks linked to pesticides from 2006 to 2009. This aims to reduce their use and the risks that they create in health terms for the users of the products and the consumers of foodstuffs, as well as their potential effects on the various sectors of the environment (water, air and soil) and biodiversity. The plan is based on the following five goals: (1) acting on the products by improving the conditions under which they are released onto the market, (2) acting on practices and minimising recourse to pesticides. (3) Reinforcing the training of professionals, the protection of users of pesticides and providing them with better information, (4) enhancing knowledge and transparency in terms of the impact of pesticides on health and the environment, and (5) evaluating the progress made.

Within the national plan it is foreseen to promote integrated plant production farming systems within the framework of the farming advice. This includes mobilising funding to develop production systems minimizing the use of pesticides, particularly within the scope of rural development regulations and water agency intervention programmes.

(1) Measures for prevention and/or suppression of harmful organisms

The plan has initiated the development of a joint INRA/CEMAGREF research programme, extending the results of the collective expert appraisal carried out by these organisations, in order to develop farming systems that use plant protection products sparingly.

(2) Tools for monitoring

Decision-support systems are available and in use, and will be developed further.

Further aspects addressed:

(10) Proper spray-free buffer zones to water areas or in general to prevent contamination of areas outside the field by wind drift

The national plan foresees obligatory compliance with a minimum non treated zone of 5 meters at the edge of water courses for all products applied by powdering or spraying and by encouraging the set up of permanent plant covered sites at the edges of such water courses.

(15) Testing/supervision of spraying equipment

The national plan is aimed at improving the quality of the spraying equipment used, through obligatory regular inspections of sprayers in service and by imposing minimum standards of an environmental nature with respect to new or second-hand sprayers sold by mechanized equipment professionals, and at taking measures to protect drinking water distribution networks against pollution by pesticides while filling sprayers.

(18) Training of farmers, mandatory certificates for users; further advice systems

The national plan makes safety training obligatory, every 5 years, for farm workers exposed to pesticides, which is not specifically related to IPM. The content of the training, which will include both theoretical and practical aspects, will be defined by the Ministry of Agriculture and Fisheries and will provide an attestation to the trainee.

(21) Research and development of new IPM measures

Since 2004, the INRA (l'institut national de la recherché agronomique) IPM/ICM network has played a part in the organisation and the development of interdisciplinary research programs, on the topic of integrated pest management, and more widely on integrated crop management. The IPM/ICM network encompasses research programs that contribute to the development of innovative cropping systems that reduce the environmental impacts of agriculture with regard to pesticides. The activities of the network are based on four major themes: (i) Modelling and decision support systems for integrated pest/crop management; (ii) Implementation and coordination of a network of field experimental sites; (iii) Promotion of sociological and economic approaches of IPM/ICM; (iv) Mobilisation of ecological concepts and approaches in IPM/ICM. Especially the network of field experimental sites is made up of INRA experimental farms that implement long-term field experiments in order to evaluate the feasibility of IPM or ICM innovative cropping systems. This experimental network is coordinated in order to optimise the sharing of common objectives, tools, methods and protocols for experiments on cropping systems. It also aims at generating, managing and analysing data collected in the network. For example, the assessment of the environmental performances of diverse cropping systems using the same methods will allow the comparison of crop management strategies for diverse plant productions (major crops, vegetables, green house crop, orchards, and vineyards).

(25) Disposal of surplus chemicals, crop washings, containers etc.

The national plan (a) promotes operations undertaken by ADIVALOR (Agriculteurs Distributeurs Industriels pour la VALORisation des déchets agricoles) for recovering and eliminating unusable pest control products and their packaging, (b) organized, in 2006, the elimination of stocks held by wine producers and the distributors of sodium arsenite, a highly toxic product that is now prohibited, and (c) improves the management of pest control effluents: an interministerial order will provide the framework for the conditions for their elimination enabling, in particular and under certain conditions, safe spreading in fields of treated effluents and tank residues after dilution.

(35) Focus on important causes and mechanisms of action

The plan has also organised, from 2006, the elimination of stocks held by wine producers and the distributors of sodium arsenite, a highly toxic product that is now prohibited.

Germany (DE)

In 2004 the German Federal Ministry of Food, Agriculture and Consumer Protection (BMELV) issued a publication announcing the "Reduction Programme Chemical Plant Protection". The aims of this reduction programme are to reduce the risks associated with pesticide use, to reduce the intensity of plant protection product use (in terms of necessary minimum) and to reduce the percentage of domestic products exceeding the existing maximum residue limits to less than 1%.

A total of 19 actions were proposed. The most important ones described below have been the introduction of a treatment index (TI), the establishing of a network of reference farms, and the supporting of the development and implementation of innovations for integrated plant protection.

The TI, or number of pesticide applications at the full authorised dosage, is used as an indicator of intensity of plant protection product use. So-called NEPTUN surveys, which were started in 2000, showed remarkable differences in the intensity of pesticide use between crops, landscapes and farms in various German regions.

Reference farms supply annual treatment index data, provide background information on why pesticide use was necessary and suggest possible reduction potentials for the future. Other actions are aimed towards improving compliance and can partly be attributed below to the IPM principles of the agreement found between the EP and the Council, or to the further general IPM aspects.

The German Plant Protection Act does not demand implementation of IPM, but good plant protection practice (GPP). This states that principles of IPM should be considered (§2a) in terms of orientation. The principles of IPM are published by the government but are not legally binding (IPM is voluntary). The Plant Protection Act also contains a definition of IPM.

In 2006, the newly elected government decided to improve the programme by following the same goals while placing greater emphasis on innovation, IPM and co-operation with the Federal states.

(1) Measures for prevention and/or suppression of harmful organisms

Crop rotation and other cultivation techniques, such as conservation tillage, are already being applied. Furthermore, resistant varieties (cereals) as well as some measures in the field of biological control, especially in greenhouses are implemented.

(2) Tools for monitoring

Monitoring of key pests and lower pesticide doses exists – partly in arable cropping, but widely spread in apple growing, viticulture and greenhouses. Forecasting systems and monitoring services are available on federal state level (federal bureau for plant protection), but generally the need for development of better forecasting tools and new research results has been noted. The German risk

indicator SYNOPS has been successfully introduced. On the governmental level, plant protection inspections are being improved.

(3) Threshold values as basis for decision making

Thresholds for control measures have been developed, but there is a necessity for further improvement.

(4) Non-chemical methods to be preferred

Biological control agents have been introduced especially in greenhouse production. To a certain extent, the measure has even been introduced into arable cropping (maize) due to incentives.

(5) Target-specificity and minimization of side effects

Adverse impacts on the environment and human health shall be reduced by reducing both the use of pesticides in general as well as the dosage.

(6) Reduction of use to necessary levels

An innovative research programme "Reduction Programme Chemical Plant Protection" with 20 perennial projects was established in 2006. The success of the reduction programme shall be assessed based on three indicators: treatment indices (established using data from NEPTUN surveys and reference farms), rating of samples exceeding the maximum residue limits (based on data from the national monitoring programme) and risk indicators (established using models such as SYNOPS).

(8) Records, monitoring, documentation and check of success

Due to the German Plant Protection Act, farmers have to document the use of pesticides, i.e. keep records of pesticide use.

Further aspects addressed:

(18) Training of farmers, mandatory certificates for users; further advice systems

The improvement of professional knowledge is targeted by specific training programmes.

(21) Research and development of new IPM measures

Research and development shall also include the development and introduction of modern plant protection equipment. Within the Julius Kuehn Institute, Federal Research Centre for Cultivated Plants the Institute for Application Techniques in Plant Protection is developing a test protocol for the classification of sprayers with respect to their saving of plant protection products. The essential contribution comes from research projects focused on air assisted spraying in fruit growing with sensor controlled nozzles for gap detection, recycling sprayers for orchards and vineyards as well as patch spraying in field crops. These results will also find consideration in the German pesticide reduction program.

Several other research projects aiming at the improvement of plant protection equipment national and EU supported exist. The obtained results broadly contribute to IPM aims. For further examples see also:http://www.zalf.de/home_zalf/ueberuns/ueberuns_e/forschung/forsch_bereiche.htm
http://www.vti.bund.de/de/institute/ab/

(22) Intensive dissemination

Actions are aimed at the provision of more and better professional information, but also at the improvement of information to the consumer and the co-operation with trade organisations and the food processing industry. Up to the present, this subject is not sufficient enough developed, but an urgent need is seen to deal with provision of information on IPM with much more intensity. Especially to the consumer much more information must be offered about the IPM idea/strategy

(26) Targeted MRL

The introduction of maximum residue limits is one of the actions of the reduction programme. The exceedance of maximum residue limits is indeed one important indicating factor within the reduction programme. Consequently it has to be monitored and annual reports need to be given on this subject. Decreeding the maximum residue limits are not an explicit IPM aim, but IPM measures broadly contribute to compliance.

(31) Supporting policy tools including economic instruments

The use of national and regional support programmes for IPM and organic farming is arranged.

Hungary (HU)

Since the 1970s, objectives to reduce the risks for humans and for the environment in Hungary, arising from the use of plant protection measures, resulted in a plant protection programme. The major objectives were the development of pest management programmes, the beginning of studies of biological control of pests (diseases, nematodes, arthropods) in agricultural crops and the development of application techniques.

Further development of the initial programme led to the now legal Plant Protection Act 2000/35, Act 2000/84 of the Hungarian Plant Protection Chambers, Council Regulation 1698/2005 and Ministerial Decree 150/2004 (X. 12.). The two main subjects of this programme concern organic farming and integrated crop production.

The objectives of integrated crop production are implementation of the IOBC General principles in the Hungarian practice, classification of plant protection practices – based on human and environmental risk assessment, assessment of pest management programmes (Can the protection of a particular crop be managed with IPM or not?), running a support system from EU and national sources, operating a control system (administrative, on-the-spot, analytical; used as a feedback as well), and working out conditions for granting a label.

Future tasks for Hungary will be the increase of area in the support system, the improvement of the system, e.g. by adaptation and application of damage thresholds, the evaluation of pest management programmes, the prevention of the resistance development, applied research on including beneficial organisms in the management, bringing forecasting closer to the farmers and, last but not least, the introduction of a label.

It is reported that the development of a label for IPM products is progressing well. The system of conditions is ready and, once it is approved, the label can be introduced.

Further aspects addressed:

(31) Supporting policy tools including economic instruments

A support system from the EU and national sources has been set up and introduced. However, there are more farmers who are interested in joining than supports are available. An area of 350,000 hectares is included in the programme, whereas IPM is used on more than 1 million hectares without any support.

Ireland (IE)

The Directive 91/414/EEC makes it a legal requirement to employ integrated control techniques in crop protection. Ireland does not yet have official guidelines. However, professional users to a large extent already employ several integrated techniques, and thus further techniques are assumed to be largely accepted. In general, the need for flexibility is emphasized to ensure that appropriate methodologies are employed, taking into account the individual requirements of the country.

(1) Measures for prevention and/or suppression of harmful organisms

Crop rotation and other cultivation techniques such as inversion tillage are already being applied.

(2) Tools for monitoring

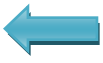
Monitoring has been introduced for the examination of harmful organisms.

(3) Threshold values as a basis for decision making

Threshold values play an important role for triggering pest control.

(8) Records, monitoring, documentation and check of success

Results in Ireland from environmental monitoring have indicated that there is little need for concern regarding environmental contamination with pesticides. The risk assessment approach employed through Directive 91/414/EEC has served well in this country.



Further aspects addressed:

(15) Testing/supervision of spraying equipment

Ireland does not yet have a scheme operational for sprayer testing, however, this has been identified as being a weak point, in the same sense as the following item concerning the training of farmers.

(18) Training of farmers, mandatory certificates for users; further advice systems

Systems of professional advice have already led to a reduced input of plant protection measures. Most farmers employ or take advantage of professionally qualified advisors. However, a compulsory training programme for professional users does not yet exist. Universities provide training within the undergraduate and post graduate programme in agricultural science, however, the IPM-specific training currently provided at farmer level is regarded as insufficient.

Italy (IT)

In Italy in the 1970s, many regions had started IPM programmes. Since 1986, the Ministry of Agriculture started "Piano Nazionale di Lotta Fitopatologica Integrata". In the 1980s and 1990s, Italian regions employed in the IPM system some professional advisors formed by specific courses financed by the EEC Reg. No 270/79. Since 1997, a document on the principles and general criteria about IPM has been applied (EC Decision No 3864/96 by the Star EU Committee). This allows enforcing the "agro-environmental measures" (EC Reg. 2078/94 and 1257/99, 1698/2005). The consistency concerning the regional rules as regards this document has been verified every year by a national committee specializing in IPM which was specifically created for this purpose by the Ministry of Agriculture with a ministerial decree. In 2008, with ministerial decree No 2722 of 17 April 2008 a national system for integrated production quality was formed as well. Among its tasks there is the activity of the IPM national committee. Reference to the aforementioned principles and criteria document has been confirmed. Such a document is annexed in this catalogue of questions. Since 2007, the national committee prepared national guidelines for IPM concerning 117 important crops within the country (see Annex 2, together with the Internet link). At a voluntary level, a UNI regulation has been developed (No 11233, 3 May 2007) in order to standardize the production process to manage integrated products. The definition of this rule has been produced by a work group in which there were many representatives of the institutions (Ministry of Agriculture and Regions), of the universities and of research, of the farmers associations and consumer associations together with the retailers' representatives.

(1) Measures for prevention and/or suppression of harmful organisms

All listed elements are among the techniques currently used in Italy (national guidelines and regional regulations). In order to obtain a financial incentive related to the agro-environmental measures (EC Reg. 1698/2005) it is mandatory to follow IPM regulations.

(2) Tools for monitoring

Not for all harmful organisms. Together with farm systems, in some areas, systems to monitor the territory have been developed. At the same time, in many areas, there are forecasting and early diagnosis systems in order to warn the farmers about the main harmful organisms. Such methods for forecasting and warning are in some instances integrated with adequate information tools (e.g. sound warning, internet, texting etc.).

(3) Threshold values as a basis for decision making

Thresholds are differentiated according to various climatic environments. In many cases they are rather generic. It should be interesting for research projects to develop systems capable of updating and improving the thresholds concerning all harmful organisms.

(4) Non-chemical methods to be preferred

Non chemical methods have been introduced.

(5) Target-specificity and minimization of side effects

It is always important to verify the other solutions (less toxic) capable of reaching the set goals. Comparative assessment has been introduced in order to eliminate or reduce the use of pesticides with high toxicity (category T, T+ and Xn with R40, 48, 60, 61, 63, 68). In many instances, IPM is founded both among independent and qualified advisors and in a reliable advisory service (forecasting weather bulletins and forecasting models of pest epidemiology). In Italy, the formation of professional users into organisations is mandatory in order to use pesticides classified T, T+, Xn. At the same time, one must obtain a specific authorization to buy and use the pesticides.

(6) Reduction of use to necessary levels

It is implemented but reduced doses are not used. In particular, herbicide doses employed are chosen among the lowest recommended level on the label. In order to obtain such a result, it is important to monitor harmful organisms, choose the best period for using the herbicides in order to control the weeds in their earlier stages. In addition, through the inspection of pesticide application equipment, it has been possible both to rationalize the distribution volume and to optimize the doses employed.

(7) Application of anti-resistance strategies

Until now, the use of pesticides, which have selected or could select mechanisms of resistance, has always been limited. Mandatory restrictions have been introduced for every family of fungicides according to FRAC's indications. Many limitations on insecticide use have been introduced as well. With some crops (e.g. wheat and rice), a specific employment of herbicides regarding products with differing modes of action has been planned.

(8) Records, monitoring, documentation and check of success

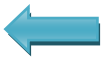
Normally, it is always important and sometimes necessary to involve a qualified advisor. Such an advisor must be independent of agro-chemical societies. Until recently and in many areas, these societies were often the only source of information for farmers. With a total absence of qualified and independent advisors and even when increasing farmers' knowledge and autonomy, IMP systems might not be realizable. In particular, such advisors are necessary in order to solve every upcoming problem. In order to respect the review programme, concerning the active substances (Directive 91/414/ECC) they must advise on and solve any problems for farmers (purchase of pesticides out of market, use of forbidden products, disposing of products legally withdrawn). More precisely, these advisors are especially needed for crops which require significant chemical input and are quite important for Italy (fruits and vegetables). Different solutions could be proposed for extensive crops (corn, wheat etc).

Latvia (LV)

Since 2006, due to a five year commitment, farmers who cultivate horticultural products by means of integrated production methods can receive national support. In addition, on 2 July 2008 the cabinet regulation No 401 “Regulations regarding integrated cultivation, storage and labelling requirements as well as the inspection procedure of agricultural produce” has been adopted. Agricultural activity using integrated production methods is confirmed by record in the register of integrated grown agricultural products. The main fields of implementation are horticulture, especially fruit and vegetable cultivation. Fruit and vegetable grower associations were also involved in the development of the regulation of the cabinet of ministers. National support is mentioned as an important measure.

Apart from this national support and some national training programmes and advisory services for farmers, according to the questionnaire response, the general IPM principles do not seem to be implemented in a substantial way. Rather, problems with the implementation of the IPM criteria are foreseen, e.g. with crop rotation. It appears also that resistant or tolerant cultivars are not always available. The accessibility to scientifically sound warning, forecasting and early diagnosis systems for farmers, and the development of scientifically sound threshold values are also regarded as problematic.

The IPM principles (1) to (7) have not yet been implemented, apart from the element of recording in the register of integrated growing agricultural products that might be formally attributed to criterion **(8) (Records, monitoring, documentation and check of success**). However, the functions, privileges or general goal of this register does not seem obvious.



Further aspects addressed:

(18) Training of farmers, mandatory certificates for users; further advice systems

A national training program and also advisory services are available for farmers.

(31) Supporting policy tools including economic instruments

National support for farmers who cultivate horticultural products by means of integrated production methods can receive national support. This is regarded as a very important measure.

The Netherlands (NL)

The Netherlands has now executed its third National Action plan running from 2003 to 2010. Regulations, measures and guidelines of Integrated Pest Management are already available at a high level. Some are regulations, i.e. for reduction of emission and for training and certification of users. There is also a covenant with several stakeholders who take their own responsibility to stimulate and implement IPM. However, the main instruments are (i) the obligation that growers need to possess a plant protection plan in which they describe how they have taken IPM into account and (ii) IPM by

education and stimulation. According to expert statements, acceptance is high among professional users as long as it is economically justifiable and/or the interest of the measure is clear to the farmers and their advisors. Acceptance of IPM is not 100%, it seems difficult to stimulate the small minority of farmers who are not interested in IPM.

(1) Measures for prevention and/or suppression of harmful organisms

Biological control agents and the use of selective pesticides have been introduced, especially for vegetable crops in greenhouses.

(2) Tools for monitoring

An environmental indicator will be elaborated. Decision support systems have been introduced, and research and development of new decision support systems is strengthened.

(4) Non-chemical methods to be preferred

Biological control agents have been introduced.

(5) Target-specificity and minimization of side effects

This is for example achieved by the use of drift reducing nozzles, and selective pesticides, especially for vegetable crops in greenhouses.

(6) Reduction of use to necessary levels

Low dose systems for herbicides are used.

(8) Records, monitoring, documentation and check of success

This can be achieved and supported in combination with setting the quantitative goals and plans (see 19).

Further aspects addressed:

(9) Pesticide-free environment with control of ground water, soil, food and feed

The quality of surface water to be used for drinking water has been set up as a final target and is being examined.

(14) Chemical soil disinfection shall not be allowed

Though not prohibited hitherto, the use of chemical soil fumigation has been reduced.

(18) Training of farmers, mandatory certificates for users; further advice systems

Farmers are encouraged and educated to produce their crops in a sustainable way, and their knowledge is going to be improved, especially using certification (since 1996). There is a licensing system for all users and traders which implies that licences have to be prolonged every five years following training. Training and improvement of knowledge is also supported by a multiple stakeholder working structure where parties from all sides assume common and individual responsibilities and tasks to work on the goals set. However, it is seen as a disadvantage that there is a lack of participation and co-operation of advisors from pesticide trade organisations.

"IPM by education and stimulation" which comprises research & development of new IPM measures such as decision supporting systems and intensive dissemination of this knowledge, amongst growers , advisors and other stakeholders is promoted as a covenant that comprises the agreement that farmers and all participating stakeholders are stimulated to take their own responsibility.

(19) Setting of national targets/plans of success for soil, groundwater, environment and biodiversity

The Netherlands have set quantitative targets to be achieved in 2010, such as for reduction of emissions, or for example a 95% reduction of impacts of plant protection products on surface water based on the reference year 1998. In order to measure the results, risk indicators have been developed. Therefore, it will be possible to measure whether the targets have been reached. Risk reduction is regarded as more important than a volume reduction of pesticides.

(21) Research and development of new IPM measures

This goal is emphasized and supported by the co-operation of a multiple stakeholder working structure. Research and development also refers to new decision support systems.

(22) Intensive dissemination

This is guaranteed by a multiple stakeholder working structure (growers, advisors and other stakeholders) that have agreed upon goals and additional measures and take their own responsibility to stimulate and implement IPM. It is regarded as important that farmers and other stakeholders participate in the development of new measures and regulations and are stimulated to take their own responsibility.

(24) Crop protection management plan

There is an obligation that growers need to possess a plant protection plan in which they describe in general how they are planning PPP uses and how they have taken IPM into account.

Poland (PL)

The current legal status is defined by the "law on plant protection" of 18 December 2003. It is obligatory to implement general principles of IPM, however, the implementation of crop specific standards is voluntary.

Measures are in use since 2004, the fields of implementation for the general principles being in all agricultural production. Moreover, in some horticultural production measures following the recommendations of crop specific guidelines are implemented. It has been pointed out by experts that there is still a lack of training for farmers and advisory services concerning all fields of the general IPM principles.

Sweden (SE)

There is no legal system for Integrated Pest Management in Sweden, but rules for general carefulness in the environmental code. There are also some voluntary systems on IPM, and among these systems the key elements for pest management are

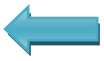
- documentation of the measures on controlling weeds and pests and the aims of spraying,
- some plant protection products are not allowed although they are registered in Sweden
- use of the monitoring systems available
- regular inspection of the spraying equipment.

In 1986, an initial programme to reduce the risks to human health and to the environment connected with pesticide use in agriculture and horticulture was introduced. After several revisions, the fourth action programme is now continuing from 2002 to 2009 and is a part of the efforts to reach the national environmental quality objectives. Plant protection centres located at five different places in Sweden assist in making plant protection in agriculture and horticulture both efficient and environmentally friendly.

(8) Records, monitoring, documentation and check of success

Indicators and ratios to be established by authorities shall measure the success of the interim targets. The Swedish Board of Agriculture offers a programme for voluntary tests of sprayers in operation. In the voluntary systems, one of the key elements is the documentation of the measures on controlling weeds and pests and the aims of spraying.

Further addressed aspects:



(9) Pesticide-free environment with control of ground water, soil, food and feed

A “non-toxic environment” is the most important objective with respect to pesticides. This objective has been operationalised by interim targets. Pesticide residues in food as well as surface, ground and drinking water are controlled.

(10) Proper spray-free buffer zones to water areas or in general to prevent contamination of areas outside the field by wind drift

Farmers using pesticides professionally, must calculate proper buffer zones to prevent contamination of areas outside the field by wind drift.

(15) Testing/supervision of spraying equipment

Spraying equipment is inspected on a regular basis.

(16) Safe storage and handling of pesticides and equipment

There exists a regulation of the handling of pesticides; also training and information on safer handling of pesticides is available.

(18) Training of farmers, mandatory certificates for users; further advice systems

Training, information and an advisory service comprising safer handling of pesticides, reduced use of pesticides, pest prognoses and early warning is provided by the Swedish board of agriculture. Training courses are mandatory for farmers and farm workers carrying out pesticide spraying professionally. Advice and information concerning the use of pesticides and the risks associated is also provided by local extension officers on an individual basis or through courses.

(19) Setting of national targets/plans of success for soil, groundwater, environment and biodiversity

One interim target of the non-toxic environment goal states that health and environmental risks associated with the manufacture and use of chemical substances will be reduced continuously up to the year 2010, as measured by indicators and ratios. National pesticide risk indicators shall continue to show a decreasing trend.

(21) Research and development of new IPM measures

The Swedish Board of Agriculture co-ordinates a programme of weed, pest and technical research and development. This has been a genuinely national programme; the Swedish government has established 16 national objectives regarding environmental quality.

(22) Intensive dissemination

The Plant Protection Centres take an active part in serving the need for information, by courses, field excursions, telephone meetings and national and international conferences. The Federation of Swedish farmers organized the information campaign “safe use of pesticides”, built on collaboration between authorities, chemical companies, the farmers’ organisation and other associations involved.

(28) Environmental protection during mixing and filling

Current legislation contains rules regarding the filling and cleaning of equipment. All farmers using pesticides professionally must take precautions to minimize the risk of leakage to surface or groundwater or to other vulnerable areas.

United Kingdom (UK)

As a result of the adoption of the thematic strategy for the sustainable use of plant protection products by the Commission, the National Action Plan of the United Kingdom was developed with an extensive range of measures influencing and controlling pesticide use. This plan consists of five separate parts covering the subjects of water protection, biodiversity promotion, amenity use, amateur use and availability. Therefore, the following existing measures are attributed to and therefore integral parts of one or several of these five detailed plans.

(1) Measures for prevention and/or suppression of harmful organisms

Use of predators (phytoseuileus persimilis) in greenhouse crops. Grass weed control through managing population via variety choice, crop rotations and cultivations to reduce the build-up of resistance.

(3) Threshold values as a basis for decision making

Some thresholds for insect control and for some diseases are widely adopted.

(4) Non-chemical methods to be preferred

Use of methods other than pesticides is applied in conjunction with pesticides where appropriate to control pests (weeds, fungal diseases and insect pests). Different methods should be used in conjunction with one another to achieve effective and cost-effective control. Biological control is more successfully practiced in protected situations and very specific in actions and effects. Adoption of mechanical methods of weed control in horticultural crops.

(5) Target-specificity and minimization of side effects

Beneficial insect safe pesticides are used on fruit and vegetables (e.g. typhlodromid mites).

(6) Reduction of use to necessary levels

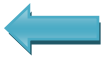
Usage of appropriate doses below those recommended by the manufacturer is widely adopted. An increase in application frequency results in less pesticides being used. The recommended manufacturer dose is typically too high.

(7) Application of anti-resistance strategies

It is suggested by scientific literature and field experience that low doses generally reduce the risk of resistance. Reducing the number of pesticide options is also supposed to lead to pesticide resistance.

(8) Records, monitoring, documentation and check of success

Water monitoring arrangements are being improved. An environmental monitoring scheme is also seen as a support of the biodiversity plan.



Further aspects addressed:

(10) Proper spray-free buffer zones to water areas or in general to prevent contamination of areas outside the field by wind drift

A buffer zone policy is being reviewed with regard to water protection.

(11) Manage the agro-ecosystem to suppress the build-up of pests

Sensitive and aquatic species and habitats are identified and mitigation measures developed. Nitrogen management is performed in nitrogen-vulnerable zones.

(12) License system allowing buying and using products, access only for professional users

Some products are labelled as available only for professional users, not for private gardeners. Inappropriate disposal of amateur products is prevented. In addition to this, the amateur use plan is addressed at those non-professional users. It includes regular surveys of amateur use and practice and

the compliance with a revised labelling guidance. There is also a communication strategy for amateurs built around the gardeners' annual calendar.

(13) Aerial spraying shall not be permitted

The aerial spraying arrangements are reviewed within the water protection plan.

(20) Adaptation of target plans, e.g. every five years

The UK strategy and the plans developed under it will be reviewed every five years.

(21) Research and development of new IPM measures

Research and development programmes are developed and reviewed within the five fields of the national action plan.

(22) Intensive dissemination

Knowledge transfer is developed within the fields of the national action plan. Information exchanges between plant breeders, crop protection and farming industries are facilitated. Communication also takes place with the European Commission and via national user groups. Promotion of IPM is performed through organisations such as LEAF.

(23) Conserving and improving biodiversity on the farm

The biodiversity plan is used to identify sensitive species and habitats and to develop a mitigation measure. A "whole farm" approach shall be developed; development and protection of farmland habitats are also promoted.

(24) Crop protection management plan

Crop protection management plans are integral parts of the Pesticide National Action plans.

(26) Targeted MRL

Regulatory controls comprise maximum residue level legislation, for example with regard to water protection.

(32) Registration and permission

The national availability plan contains elements of the EU and national approvals process, including the review of the operation of a special off-label recognition scheme, possible fast-track schemes for semiochemicals, biopesticides and minor uses, and a promotion of mutual recognition.

5.2 Evaluation of and summary on existing general IPM principles

Based on the information provided in chapter 5.1, it can be seen that many different key aspects related to plant protection measures – sometimes addressing specifically IPM – exist on national and international levels. In the following list, all aspects are summarised with an indication of which countries or international organisations in particular mentioned or explained these items (column 4). Column 2 covers the keywords or heading under which a principle or new element can be summarised. In column 3, the relationship to the other principles or other legislation is mentioned. In column 5, the

direct link to IPM is considered. It can be seen that most elements are not directly linked to IPM but to plant protection in general. In the following, such elements not directly linked to IPM are not considered further.

The principles already included in the agreement established between the EP and the Council are highlighted in green.

Table 3 IPM principles/elements mentioned in the concepts of various organisations/countries

No.	IPM principle/elements	Relationship with other principles (to be subsumed under/combined with/tool for achieving)	Organisation/ Member State where principle can be found	Link to IPM
(1)	Measures for prevention and/or suppression of harmful organisms		Agreement found between the EP and the Council Also found completely at IOBC, EISA and to a great extent at PAN Europe and FAO	
(2)	Tools for monitoring			
(3)	Threshold values as basis for decision-making			
(4)	Non-chemical methods to be preferred			
(5)	Target-specificity and minimization of side effects			
(6)	Reduction of use to necessary levels			
(7)	Application of anti-resistance strategies			
(8)	Records, monitoring, documentation and check of success			
(9)	Pesticide-free environment with control of ground water, soil, food and feed	Pesticide-free environment is a target value of the implementation of (5) with use of (8), not an independent principle	SE, NL and others	Not directly related to IPM
(10)	Proper spray-free buffer zones to water areas (many countries) or in general to prevent contamination of areas outside the field by spray drift (SE)	Requirement and practice for minimisation of side effects (5) and supporting function for prevention measures (1). Also required under Article 10 of the agreed text by EP and Council.	Many countries, SE tightened; EISA, IOBC	Not directly related to IPM
(11)	Manage the agro-ecosystem to decrease the build-up of pests	Might be subsumed to (1), organisation of measures; but this is a real long-term and challenging task	FAO, PAN, BG, Latin America	Yes
(12)	License system allowing buying and using products (AT and others), access only for professional users (UK)	Not a part of IPM; at best a tool/political instrument in order to reach or to second other goals, therefore part of policy tools (31). Covered by Articles 5 and 6 in the agreement reached among EP and the Council.	UK, others,	Not directly related to IPM
(13)	Aerial spraying shall not be permitted	Measure in order to achieve (5). Also considered in Article 9 in the agreement reached among EP and the Council.	Several countries, IOBC	Not directly related to IPM
(14)	Chemical soil disinfection shall not be allowed	Measure in order to achieve (4) and (5)	IOBC	Yes
(15)	Testing/supervision of spraying equipment.	Measure in order to achieve (5) and (6), also covered by Article 8 in the agreement reached among EP and the Council.	DE, DK, FI and others, IOBC, EISA	Not directly related to IPM
(16)	Safe storage and handling of pesticides and equipment	Additional and independent principle, preventing negligence, malpractice and abuse. Also covered by Articles 8 and 12 in the agreement found between the EP and the Council (see also Annex II of the agreement reached between EP and the Council)	Several countries, EISA, IOBC	Not directly related to IPM
(17)	System to recover pesticide packaging	Supplement to (16), safe storage and handling of equipment. Also considered in	BE	Not directly related to IPM

No.	IPM principle/elements	Relationship with other principles (to be subsumed under/combined with/tool for achieving)	Organisation/ Member State where principle can be found	Link to IPM
		Articles 8 and 12 in the agreement found between the EP and the Council (see also Annex II of the agreement reached between EP and the Council)		
(18)	Specific training scheme for farmers dedicated to IPM, (certificates for users mandatory); further IPM specific advice systems	Additional and independent principle. However, also considered in Articles 5 and 6 in the agreement reached between EP and the Council.	FI, AT and others, Latin America; EISA, PAN, IOBC, FAO; improvement required by several countries	Yes
(19)	Setting of national targets/plans of success for soil, groundwater, environment and biodiversity	Belonging to (8) for the national perspective – operational targets and goals are a prerequisite for checking success.	NL and others	Not directly related to IPM
(20)	Adaptation of target plans, e.g. every 5 years	To be combined with (19) and therefore (8) – targets are a prerequisite for checking success. Considered in Article 4 in the agreement reached between EP and the Council	Many countries	Not directly related to IPM
(21)	Research and development of new IPM measures	Additional and independent principle	especially NL and FR	Yes
(22)	Intensive dissemination	Element of training measures, to be combined with (20). Considered in Article 4 in the agreement reached between EP and the Council	especially NL	Yes
(23)	Conserving and improving biodiversity in the farm	Could be subsumed under (1)	BG	Yes
(24)	Crop protection management plan	Indefinite superordinated concept comprising other principles already mentioned, therefore no separate principle. Also considered by Articles 4 and 13 (crop specific guidelines) in the agreement reached between EP and the Council	EISA, USA, PAN	Not directly related to IPM
(25)	Avoidance of surplus chemicals, adequate disposal of surplus mix or tank washings, containers etc.	Measure in order to reach (9) and therefore finally (5)	IOBC, EISA	Not directly related to IPM
(26)	Targeted MRL	Principle similar but weaker than (9), therefore also to be subsumed under (5) and (8). Covered by a separate EU-directive	EISA, IOBC, DK	Not directly related to IPM
(27)	Emergency action plan	Obligatory part of good practice and of any production processes, therefore no genuine part of IPM. Also considered by Articles 4 and 13 (crop specific guidelines) in the agreement reached between EP and the Council	EISA	Not directly related to IPM
(28)	Environmental protection during mixing and filling	Should be part of good practice, no genuine essential component of IPM. Also considered by Articles 8 and 12 in the agreement reached between the EP and the Council and in detail already specified in Annex II of the agreement reached between EP and the Council	EISA	Not directly related to IPM
(29)	Observing pre-harvest intervals	Part of Good Plant Protection Practice, not IPM-specific. Considered by Article 4 in the agreement reached between EP and the Council	PAN, EISA	Not directly related to IPM
(30)	Designing a balanced soil structure, farming structure and species in order to support the reproduction of beneficial organisms	One possible measure of (1) which is further developable	PAN	Yes
(31)	Supporting policy tools including economic	additional and independent principle	PAN, FAO, several countries	Not directly related to IPM

No.	IPM principle/elements	Relationship with other principles (to be subsumed under/combined with/tool for achieving)	Organisation/ Member State where principle can be found	Link to IPM
	instruments e.g. pesticide tax, subsidies, but also financial and insurance tools for IPM farmers			
(32)	Registration and permission	Element of good practice, no specific IPM principle. Also considered by Articles 5 and 6 in the agreement reached between EP and the Council.	IOBC	Not directly related to IPM
(33)	Compliance with statutory conditions	General instruction covered in detail by other principles and good plant protection practice.	IOBC	Not directly related to IPM
(34)	Spray windows (small untreated areas)	As a recording and monitoring instrument to check the effect of spraying versus untreated field covered by (8) and (1).	IOBC	Yes
(35)	Focus on important causes and mechanisms of action	One important approach and focus point within research and development (21). Might also be considered in crop specific guidelines (Article 13 in the Common Position) as a universal principle	FAO	Yes

In total nearly 30 elements – in addition to the 8 principles available in the agreement between the EP and the Council – could be identified as mentioned in already existing material on plant protection and IPM. However, there are several elements included which are related in a broader frame to the use of pesticides and not directly to IPM as for example (12) changeover to pesticides with less risks if possible, (16) safe storage and handling of pesticides and equipment or the introduction of element (17) systems to recover pesticide packaging. Others refer to general issues related to the environment, such as (11) management of the agro-ecosystem to suppress the build up of pests or (22) conserving and improving biodiversity in the farm. Several identified element refer to political instruments or actions to be taken, such as (20) adaptation of target plans or (31) supporting policy tools including economic instruments.

Several of the identified elements are already correspondingly covered by principles of the agreement reached between the EP and the Council or are already considered within general articles of the draft Framework Directive and are also not directly related to IPM.

Only very few aspects – differing from the eight general principles – could be identified as linked directly to IPM.

It could be shown that nearly all identified already-existing elements are somehow closely related to the eight principles, can be regarded as a sub-category to one of the principles or as a tool to achieve it. In the following, Table 3 is shown in an updated version highlighting only elements which are directly linked to IPM and not just to general plant protection elements.

Table 4 Existing IPM principles and their usability for amending the current agreement reached between the EP and the Council

No.	IPM principle/elements	Relationship with other principles (to be subsumed under/combined with/tool for achieving)	Organisation/ Member State where principle can be found	Link to IPM
(1)	Measures for prevention and/or suppression of harmful organisms		Agreement reached between the EP and the Council	

No.	IPM principle/elements	Relationship with other principles (to be subsumed under/combined with/tool for achieving)	Organisation/ Member State where principle can be found	Link to IPM
(2)	Tools for monitoring		Also found completely at IOBC, EISA and to a great extent at PAN Europe and FAO	
(3)	Threshold values as basis for decision-making			
(4)	Non-chemical methods to be preferred			
(5)	Target-specificity and minimization of side effects			
(6)	Reduction of use to necessary levels			
(7)	Application of anti-resistance strategies			
(8)	Records, monitoring, documentation and check of success			
(11)	Manage the agro-ecosystem to decrease the build-up of pests	Might be subsumed to (1), organisation of measures; but this is a real long-term and challenging task	FAO, PAN, BG, Latin America	Yes
(14)	Chemical soil disinfection shall not be allowed	Measure in order to achieve (4) and (5)	IOBC	Yes
(18)	Specific training scheme for farmers dedicated to IPM, (mandatory certificates for users); further IPM specific advice systems	Additional and independent principle. However, also considered in Articles 5 and 6 in the agreement reached between EP and the Council.	FI, AT and others, Latin America; EISA, PAN, IOBC, FAO; improvement required by several countries	Yes
(21)	Research and development of new IPM measures	Additional and independent principle	especially NL	Yes
(22)	Intensive dissemination	Element of training measures, to be combined with (18). Considered in Article 4 in the agreement reached between EP and the Council	especially NL	Yes
(23)	Conserving and improving biodiversity in the farm	Could be subsumed under (1)	BG	Yes
(30)	Designing a balanced soil structure, farming structure and species in order to support the reproduction of beneficial organisms	One possible measure of (1) which is further developable	PAN	Yes
(34)	Spray windows (small untreated areas)	As a recording and monitoring instrument to check the effect of spraying versus untreated field covered by (8) and (1).	IOBC	Yes
(35)	Focus on important causes and mechanisms of action	One important approach and focus point within research and development (21). Might also be considered in crop specific guidelines (Article 13 in the agreement reached between EP and the Council) as a universal principle	FAO	Yes

Principle (1) of the agreement reached between the EP and the Council is a kind of non-exhaustive list covering general preventive and supportive measures to be applied to achieve prevention and suppression of harmful organisms. The identified elements (11), (23) and (30) are further elements which could be mentioned.

Element (11) however, “Manage the agro-ecosystem to suppress the build-up of pests” goes further than the approach in Europe.

An agro-ecosystem might be defined as a functional unit, producing agricultural products and providing rural services, which includes a set of agriculturally related elements and interactions among those elements. For instance, agricultural land, labour, capital, and management can be identified as

the input elements for an agro-ecosystem at the farm level. These elements inter-link with one another and interact with external attributes. The internal and external interactions determine various functions of an agro-ecosystem. To simplify the complex relationships in agro-ecosystems, one fundamental approach is to divide the system into some broad dimensions or components such as for example environmental, economic, and human dimensions.

These dimensions exist in agro-ecosystems at different scales. The fundamental idea of such an approach is to analyze the complexity of an agro-ecosystem by characterizing each component part separately and exploring the relationship among these parts. The understanding of an agro-ecosystem as a whole depends largely on how the inherent interactions among these dimensions are recognized and generalized.

One aspect considered in agro-ecological management systems is for example polycultivation of various plants with a positive effect to each other at the same cultivation period in the same field. As this system is not established for the majority of arable crops, it is recommended to invest further in research in order to learn more about the potentials and how to extend the concept to additional crops.

Element (23) is more or less already covered by the aspect “protection and enhancement of important beneficial organism for example by adequate plant protection measures or the utilisation of ecological infrastructures inside and outside production sites”.

Element (30) can be linked to the sub-element “protection and enhancement of important beneficial organisms.”

This might be different for element (18) “training of farmers, mandatory certificates for users, and further advice systems” as well as element (21) “research and development of new IPM measures” and element (22) “intensive dissemination”. All these elements are general but can also be specifically linked to IPM.

Element (34) “spraying windows” is somehow related to the general principle 2 as it might be one way of monitoring success of a plant protection measure.

It could be shown that most aspects which are on the same level as the general eight principles and addressed in the existing concepts of countries and leading organisations are already covered by the principles proposed in the agreement reached between the EP and the Council. However, it could be identified that additional aspects not addressing the professional user but the policy makers are of major importance.

Aspects suck as training and research cannot be made mandatory and will therefore be stressed in the draft guidance document.

Based on the fact that Member States approaches related to IPM are sometimes very different, the question arises as to what aspects seem to be necessary – as a minimum – to call an applied system Integrated Pest Management. Based on the feedback from the questionnaires and discussions with

experts, it seems that the following aspects need to be respected in an integrated way when IPM is applied:

- Where feasible, application of **general precautionary and supportive measures** such as appropriate crop rotation, cultivation techniques, hygiene measures and enhancement of important beneficial organism by the utilisation of ecological features inside and outside the production sites.
- Using a well established **continuous monitoring methodology/system**, where available in order to follow the development of pests and diseases.
- Using an **appropriate decision making system, where feasible and available**. Based on the monitoring results, this shall enable the professional user to decide whether and when to apply plant protection measures.
- Consider **several rules in cases where a plant protection measure is necessary** such as:
    - Non chemical methods should be preferred whenever they provide satisfactory control taking economic aspects into account as well
    - In cases where chemical methods have to be used they shall be as specific as possible and shall have the least side effects
    - The doses applied shall be kept to a minimal possible level
    - Anti resistance strategies shall be taken into account
- Using a **record system** that enables checking the success of the applied plant protection measures

It should be stressed again that only the combination of all these elements leads to an effective IPM system. When applying IPM it is also essential to consider "what to do when" so that a well functioning management system can be established. In this regard, it seems appropriate to consider different periods over the year, which will vary for different crops as well as from MS to MS due to climatic differences. In general, a splitting into post-harvest and pre-planting (off-season) as well as different stages in the growing season – e.g. based on the different levels of development of a plant during the growing season, seems appropriate.

The aspects mentioned above as a minimum necessary for an IPM system reflect the eight general principles addressed in the Framework Directive. Principles 4 to 7 of the Framework Directive are all relevant under the aspect "considering several rules in case a plant protection measure is necessary." In other words the eight principles show exactly the key elements necessary for an IPM system.

After having considered the minimum level, it seems interesting also to consider the maximum level that can be achieved when applying IPM? As the eight principles are very general and not yet operational for application in the field, Member States have to provide much information to the professional user such as various threshold levels, information on pesticides or recommendations for use of non-chemical plant protection methods. This is related to many additional requirements that a professional user has to consider. In some cases, such information will only be provided based on common accepted standards, but in some cases the provision of such information is related to extensive research and continuous work for example via reference farms. This means that in this regard the invested efforts can vary from a minimum to a maximum.

An example how MS can implement the eight principles in a minimum and maximum approach is shown in the following:

Increasing efforts for MS →

Minimum	Minimum – Maximum	Maximum
Appointment of certified and qualified advisors. Professional user complies with the legislative obligations if a regular contact to an advisor is ensured	Information and data will be provided on regional levels for main crops and main pests in a way that professional users have access to such information.	Information and data will be provided on regional levels for main and minor crops and main and minor pests in a way that professional users have access to such information. Via training and awareness-raising activities, the use of the information is supported.
No – or only very limited – information is provided by MS.	The information provided is based on scientific knowledge and experience.	The information provided is based on continuous research (e.g. reference farms) and is updated and adapted whenever necessary.

Figure 1 Minimum and Maximum approach for IPM

To sum up, the basic model of IPM is covered with the general principles, a maximum approach does not necessarily mean additional elements but the framework necessary for the application of the general principles in the field can vary from a basic scenario to an extended scenario going into much more detail than the basic scenario. This can then be regarded as a maximum approach. However, it should be made clear that the basic elements remain the same – only the level of detail and effort related to the application differs.

Even if not addressed in the IPM-related legislation, there are several aspects which have been stressed by several Member States' experts, namely that it is of importance to:

- carry out continuous training activities for professional users
- have funds available for advisors, both qualified and independent
- raise awareness for IPM at community level; marketing must be promoted in order to increase the value of IPM products; information regarding the advantages and benefits obtained by IPM programmes for the environment, farmers and consumers must be provided to customers.
- carry out and support research in this field, funds for research and experimentation must be made available
- have sufficient personnel available in the countries to enable effective IPM
- have funds for monitoring, forecasting and warning available
- find ways to guarantee funds for farmers adopting IPM measures

Having discussed the general principles and the minimum and maximum approach thereto in the paragraphs before it appears to be important to check how MS should specify the general IPM principles. Therefore it seems interesting to look on the feedback from the questionnaire survey and in particular on the question "Do you regard the description of the general principles of integrated pest management as too abstract or general, sufficiently specific or too detailed or particular?". The large majority of Member States experts considers the general principles as sufficiently specified. It was mentioned several times that further specification in such a legislative text seems not possible because every situation (crop, target organism, conditions), where the principles apply, is different. There is a

need to make more specific details for crops and pests, but that kind of details will be best given on a crop specific level. In a practical and changing environment the professional user has to be advised how to behave in order to comply with the legal requirements.

Based on this background it seems appropriate for MS to specify the general IPM principles in a similarly general way in their national legislations. In parallel it is necessary to provide professional user where they can get further information or advice on how they can comply with the general principle in the practical work.

In the following this should be underlined by an example focusing on principle 4 (non chemical methods to be preferred) when controlling Colorado potato beetle (Leptinotarsa decemlineata), CPB.

It is assumed that the professional user is aware of all his obligations in the framework of IPM. He has attended several training courses and field meetings and knows that beside various precautionary actions, monitoring activities as well as decision making systems are necessary.

Although he has already applied several precautionary measures like appropriate crop rotation etc. he discovers the appearance of Colorado potato beetle newly hatched larvae in a number which is above the threshold level provided by the MS advisory service.

He is aware that plant protection measures are necessary in order not to lose the harvest.

His national legislation related to IPM is based on the EU Framework Directive and requires him in case of a plant protection measure to prefer sustainable biological, physical and other non-chemical methods to chemical methods if they provide satisfactory pest control.

In order to comply with these general requirements, he is aware that he has to check what to do exactly in his situation and he immediately contacts an advisory service or checks the information provided by the plant protection service of the MS related to potatoes and in particular the Colorado potato beetle.

The information he receives is that there are some biological measures available which are suitable to control the Colorado potato beetle, namely

- NOVODOR FC (B. thuringiensis ssp. tenebrionis), a form of Bt that is not genetically engineered and can be used
- NEEMAZAL-T/S (Neem seed-extracts)
- SPRUZIT NEU (pyrethrum/rape oil)

Furthermore he receives the following recommendations:

- combined application of NEEMAZAL-T/S and 2 days later NOVODOR FC treatment is the best strategy for controlling defoliation through CPB parasitic nematodes;
- commercial formulations of Heterorhabditis species are available and have been shown to be more pathogenic, to the CPB than Steinernema species of nematodes, which are also commercially available
- Bt is effective only if ingested by the pest, and then only in the larval stage. Furthermore, Bt sprays are generally effective only against newly hatched CPB larvae. Applications should be made within one to two days.
- essential for a successful control of CPB by using the listed bio- pesticides is the ideal timing of the treatment at the maximum occurrence of larvae (L3/L4).

As he has discovered the infestation quite early, his timing is ideal and he can apply Bt as bio-pesticide against the newly hatched larvae. He documents all the measures carried out.
He is well aware that he has to control the success of the measure and luckily he can record the success of this measure as the monitoring results shows that the Colorado potato beetle larvae have been reduced to a level far below the action threshold.
He is aware that this recommendation for appropriate non chemical methods might change over time and in case of a similar situation 5 years later he has to check again the information provided by MS advisory services.
To summaries, the farmer has preferred a non chemical plant protection measure and therefore complies with the general requirements related to principle 4 in his national legislation. The way how he could achieve the compliance was directed by the involved kind of plant and the identified pest. In case of a different plant and a different pest a different strategy would have been necessary.
In order to enable professional user in MS to comply with general IPM principles it seems necessary to specify general IPM principles in a similar way as done in the EU Framework Directive. In addition it is necessary to oblige professional user to consider the information on a crop specific level provided by MS or appointed advisory services that is necessary in order to be able to comply with the general principles. What is also important on a national level is that MS should foresee some obligatory requirements for professional user related to training activities, field meetings, workshops or similar activities.

6 Evaluation of the proposals made by the EP and the Council

Following the results presented in chapter 5, chapter 6 covers the evaluation of the proposal made by the European Parliament and the European Council. As differences between the proposals occurred only in the first available versions and therein also only in principle 1, in the following, the eight principles are evaluated as they are included in the Common Position of the Council and as they have been accepted by the European Parliament in its second reading.

6.1 Pros and cons of the proposals

While collecting the information provided in chapter 5.1, several parameters have been discussed with various national and international experts such as for example the feasibility or the expected cost benefit ratio or the expected controllability. Even if the principles currently suggested seem to cover all important aspects, it is one of the tasks within this study to look critically at them, to go one step back and to consider firstly their usability and efficiency – this means to consider if they are useful at all to achieve the aim of IPM and subsequently to evaluate the feasibility and implementability of each principle. Further important criteria should be acceptance by professional users, the cost benefit ratio and the controllability, otherwise severe problems might show up if a measure cannot be monitored and is not accepted by the intended target group.

In the following, the eight available principles are evaluated against these seven criteria namely: usability, feasibility, efficiency, implementability, acceptance, cost/benefit ratio (economic justifiability) and enforceability. Therefore, a simple point system is used. The evaluation is based on input from discussions with experts as well as on existing experiences of the project team.
It is carried out from two different perspectives – on the one hand, from the point of view of a professional user and on the other from the point of view of the authorities.

Table 5 Evaluation of general IPM principles – point of view of professional user

General principles		(A)	(B)	(C)	(D)	(E)	(F)	(G)	In total
(1)	Measures for prevention and/or suppression of harmful organisms	2	2	2	2	1	1	2	12
(2)	Tools for monitoring	2	2	2	2	2	1	2	13
(3)	Threshold values as a basis for decision-making	2	2	2	2	2	2	2	14
(4)	Non-chemical methods to be preferred	2	1	2	1	1	1	2	10
(5)	Target-specificity and minimization of side effects	2	2	2	2	2	2	2	14
(6)	Reduction of use to necessary levels	2	2	2	1	1	2	2	12
(7)	Application of anti-resistance strategies	2	2	2	2	1	2	2	13
(8)	Records, monitoring, documentation and check of success	2	2	2	2	1	1	2	12

Assessment: 0 = criteria not fulfilled; 1 = criteria only partly fulfilled; 2 = criteria fulfilled
(A) Usability; (B) Feasibility; (C) Efficiency (D) Implementability; (E) Acceptance; (F) Cost/benefit ratio (economic justifiability); (G) Enforceability

Table 6 Evaluation of general IPM principles – point of view of the authorities

General principles		(A)	(B)	(C)	(D)	(E)	(F)	(G)	In total
(1)	Measures for prevention and/or suppression of harmful organisms	2	1	2	1	1	1	1	9
(2)	Tools for monitoring	2	1	2	1	2	2	1	11
(3)	Threshold values as basis for decision-making	2	2	2	2	2	2	1	14
(4)	Non-chemical methods to be preferred	2	2	2	1	2	2	2	13
(5)	Target-specificity and minimization of side effects	2	2	2	2	2	2	2	14
(6)	Reduction of use to necessary levels	2	1	2	1	2	2	1	11
(7)	Application of anti-resistance strategies	2	2	2	2	2	2	2	14
(8)	Records, monitoring, documentation and check of success	2	2	2	2	2	2	2	14

Assessment: 0 = criteria not fulfilled; 1 = criteria only partly fulfilled; 2 = criteria fulfilled
(A) Usability; (B) Feasibility; (C) Efficiency (D) Implementability; (E) Acceptance; (F) Cost/benefit ratio (economic justifiability); (G) Enforceability

As a result of this evaluation, it can be seen that none of the principles currently proposed is expected to fail for the criteria used for the evaluation, however, in some cases it seems that a complete fulfilment might be critical and needs further actions.

From the point of view of a farmer for example, there might be some concerns relating to implementability, acceptance as well as the cost benefit ratio. Especially for the first two aspects, MS are in a position to support and to assist the professional user so that no problems arise in relation to implementability and acceptance. If MS provide sufficient information and ensure training activities for professional users, acceptance will increase and implementability will be ensured. The situation related to the cost benefit ratio is slightly different. When applying IPM, it might happen that the professional user will have to cope with higher costs in some actions. Possible higher costs might have to be supported somehow by MS authorities. As already mentioned above, various elements have to be considered by MS such as promoting IPM products on the market and having funds available for research as well as for advisors and farmers.

From the point of view of a Member State authority, the situation is different. Weak points seem to be feasibility, implementability and controllability. For the first two aspects, MS authorities will have to work on information material, on training courses for professional users, but they will also have to raise awareness on the overall aims of IPM. The controllability seems to be different. While for some of the principles it seems possible to monitor if professional users apply the principle, some others seem to be difficult to control, like the appropriate application of a monitoring system. This is a point where MS have to trust in their professional users underlining again the importance to train and to support professional users or where additional actions such as involvement of certified advisors has to be considered.

6.2 Monitoring of implementation

Point 1 is very important in order to make professional users aware of the regulation, the benefits and related support. It is expected that once the framework is provided to implement IPM, the majority of professional users will aim to comply with the principles. However, for a minority, deterrence is necessary. The effectiveness of a deterrence approach depends upon:

- the perception by the potential violators that they are likely to be detected;
- a quick response when non-compliance is detected; and
- penalties that encourage violators to change their behaviour.

These are some very general points, and since the Framework Directive leaves some leeway as to how to monitor professional users applying the general principles, it is essential to find a proper method of compliance monitoring in order to take into account national considerations. Aspects such as control form, control frequency, evaluation of key aspects, control techniques, control documentation, as well as consequences and penalties in case of non-compliance of professional users with national legislation should be taken into account.
Another element, which appears to be important, is to check if any similar monitoring systems already exist and if they can be used for this purpose as well.

Based on this background, there are various possibilities which can be considered for compliance monitoring. As agricultural structures and common attitudes towards plant protection in general in the MS are differently developed, there might also be varying approaches to promote implementation of IPM. On the one hand side MS might emphasise the significance of advisory services and on the other hand relay upon the already responsible handling of the issue by the farmers. In other words some MS might need to be more restrictive than others to be in compliance with IPM.

– One possibility would be to strengthen the involvement of certified advisors. It might be a tool to expect compliance if a professional user is supported by such an advisor.
  From a MS point of view, it seems important to provide some criteria for such advisory services, including for example a certification scheme.
  Depending on the national situation – for example, the advisory service is a public organisation, or if various private organisations are involved, it would be important to consider who could bring in the knowledge necessary to implement IPM. It is common practise that advisory services provide initial warnings and that farmers react with monitoring activities in this regard. Where a MS decides to involve various private organisations and to expect compliance of professional users that work with these advisory services, it seems necessary to provide a standard set of information (for example guideline considering pests and diseases in the proceeding of the year, threshold levels, etc.) to be used. This ensures that all advisory services work on a similar level and guarantees fair treatment of professional users. It is also necessary to highlight the importance of monitoring activities. Where insufficient numbers of advisors are available, professional users have to ensure regular monitoring activities of their fields by themselves.

→ If a MS chooses to follow such an approach, the following performance indicators seem appropriate:
- evidence provided by the professional user showing the appointment of an appropriate advisory service (including implementation of e.g. warning service subscription)
- evidence provided by the professional user showing regular contacts with the advisory service (regular monitoring and consultations have to be ensured)
- evidence provided by the professional user and issued by the advisory service showing that the farmer is in line with IPM requirements

In many countries, advisory services are well established and can be used in an adapted way for implementing IPM. However, MS have to ensure that the work carried out by the advisors is in line with the general requirements in the Framework Directive via certification for example.
It should be mentioned that the involvement of qualified advisory services is important regarding implementation of IPM. Even if a MS does not to expect compliance by professional users where they are supported by such an advisory service, the involvement is necessary in order to assist the farmer in compliance with the requirements.

– Another possibility would be to place more responsibility for compliance on the farmers themselves. This does not exclude the involvement of advisors; however, the professional user is more actively involved in ensuring compliance. Choosing this approach means for MS that sufficient and updated information has to be available for the professional users upon which they can base their work. It is necessary in this regard to provide information on how monitoring should be conducted, which threshold levels should be used and – in the case of a necessary plant protection measure – how to choose the right measure considering resistance problems as well as the effectiveness of a measure. As soon as such an information framework is provided, a set of inspections to assess or verify compliance by professional users can be carried out. The types of inspections include the following:
  - inspections; these are inspection actions whereby professional users must provide evidence that they practise IPM according to the requirements. This can for example be achieved by control of their documentation and some questions related to their working practise. Therefore, a specific control sheet seems suitable which could be similar to the crop specific control sheets used by IOBC.
  - surveillance inspections; these are actions that take place continuously and on a broader range. Such activities could for example be linked to advisory services, which report to MS authorities on their observations. In addition, this could mean that a representative number of farmers are asked to report plant protection measures via e.g. an internet tool.
  - Control inspections; these are actions that take place in cases where professional users have been identified within an inspection as being non compliant and determines whether behaviour has changed.

→ If a MS chooses to follow such an approach, the following performance indicators seem appropriate:
- evidence provided by the professional user showing that a monitoring and decision making system is in place (documentation of monitoring results, knowledge of and compliance with

threshold values, correct choice and application of chemical/non-chemical measures, knowledge and application of supportive measures)

Both approaches must allow for action to be taken in case of non-compliance. Such actions might comprise the following and might change over the years, since it seems appropriate to have a transition period in which consequences aim at encouraging professional users rather than penalising them:

- provision of further advice (warning) and/or penalty: this can for example mean an educational letter informing professional users of how they can improve their behaviour, or which obliges them to attend a training seminar; control inspections are recommended
- sanctions and penalties; such penalties can range from small to higher fines or they might lead to a stop or shut down of any activity related to non compliance;

It is important to consider that professional users cannot be expected to perfectly implement the provided guidance from the beginning on. A reasonable transition period is necessary between establishment of guidance and first control/sanctions, in order to allow users to learn how to implement the guidance.

7 Crop specific IPM elements

7.1 Selection of main crops

In order to cover crops – relevant within the EU – a selection of the most important crops for the examination of crop-specific IPM elements has been carried out as an initial step.

The following quantity related criteria were taken into consideration for the selection:

- relevance of the crops with respect to the use of plant protection products
- relevance of the crop in the crop protection market
- treatment index for pesticide application
- relevance of the crops in terms of volume of harvested production
- relevance of the crops related to the cultivated area

In addition to these quantity related and statistically available data, several further aspects have been taken into account:

- The geographic distribution area of the selected crops should cover the European Union in a well balanced manner
- The categories cereals, oilseeds, fruits, crop trees, vegetables and potatoes should all be represented
- Crop rotation systems and individual crops should both be represented
- Field growing and greenhouse growing should both be represented
- The selection of crops should be limited to a number that is manageable within the project resources
- Already available crop specific IPM guidelines should be available for the crops in order to enable further project work (evaluation of existing approaches)

Taking these criteria into account, the following main crops cultivated in Europe have been selected in close coordination with the Commission Services for the further examination of crop specific IPM elements:

- Common wheat (cereals)
- Maize (cereals)
- Rapeseed (oilseed)

} Can be merged

- Potato

- Tomato (vegetables) → field growing and protected growing
- Vine → "viticulture"
- Apples (crop trees)

The first three categories can be merged into "arable crops" representing an important typical crop rotation system, and each single component of this system is related to substantial quantities of production, use of plant protection products and is cultivated on large areas.

Potatoes represent arable production in high quantities. The cultivation requires the use of important quantities of plant protection products.

Tomatoes represent greenhouse cultivation with increasing importance which is related to considerable quantities of plant protection products used.

The production of wine and must represents the cultivation of perennial crops with high production volumes and a high input of plant protection products.

Apples represent the most important crop of the crop-trees category, with respect to production volume, and the use of plant protection products and also the historic prototype of integrated pest management.

Table 7 and Table 8 show the selected crops in relation to relevant statistical and indicator data.

Table 7 Selection of main crops for the further examination of crop specific IPM elements and related statistical data

	Crop (crop category)	Percentage of EU-25 and EFTA crop protection market	Treatment index for pesticide application [1)]	Volume of harvested crop production (in 1000 t)	Cultivated area (in 1000 ha)	Characteristics/ distribution
1	Common wheat (cereals)	32.6 [2)]	1.4-1.4-0.4-0.6	125,889	22,793	**Wheat, maize and rapeseed are suitable for crop rotation (system approach on plant level)**
2	Maize	8.6	0-1.2-0.03-0	55,368	8,531	
3	Rapeseed	7.9	0.7-1.2-1.4-0.1	15,658	5,215	
4	Potato	5.1	6.1-1.6-0.9-0	56,702	2,241	
5	Tomato (vegetables)	[3)]	2.7-0-1.2-0.4	21,326 [4)]	338 [5)]	**Greenhouse growing; extension of acreage in Spain**
6	Vine	9.8	12.4-0.1-0.6-0	173,008 [6)]	3,643	
7	Apples (fruit)	4.6	21.8-1.4-4.8-0	11,582	621	

1) Coefficient of measures for fungicide, herbicide, insecticide and growth regulators application, developed and applied for Germany within the NEPTUN project series.
Source:http://www.bba.bund.de/nn_921032/DE/Home/koordinieren/neptun/neptun__node.html__nnn=true (13 October 2008), values based on different years
2) Percentage of cereals in total
3) Percentage of other fruit and vegetables in total: 12.9%
4) 2006 values for Europe as a whole, source: FAO database
5) 2003 values
6) Wine and must in 1000 hl

Values for production volume and area of 2005 (wheat), 2005/06 (wine and must), 2006 (maize, potatoes)

Sources: European Commission, DG Agriculture and Rural Development, Agriculture in the European Union, Statistical and Economic Information 2007 (volume of harvested crop production and cultivated area); ECPA Annual Review 2007, Market overview, percentage of EU-25 and EFTA crop protection market

Table 8 Use of plant protection products by crop selected, or generic crop category in tons of active substance

	Crop	Fungicides	Herbicides	Insecticides	Sum
1	Common wheat [1)]	9,969	42,160	697	**52,826**
2	Maize	97	13,139	576	**13,812**
3	Rapeseed [2)]	1,047	6,669	398	**8,114**
4	Potato	10,719	2,057	487	**13,263**
5	Tomato [3)]	5,339	2,439	1,256	**9,034**
6	Vine	68,773	4,507	1,046	**74,326**
7	Apples [4)]	9,606	1,748	1,855	**13,209**

1) Tons for cereals in total
2) Tons for oilseed in total
3) Tons for vegetables in total
4) Tons for fruit trees in total

Source: Eurostat, Statistical books. The use of plant protection products in the European Union. Data 1992-2003. 2007 edition

7.2 Existing approaches for main crops – discussion and evaluation

Due to the very sparse feedback of the call for existing national crop specific IPM guidelines within the EU Member States, available reports have also been considered in this regard. Very useful information was already compiled for example in the report "Integrated crop management systems in the EU"[12] as well as in "Controlled-integrated production of fruits and vegetables – a European comparison of cultivation guidelines and control procedures."[13]

It seems that crop specific guidelines are most often included within the framework of "Integrated Production (IP)" or "Integrated crop management (ICM) of which IPM is one part.

The following illustration shows this relationship:

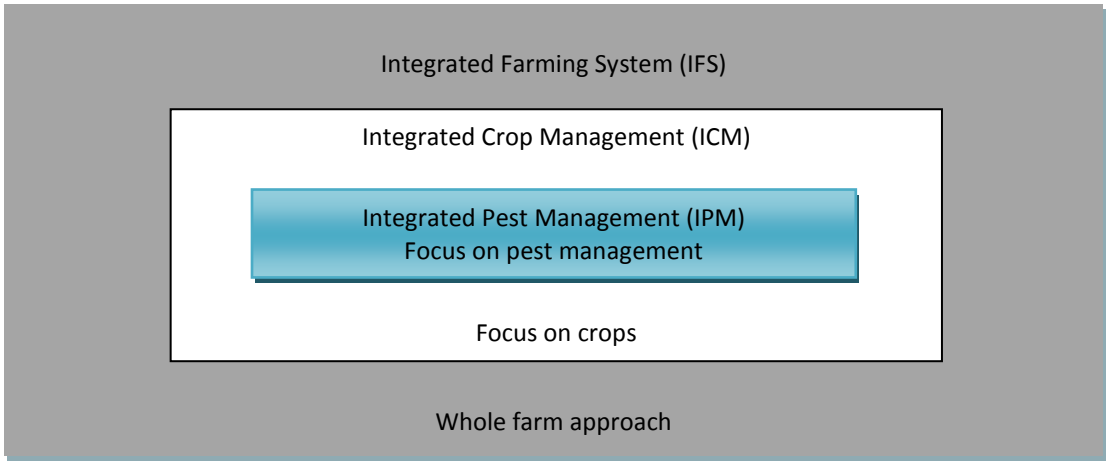


Figure 2 Relation of IPM and related terms

12 Based on a study contracted by DG ENV in 2002 which was carried out by Agra CEAS Consulting

13 Schriftenreihe des Bundesministeriums für Verbraucherschutz, Ernährung und Landwirtschaft, Reihe A, Angewandte Wissenschaft,

The majority of such integrated production schemes are provided by specific organisations which guarantee the consumer several quality aspects. Most often, professional users that follow such guidelines are allowed to label their products with specific marketing seals which are commonly known by consumers. For the purpose of this project, such crop specific guidelines have also been investigated.

Some of the most used and cited crop specific guidelines are the Integrated Production guidelines elaborated by IOBC. The basic IOBC (International Organization for Biological Control of Noxious Animals and Plants) document for the establishment of crop-specific IP guidelines is the 3rd edition 2004 of "Guidelines for Integrated Production: Principles and Technical Guidelines" – referred to as "IOBC Standard 2004 for Integrated Production" (Boller et al. 2004 a, www.iobc.ch). The "IP Standard 2004" introduces a total quality approach. Aspects covered include product quality, production quality, ethical quality and social impact, consumer perceptions, food safety, environment, animal welfare and workers' health, safety and welfare.
This basic document includes Technical Guidelines I (requirements for organisations and their members) and Technical Guideline II (general agronomic requirements valid for all crops).
Crop-specific guidelines (Technical Guidelines III) are established by the IOBC Commission on "IP Guidelines and Endorsement" in close collaboration with the respective crop-oriented IOBC working groups and *ad hoc* expert panels. They are updated every 5 years and cover the most important crops of the temperate zones: Pome fruits (1991, 1994, 2002), arable crops (1997), stone fruits (1997, 2003), grapes (1999, 2008), soft fruits (2000), olives (2002), citrus (2004) and field grown vegetables (2005). The guidelines published before 2004 are now being revised and adapted to the new IOBC Standard 2004. All of these documents serve to provide a framework for the formulation of regional or national guidelines according to IOBC standards and to facilitate their harmonisation.

The chapters of all crop-specific guidelines follow the same pattern and cover the following topics:

1. General aspects (e.g. definition and objectives of IP; traceability; self-evaluation by farmers);
2. Biological diversity and landscape (ecological infrastructures; buffer zones);
3. Site selection;
4. Site management (e.g. crop rotation; soil management, soil protection);
5. Cultivars, seeds, and cultivation systems;
6. Nutrition;
7. Irrigation;
8. Integrated plant protection (the principles; the choice of direct control measures; information on the toxicity/ecotoxicity of plant protection products; storage and handling of pesticides);
9. Harvest;
10. Post-harvest procedures;
11. Animal production on mixed farms;
12. Workers' health, safety and welfare.

All the following documents can be downloaded in full text from the website www.iobc.ch:

Guidelines for Integrated Production of Pome Fruits. (45 pp.)
Technical Guideline III.3rd edition 2002
Edited by J.V. Cross, 10 BC IOBC WPRS Bull. Vol. 25 (8), 2002. ISBN 92-9067-145-4 (English, French, German, Italian, Spanish)

Guidelines for Integrated Production of Stone Fruits. (52 pp.)
Technical Guideline III. 2nd edition 2003.
Edited by C. Malavolta, J.V. Cross, P. Cravedi & E. Jörg. IOBC WPRS Bull. 26 (7) 2003. ISBN 92-9067-155-4. (English, French, German, Italian, Spanish, Portuguese)

Guidelines for Integrated Production of Arable Crops in Europe. (in revision). (115 pp.) Technical Guideline III. 1st edition 1997.
Edited by E.F. Boller, C. Malavolta & E. Jörg. IOBC WPRS Bull. Vol. 20 (5), 1997. ISBN 92-9067-090-8 (English, French, German, Italian, Spanish, Portuguese)

Guidelines for Integrated Production of Grapes. (in revision). (75 pp.)
Technical Guideline III. 2nd edition 1999.
Edited by C. Malavolta & E.F.Boller, IOBC WPRS Bull. Vol. 22 (8), 1999. ISBN 92-9067-113-0
(English, French, German, Italian, Spanish, Portuguese, Greek)

Guidelines for Integrated Production of Soft Fruits. (51 pp.)
Technical Guideline III. 1st edition 2000. Edited by E. Jörg & J.V. Cross. IOBC WPRS Bull. Vol. 23 (5), 2000. ISBN - 92-9067-121-1
(English, French, German, Italian, Spanish, Polish, Hungarian)

Guidelines for Integrated Production of Olives (67 pp.)
Technical Guideline III. 1st edition 2002. Edited by C. Malavolta, G. Delrio & E.F. Boller. IOBC WPRS Bull. Vol. 25 (4),2002. ISBN - 92-9067-141-4
(English, French, Italian, Spanish, Portuguese, Greek, Arabic)

Guidelines for Integrated Production of Citrus
(10 pp.) Technical Guideline III. 1st edition 2004. (English). IOBC WPRS Bulletin in preparation.

Guideline for Integrated Production of Field Grown Vegetables
(24 pp.) Technical Guideline III. 1st edition 2004.
Edited by C. Malavolta, E.F. Boller & F.G. Wijnands. IOBC WPRS Bull. Vol 28 (5) 2005. ISBN 92-9067-177-5.
(English)

By means of providing crop specific guidelines, IOBC working groups actively promote the implementation of IPM into practice. Respective IP guidelines developed by IOBC/wprs (West Palaearctic Regional Section) working groups and local production organisations in Germany, Italy, Spain, Switzerland and other countries are currently being used, particularly in pome fruits and grapes. In arable cropping however, there is still no comprehensive IPM concept being implemented in practice. However, certain IPM methods are widely used.

In **Germany**, professional federations such as the Bundesausschuss Obst und Gemüse developed crop specific guidelines for fruit, vegetables and viticulture, relevant for all producers in the federal states. More crop specific guidelines relating to certain cropping regions, especially for apple and viticulture are published, e.g. “FUL” (Grundsätze des Landes Rheinland-Pfalz für den umweltschonenden Weinbau des Förderprogramms Umweltschonende Landbewirtschaftung) and only available as a draft “PAULa Grundsätze” (PAULa Grundsätze des Landes RheinlandPfalz für die Umweltschonender Steil- und Steilstlagenweinbau). These programmes mainly comprise instructions regarding environmentally friendly and sustainable viticulture. However, several of the IPM principles are implemented as well.
Moreover, some of these directions are accomplished by more general enhancement programmes to regional features, for example Kontrolliert umweltschonender Weinbau Pfalz e.V. www.kuw-online.de.
Currently, several drafts are available for crop and sector-specific guidelines. Therein six overarching aspects are suggested to be addressed, each of them subdivided into several specific guidance information points. These are:

- Integrated and holistic approach and ensuring availability of necessary information
- Support and use of natural control mechanism
- Measures which prevent pest infestation
- Identification of infestation and application of decision-making guidance
- Application of non-chemical and chemical pest prevention measures
- Control of success and documentation

All important aspects for a crop specific guideline can be allocated to these six categories and specifically elaborated for each individual crop.

In **Italy**, general instructions for the implementation of IPM are provided. The crop specification “PARTE SPECIALE” is not realised in a completed document, but exists as several single excel files. They are available online and can be accessed free of charge. In **Spain**, crop specific guidelines exist for all of the previously selected crops (main crops). Additionally, Spain provides documents about protected grown (greenhouse) tomatoes.

In the **Netherlands**, crop specific guidelines for arable crops (cereals and potato), fruit and vegetables are provided. The documents include instructions for IPM in protected grown (greenhouse) tomatoes as well. In general, there is a kind of hierarchy of IPM measures in the Netherlands following the list: Prevention, Technical measures for cultivation, systems for early warning and advice, non-chemical crop protection, chemical crop protection and application techniques and emission reduction. Each of the six categories is further subdivided into various subtypes. They are shown in the following figure:

Table 9 Hierarchy of IPM measures in the Netherlands

Type of measure	Subtype
1. Prevention	1a. Healthy starting materials 1b. Hygienic measures on the farm 1c. Condition/treatment of the soil

Type of measure	Subtype
	1d. Cultivation and crop rotation 1e. Choice of crop and variety 1f. Time of planting/sowing 1g. Knowledge of diseases, pests and weeds
2. Technical measures for cultivation	2a. Scouting/crop quality damage threshold 2b. Plant distance and density 2c. Dunging 2d. Climate regulation in glasshouses 2e. Crop care
3. Systems for early warning and advise	3a. Use of weather systems and pest traps 3b. Decision supporting systems
4. Non-chemical crop protection	4a. Use of natural enemies 4b. Mechanical/thermal foliage killing 4c. Mechanical techniques of weed killing 4d. Plant strengtheners 4e. Crop protection substances of natural origin 4f. Inundation 4g. Biological soil treatment
5. Chemical crop protection and application techniques	5a. Choice of substance 5b. Seed coating 5c. Spot-wise application 5d. Low dosing system
6. Emission reduction	6a. Choice of substance 6b. Catch crop/bigger cultivation-free zone

For **Denmark**, a scientific report exists, providing detailed information about efforts to reduce the pesticide usage in winter wheat. In Denmark, Integrated Production is incorporated within general production practise. For the **United Kingdom**, instructions exist, providing general information concentrating on the management of common fungal diseases (e.g. in wheat). However, these instructions do not extend beyond providing suggestions for the use of resistant varieties.
In **Austria** some elements of crop-specific integrated production are currently covered by the AMA Gütesiegel which is a commonly known marketing label provided by a governmental organisation. No information on national crop specific guidelines could be found. However, it might be that such guidelines exist on the regional level.
In several other countries such marketing labels are also available, but are most often provided by private organisations. Such examples are available especially for wine in France (e.g. Terra Vitis) or related to different supermarkets such as in Italy (e.g. Conad, Percorso Qualità, Co-op Italia – Prodotti con Amore).

In addition, documents from other international organisations have been screened. Pan Europe for example published in 2007 a state-of-the-art paper related to integrated crop management with particular reference to pest management for apples in Europe.

In the following, all these mentioned crop-specific guidelines have been investigated and relations to the general principles have been recognised. The approach used is similar to the one used for the

general principles. Elements listed under points (1) to (8) refer to the general principles which are also addressed in the crop-specific principles – although with a different level of detail. Any further numbering refers to elements that are new and independent crop-specific principles in the crop-specific guidelines of different organisations or MS. In the following, tables are presented for all selected crops.

Table 10 Evaluation of crop specific guidelines related to arable crops

No.	IPM principle	**Elements mentioned in crop-specific IPM guidelines IOBC and Member States**
		Arable crops (wheat – maize – oilseed rape)
(1)	Measures for prevention and/or suppression of harmful organisms	
	(1.1) crop rotation	Is mentioned in **IOBC** Is mentioned in **MS** (e.g. DE, NL) (number of fields in a crop rotation, cultivation rates, cultivation breaks, weed management by the use of crop rotation)
	(1.2) adequate cultivation techniques	Is mentioned in **IOBC** Is mentioned in **MS** (e.g. DE, NL) (no-tillage or reduced tillage intensity (depth and frequency), use of combined operations, seed rate, seed placement, depth and seed cover, sowing periods)
	(1.3) appropriate seed and planting material	Is mentioned in **IOBC** Is mentioned in **MS** (e.g. DE, NL) (use of descriptive list of varieties, consultation of advisors with special knowledge in varieties)
	(1.4) balanced fertilisation, liming, irrigation/drainage if feasible	
	(1.5) hygiene measures	
	(1.6) protection/enhancement of beneficial organisms	Is mentioned in **IOBC** Is mentioned in **MS** (e.g. DE) (Installation and maintenance of field margins, if feasible by utilisation of environmental enhancement programmes e.g. "Ackerschonstreifenprogramm", domestic shrubs and trees are to be selected when new margins including woody plants are built up)
(2)	Tools for monitoring	Is mentioned in **IOBC** Is mentioned in **MS** (e.g. DE, NL) (monitoring of harmful organisms: one method is given; list of harmful organisms that shall be monitored according to forecasting programmes)
(3)	Threshold values as basis for decision-making	Is mentioned in **IOBC** Is mentioned in **MS** (e.g. DE, NL)
(4)	Non-chemical methods to be preferred	Is mentioned in **IOBC** Is mentioned in **MS** (DE, NL) (sitting supports for birds of prey, substances to be preferred when pest and antagonists occur simultaneously, destruction of European corn borer (*O. nubiliaris*) larvae in stubble by employing mechanical measures)
(5)	Target-specificity and minimization of side effects	Is mentioned in **IOBC** Is mentioned in **MS** (e.g. DE, NL) (equipment has to be implemented that reduces drift by 75%, buffer zones of **3m** minimum)
(6)	Reduction of use to necessary levels	Is mentioned in **MS** (e.g. DE, NL) (annual data from state authorities are being proved and are annually modified, if necessary.)
(7)	Application of anti-resistance strategies	Is mentioned in **MS** (e.g. DE) (advisory service are to be taken into account)
(8)	(8.1) Records about pest monitoring and plant protection measures	Is mentioned in **IOBC** Records about pest monitoring are not explicitly demanded in **IOBC** Is mentioned in **MS** (e.g. DE) (Field specific documentation, listing developmental state of crop, defined infestation level

No.	IPM principle	Elements mentioned in crop-specific IPM guidelines IOBC and Member States
		Arable crops (wheat – maize – oilseed rape)
		in context with threshold value and reasons for the decision made)
	(8.2) Check of success and recording	
(9)	Additional elements to the legally bound requirements	Measures of soil protection in **IOBC** Analysis of nutrient supply in **IOBC**
(10)	Criteria ensuring the implementation of a holistic IPM approach by professional users	The professional user is obliged to procure required information on IPM and to participate in annual continuous trainings. As a minimum request, farmers have to participate in advanced training once a year, use an official forecasting programme and have subscribed to a professional journal. The compliance of these requests has to be attested.

Based on the evaluated material, it could be shown that the main part related to crop specific guidelines for arable crops consists of concretisation of the general IPM principles. Only the element of balanced fertilisation could not been identified. However, additional and different soil protection measures are addressed. Also, the element 'check of success' based on the records seems not to be included in national guidelines. As all of the investigated guidelines are included in the framework of integrated production, additional elements could be identified such as elements to be considered in relation to nutritional aspects.

Table 11 Evaluation of crop specific guidelines related to potatoes

No.	IPM principle	Elements mentioned in crop specific IPM guidelines IOBC and Member States
		Potato
(1)	Measures for prevention and/or suppression of harmful organisms	
	(1.1) crop rotation	Is mentioned in **IOBC** Is mentioned in **MS** (e.g. DE, AT) (Number of fields in a crop rotation to limit disease and nematode infestation, cultivation rates, cultivation breaks, weed management by the use of crop rotation)
	(1.2) adequate cultivation techniques	Is mentioned in **IOBC** Is mentioned in **MS** (e.g. DE, NL) (No-tillage or reduced tillage intensity (depth and frequency), use of combined operations, seed rate, seed placement, depth and seed cover, sowing periods)
	(1.3) appropriate seed and planting material	Is mentioned in **IOBC** Is mentioned in **MS** (e.g. DE, NL)
	(1.4) balanced fertilisation, liming, irrigation/drainage if feasible	Is mentioned in **MS** (e.g. AT, NL)
	(1.5) hygiene measures	Is mentioned in **MS** (e.g. AT)
	(1.6) protection/enhancement of beneficial organisms	Is mentioned in **IOBC** Is mentioned in **MS** (e.g. DE)
(2)	Tools for monitoring	Is mentioned in **IOBC** Is mentioned in **MS** (e.g. DE, NL)
(3)	Threshold values as basis for decision-making	Is mentioned in **IOBC** Is mentioned in **MS** (e.g. DE, NL)
(4)	Non-chemical methods to be preferred	Is mentioned in **IOBC** Is mentioned in **MS** (e.g. DE, NL) (control of Colorado potato beetle by *Bacillus thuringiensis*, control of Sclerotinia by *Coniothyrium minitans*)
(5)	Target-specificity and minimization of side effects	Is mentioned in **IOBC** Is mentioned in **MS** (e.g. DE, NL)

No.	IPM principle	Elements mentioned in crop specific IPM guidelines IOBC and Member States
		Potato
(6)	Reduction of use to necessary levels	Is mentioned in **MS** (e.g. DE)
(7)	Application of anti-resistance strategies	Is mentioned in **MS** (e.g. DE)
(8)	(8.1) Records about pest monitoring and plant protection measures	Is mentioned in **IOBC** Records about pest monitoring are not explicitly demanded in **IOBC** Is mentioned in **MS** (e.g. DE, AT)
	(8.2) Check of success and recording	
(9)	Additional elements to the legally bound requirements	Measures of soil protection in **IOBC, AT** Analysis of nutrient supply in **IOBC** Harvest and storage in **AT**
(10)	Criteria ensuring the implementation of a holistic IPM approach by professional users	The professional user is obliged to procure required information on IPM and to participate in annual continuous training schemes. As a minimum request, farmers have to participate in advanced training once a year, use an official forecasting programme and have subscribed to a professional journal. The compliance of these requests has to be attested

Based on the evaluated material, it could be shown that the main part related to crop specific guidelines for potatoes consists of concretisation of the general IPM principles. As all of the investigated guidelines are included in the framework of integrated production, additional elements could be identified such as elements to be considered in relation to nutritional aspects. In addition, further elements of soil management and rules related to harvest and storage have been addressed in addition to the one mentioned within general principle 1.

Table 12 Evaluation of crop specific guidelines related to tomatoes

No.	IPM principle	Elements mentioned in crop specific IPM guidelines IOBC and Member States	
		Tomato Field growing	Tomato protected growing
(1)	Measures for prevention and/or suppression of harmful organisms		
	(1.1) crop rotation	Is mentioned in **IOBC** (Crop rotation is mandatory, systems must be chosen to avoid problems with soil-borne pathogens and pests) Is mentioned in **MS** (e.g. DE)	
	(1.2) adequate cultivation techniques	Is mentioned in **IOBC** (stale/false seedbed technique, sowing dates, sowing densities, undersowing)	Is mentioned in **MS** (e.g. NL)
	(1.3) appropriate seed and planting material	Is mentioned in **IOBC** (cultivars chosen should meet the specified requirements of the market e.g. taste, visual appearance, shelf life, agronomic performance and minimum dependence on agrochemicals, high tolerance to nematodes, viruses, bacteria, fungi)	Is mentioned in **MS** (e.g. NL)
	(1.4) balanced fertilisation, liming, irrigation/drainage if feasible	Is not mentioned in **IOBC** Is not mentioned in **MS** (e.g. DE)	Is mentioned in **MS** (e.g. AT, NL)
	(1.5) hygiene measures		Is mentioned in **MS** (e.g. AT)
	(1.6) protection/enhancement of beneficial organisms	Is mentioned in **IOBC** Is mentioned in **MS** (e.g. DE)	
(2)	Tools for monitoring		
(3)	Threshold values as basis for	Is mentioned in **IOBC**	

No.	IPM principle	Elements mentioned in crop specific IPM guidelines IOBC and Member States	
		Tomato Field growing	Tomato protected growing
	decision-making		
(4)	Non-chemical methods to be preferred	Agriotes spp. (wireworms): should be monitored e.g. sex pheromone or bait traps, soil insecticides only applied as placed (band) treatments, monitoring for lepidopteran eggs and first larval stages, treatments against spider mites should only be carried out against early infestations) Is mentioned in **IOBC**	
(5)	Target-specificity and minimization of side effects	Is mentioned in **IOBC** (application of selective products, e.g. Bt, IGR, where available and effective, is mandatory. (Pesticides available locally or nationally identified as meeting defined criteria, as well as being as safe as possible to key natural enemies, must be identified in a list of permitted products (green list) in regional guidelines and standards with restrictions where appropriate (yellow list). All other pesticides must not be permitted and examples may be given (red list)	Is mentioned in **MS** (e.g. NL)
(6)	Reduction of use to necessary levels	Is mentioned in **IOBC** (reduced dosages are possible, especially in herbicides)	Is mentioned in **MS** (e.g. NL)
(7)	Application of anti-resistance strategies	Is mentioned in **IOBC**	
(8)	(8.1) Records about pest monitoring and plant protection measures		Is mentioned in **MS** (e.g. AT)
	(8.2) Check of success and recording		
(9)	Additional elements to the legally bound requirements	(soil management nutrient management, short time lapse between harvest and processing. Adequate transportation) in IOBC	Harvest and storage in **MS** (e.g. AT)
(10)	Criteria ensuring the implementation of a holistic IPM approach by professional users	The professional user is obliged to procure required information on IPM and to participate in annual continuous training schemes. As a minimum request, farmers have to participate in advanced training once a year, use an official forecasting programme and have subscribed to a professional journal. The compliance of these requests has to be attested	

Based on the evaluated material, it could be shown that the main part related to crop specific guidelines for tomatoes consists of concretisation of the general IPM principles. For field growing tomatoes, record keeping could not been identified in national guidelines as well as record keeping for the element “hygiene measures” which means that machinery and equipment has to be cleaned in order to avoid any spreading of harmful organisms. The situation for protected growing tomatoes is different. Monitoring and decision-making systems could not be identified as listed in national guidelines. As all of the investigated guidelines are included in the framework of integrated production, addition elements could be identified such as fruit storage management as well as elements to be considered in relation to nutritional aspects. Further elements of soil management have been addressed in addition to the one mentioned within general principle 1.

Table 13 Evaluation of crop specific guidelines related to viticulture

No.	IPM principle	Elements mentioned in crop specific IPM guidelines IOBC and Member States
		viticulture
(1)	Measures for prevention and/or suppression of harmful organisms	
	(1.1) crop rotation	Is not mentioned in **IOBC** Is not mentioned in **MS** (e.g. DE)
	(1.2) adequate cultivation techniques	Is mentioned in **IOBC** Is mentioned in **MS** (e.g. DE) (Site of the vineyard, planting systems must be selected and harmonised for regular yields of quality grapes, choice of training systems, alleyways with cover plants, total green cover during winter is mandatory, must be trained and pruned to achieve a balance between growth and regular yields and to allow good penetration of light and sprays)
	(1.3) appropriate seed and planting material	Is mentioned in **IOBC** Rootstocks and cultivar to be selected Is mentioned in **MS** (e.g. DE) Cultivars and clones resistant to diseases and/or pests as well as a diversification of cultivars and rootstocks are recommended. Planting material should be sound and certified as virus-tested.
	(1.4) balanced fertilisation, liming, irrigation/drainage if feasible	Is mentioned in **IOBC** Is mentioned in **MS** (e.g. DE)
	(1.5) hygiene measures	Is not mentioned in **IOBC** Is not mentioned in **MS** (e.g. DE)
	(1.6) protection/enhancement of beneficial organisms	Is mentioned in **IOBC** Is mentioned in **MS** (e.g. DE) (Where Phytoseiid predators are absent from vineyards, they must be introduced where the pest situation (e.g. spider mites, thrips) requires regular control measures)
(2)	Tools for monitoring	Is mentioned in **IOBC** Is mentioned in **MS** (e.g. DE)
(3)	Threshold values as basis for decision-making	Is mentioned in **IOBC** Is mentioned in **MS** (e.g. DE)
(4)	Non-chemical methods to be preferred	Is mentioned in **IOBC** Is mentioned in **MS** (e.g. DE) (Pruning for control of Botrytis, Control of European grape berry moth by pheromone traps or *Bacillus thuringiensis)*
(5)	Target-specificity and minimization of side effects	Is mentioned in **IOBC** (Pesticides available locally or nationally identified as meeting defined criteria, as well as being as safe as possible to key natural enemies, must be identified in a list of permitted products (green list) in regional guidelines and standards with restrictions where appropriate (yellow list). All other pesticides are not permitted and examples may be given (red list) Is mentioned in **MS** (e.g. DE) (No usage of acaricides to spare phytoseiids)
(6)	Reduction of use to necessary levels	Is mentioned in **MS** (e.g. DE) **(application on partial areas or partial zones of the foliage)**
(7)	Application of anti-resistance strategies	Is mentioned in **IOBC**
(8)	(8.1) Records about pest monitoring and plant protection measures	Is mentioned in **IOBC** Is mentioned in **MS** (e.g. DE)
	(8.2) Check of success and recording	Check of success is mentioned in **MS** (e.g. DE)
(9)	Additional elements to the legally bound requirements	Analysis and preparation of the soil prior to planting, soil management and nutrition **IOBC**
(10)	Criteria ensuring the implementation of a holistic IPM approach by professional users	The professional user is obliged to procure required information on IPM and to participate in annual continuous training schemes. As a minimum request, farmers have to participate in advanced training once a year, use an official forecasting programme and have subscribed to a professional journal. The compliance of these requests has to be attested

Based on the evaluated material it could be shown that the main part related to crop specific guidelines for viticulture consists of concretisation of the general IPM principles. As all of the investigated guidelines are included in the framework of integrated production, additional elements could be identified such as elements to be considered in relation to nutritional aspects. Further elements of soil management have been addressed in addition to the one mentioned within general principle 1.

Table 14 Evaluation of crop specific guidelines related to apples

No.	IPM principle	Elements mentioned in crop specific IPM guidelines IOBC and Member States
		Apple
(1)	Measures for prevention and/or suppression of harmful organisms	
	(1.1) crop rotation	Is mentioned in **PAN Europe**
	(1.2) adequate cultivation techniques	Is mentioned in **IOBC, PAN Europe** Is mentioned in **MS** (e.g. DE, NL) (Planting systems may be single or multi-rows, but single rows are preferred, small trees of uniform size ensure the implementation of safer, more efficient spraying practices, alleyways must be of grass and/or herbs, synthetic plant growth regulators are prohibited, young fruitlets must be thinned shortly after blossom to the optimum number to ensure adequate fruit size and quality)
	(1.3) appropriate seed and planting material	Is mentioned in **IOBC, PAN Europe** Is mentioned in **MS** (e.g. DE, NL) (Golden Delicious must not be planted on sites prone to russeting, nor Jonagold on sites unfavourable for fruit colouring and firmness, certified virus-free planting material)
	(1.4) balanced fertilisation, liming, irrigation/drainage if feasible	Is mentioned in **IOBC** Is mentioned in **MS** (e.g. DE)
	(1.5) hygiene measures	
	(1.6) protection/enhancement of beneficial organisms	Is mentioned in **IOBC, PAN Europe** Is mentioned in **MS** (e.g. DE) (Where Phytoseiid predators are absent from orchards, they must be introduced where the pest situation (e.g. spider mites, thrips) requires regular control measures)
(2)	Tools for monitoring	Is mentioned in **IOBC, PAN Europe** Is mentioned in **MS** (e.g. DE, NL)
(3)	Threshold values as basis for decision-making	Is mentioned in **IOBC** Is mentioned in **MS** (e.g. DE, NL)
(4)	Non-chemical methods to be preferred	Is mentioned in **IOBC, PAN Europe** Is mentioned in **MS** (e.g. DE, NL) (biological, genetic or biotechnical control method (e.g. granulovirus for codling moth, Bacillus thuringiensis for noctuid caterpillars in summer, or pheromone mating disruption for codling moth and/or tortricids)
(5)	Target-specificity and minimization of side effects	Is mentioned in **IOBC, PAN Europe** Is mentioned in **MS** (e.g. DE)
(6)	Reduction of use to necessary levels	Is mentioned in **PAN Europe**
(7)	Application of anti-resistance strategies	Is mentioned in **IOBC, PAN Europe**
(8)	(8.1) Records about pest monitoring and plant protection measures	Is mentioned in **IOBC** Is mentioned in **MS** (e.g. DE)
	(8.2) Check of success and recording	
(9)	Additional elements to the legally bound requirements	soil management and nutrition, fruit storage management IOBC, PAN Europe
(10)	Criteria ensuring the implementation of a holistic	The professional user is obliged to procure required information on IPM and to participate in annual continuous training schemes. As a minimum request, farmers have to participate

No.	IPM principle	Elements mentioned in crop specific IPM guidelines IOBC and Member States
		Apple
	IPM approach by professional users	in advanced training once a year, use an official forecasting programme and have subscribed to a professional journal. The compliance of these requests has to be attested

Based on the evaluated material, it could be shown that the main part related to crop specific guidelines for apples consists of concretisation of the general IPM principles. Only two elements could not been found in national guidelines, namely: (i) the element “hygiene measures” which means that machinery and equipment has to be cleaned in order to avoid any spreading of harmful organism, and (ii) the element of ‘checking the success’ based on the records. As all of the investigated guidelines are included in the framework of integrated production, additional elements could be identified, such as fruit storage management as well as elements to be considered in relation to nutritional aspects. Further elements of soil management have been addressed in addition to the one mentioned within general principle 1.

Even if the evaluation has been carried out within the scope of this project only for selected crops, a similar picture can be obtained for many other crops. The main elements addressed in crop specific guidelines are related to the general IPM principles. IPM focuses on pest management – however, crop specific guidelines are most often integrated into the scheme of Integrated Production. Therefore, additional elements are addressed which go further than just pest management, such as conditions for harvest and storage or considerations relating to nutritional value. Such elements are useful in a broader concept, however, they are not a priori necessary in an integrated pest management system.

Two elements of the eight principles – namely, the checking of success based on the records as well as the application of specific hygiene measures – could not been identified in all crop specific guidelines. However, these two elements seem to be necessary and they are also easy to implement. Therefore, it is expected that these two elements will be considered in crop specific guidelines in the future, following the legal approach of the Framework Directive.

To sum up, it could be shown that the major elements of crop specific guidelines are based on the eight general principles addressed in the Framework Directive. A concretisation relating to the various crops is necessary. Only in cases where the crop specific guideline is included in the framework of Integrated Production – of which IPM is just one part – are additional elements considered.

7.3 Link to general IPM elements

It is important to be very clear about the boundaries between general IPM principles and crop specific ones. As stated in the Framework Directive, only the eight general IPM principles are proposed to become mandatory while crop specific IPM principles shall be voluntary. In this regard “crop-specific” means in particular, aspects that differ from crop to crop and that have to be considered just for specific crops.

At first sight, this differentiation seems clear but consider the fact that some of the general IPM principles are applied differently when they are concretised for each crop. Therefore, it is necessary to consider two different crop specific IPM principles – on the one hand, crop specific concretisation of the general principles, and on the other, additional and independent principles, which are not yet addressed within the general principles but are added for specific crops. Examples for the latter are most often included in cases where crop specific guidelines are included in the framework of Integrated Production. In such cases, additional elements for example those related to specific treatments to the harvest or nutritional supply are mentioned. However, no additional IPM specific elements could be identified.

A concretisation of the general principles is necessary in all cases in order to assure effectiveness. This means for example that a specific crop rotation scheme has to be used for specific crops or that specific non-chemical methods have to be used for specific pests and crops. Such an appropriate concretisation is a pre-requisite for the success of the IPM system. The text of the agreement reached between the EP and the Council considers this issue by using expressions like “adequate techniques” or “as specific as possible” or “suitable”. Therewith, it becomes clear that not just the application of a principle shall be mandatory but that the adequate – this means the scientifically accepted – application of it is requested to be mandatory. It should be considered as well, that such concretisations could change over time. In this regard, it is essential to provide professional users with guidance in order to enable them to apply the correct measures.

Against the background, the question of which principles shall be mandatory and which shall be voluntary is still not answered. It is clear that the general principles are mandatory and that therefore professional users are obliged to take them into account following the information provided by MS authorities. However, the ways in which the general principles are implemented in practise differs from MS to MS, depending on various parameters that even change over time. More or less crop specific elements add additional requirements to the general principles. In some cases there might be several possibilities for such additional requirements to consider a general principle in practise. For example, if several target specific pesticides might be available which all have similar hazardous properties. In such a case, it is not mandatory to apply one specific pesticide, but the professional user has to comply with the general principle “use the most target specific and less hazardous pesticide”. If he/she uses a pesticide from a recommended list he/she will comply with the general principle and is therefore compliant with the requirements in the Framework Directive. As mentioned, such requirements can change over time. Taking this differentiation into account, this would mean that the recommendations have to be changed but not the legislation itself. In such a way it can be assured that updated scientific knowledge can be used immediately by professional users without facing the necessity to change the complete legislation.

The following figure shows this approach schematically:
The eight general principles are the basis and are mandatory. For each of the eight principles, additional requirements will arise when they are translated into practise. This means crop specific specifications will be necessary. Some of these additional requirements are closely linked to the fulfilment of the eight general principles. However, there might be several possibilities available or there will even be changes over time in order to comply with the general principles. Therefore, these additional requirements are necessary but they are not mandatory.

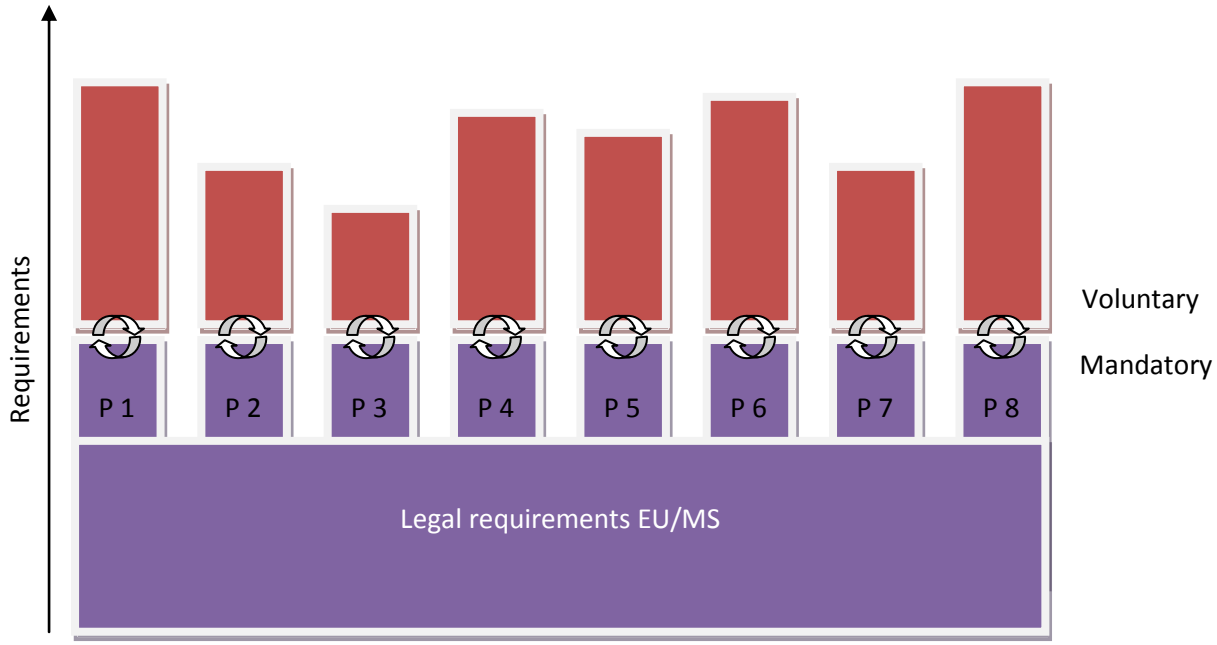


Figure 3 Relation between general and crop specific IPM principles (P= principle)

In the following table it is shown what a MS has to do in relation to the general principles and what is necessary on a crop specific level. It becomes obvious that considerable, very specific information needs to be available when the general principles are applied in practise. This is in line with the aforementioned additional requirements necessary for a crop specific application of the general requirements. The example focuses on controlling Colorado potato beetle (Leptinotarsa decemlineata), CPB.

Table 15 General and related crop specific requirements

(1) Measures for prevention and/or suppression of harmful organisms			
General IPM -obligatory-		**Actions necessary to bridge the gap between general and crop specific**	**Crop specific IPM -voluntary-**
1.1 Crop rotation	MS obliges professional user to consider appropriate crop rotation schemes for all his crops.	- MS have to elaborate information on appropriate crop rotation based on scientific knowledge or have to involve advisory services. - MS have to inform professional users on where to obtain information on appropriate crop rotation for main crops	- planting potatoes in the same field year after year is unfavourable. - the infestation level caused by CPB considerably increases when the distances between rotated fields and locations where potatoes were planted the previous season are near. - crop rotation can delay CPB population build up, but will not prevent an infestation unless fields are fairly well isolated. - Non host crop rotation is to be preferred. - avoid solanaceous crops as rotation choices. - non-host crop rotations are ideal, a rotation of less duration is still

				beneficial, but to a lesser degree. - possible example for crop rotation: potato, winter wheat, winter rye.
1.2 Cultivation techniques	MS obliges professional user to consider appropriate cultivation techniques for all his crops.	- MS have to elaborate information on appropriate cultivation techniques based on scientific knowledge or have to involve advisory services. - MS have to inform professional users on where to obtain information on appropriate cultivation techniques.		- information about the current practicable cultivation techniques that helps to optimise crop growing resulting in plants holding a high tolerance to CPB feeding.
1.3 Resistant varieties	MS obliges professional user to consider appropriate resistance varieties for all his crops.	- MS have to elaborate information on appropriate resistant varieties based on scientific knowledge or have to involve advisory services. - MS have to inform professional users on where to obtain information on appropriate resistant varieties.		- no varieties known in Europe to be resistant to CPB. - information on tolerant varieties by MS authorities. - information about the different levels of susceptibility of approved potato varieties and their suitability for different regional conditions. - as many pests can be transmitted in infected seed tubers, including bacterial ring rot, blackleg, common scab, late blight, potato viruses, powdery scab, rhizoctonia, root knot nematodes, silver scurf, and wilt diseases, certified seed tubers should be used. - specialised advisors on varieties should be consulted in this matter in order to help the farmer to choose a variety that is appropriate for the regional growing conditions and possibly in being more tolerant to CPB
1.4 Fertilisation/irrigation	MS obliges professional user to consider appropriate fertilisation and irrigation for all his crops.	- MS have to elaborate information on appropriate fertilisation and irrigation based on scientific knowledge or have to involve advisory services. - MS have to inform professional users on where to obtain information on appropriate fertilisation and irrigation.		- special information on fertilisation and irrigation measures and techniques appropriate for the regional conditions. - fertilisation, irrigation shall contribute to healthy crops, consequently being more tolerant to CPB infestation.
1.5 Hygiene measures	MS obliges professional user to consider appropriate hygiene measures in his daily work (e.g. disinfection of equipment)	- MS have to elaborate information on appropriate hygiene measures based on scientific knowledge or have to involve advisory services - MS have to inform professional users on where to obtain information on appropriate hygiene measures.		- hygiene measures are of less importance in CPB control - measures of equipment disinfection have to be considered when soil is infested by yellow and white potato cyst nematode (Globodera rostochiensis and Globodera pallida) or virus diseases.

1.6 Enhancement of beneficial organisms	MS obliges professional user to consider appropriate measures to enhance beneficial organism.	- MS have to elaborate information on appropriate measures to enhance beneficial organism based on scientific knowledge or have to involve advisory services. - MS have to inform professional user on where to obtain information on appropriate measures to enhance beneficial organism.	- information on the potential of beneficial organisms in reducing the infestation level. - general predators such as ladybirds, beetles, lacewings, predatory bugs, spiders, etc. provide some control. - there are also a number of CPB parasites: Doryphorophaga doryphorae and D. coberrans are two species of fly that parasitize CPB larvae; a wasp, Edovum puttleri, parasitizes eggs. - in the first half of the season, soil predators, mostly ground beetles, climb potato plants to feed on second and third-instar larvae of the CPB. - in the second half of the season, ladybirds, beetles and green lacewings are the predominant predators, feeding on eggs and on first and second instars. - mulched plots support greater numbers of predators compared to non-mulched plots, resulting in significantly less defoliation by CPB. - tuber yields were increased by a third. - support the maintenance and building of field margins by providing information and raising awareness of regional environmental programmes including financial promotions if available.

(2) Tools for monitoring			
General IPM -obligatory-		**Actions necessary to bridge the gap between general and crop specific**	**Crop specific IPM -voluntary-**
MS obliges professional user to apply an appropriate monitoring system. **MS obliges professional user to consider information obtained via installed forecasting systems.**		- MS have to elaborate information on appropriate monitoring systems based on scientific knowledge or have to involve advisory services. - MS can implement forecasting systems (e.g. computer-based models). - MS have to set up monitoring activities on MS level (early warning). - MS have to inform professional users on where to obtain information on appropriate monitoring systems and any information related to forecasting and early warning.	- information on recent appropriate tools for monitoring CPB e.g. estimation of foliage loss in % and check of 5 plants at 5 sampling points in a visualized line. - to assist in the detection of insects, a small, white drop cloth can be positioned at the base of the plant; then gently tap the plant to dislodge any insects that may be present. - information that a batch of CPBs eggs are easily mistaken for ladybird eggs. - if appropriate implementation of computer-based forecasting systems can be used in order to obtain the precise date for chemical control measure by plant protection advisory service and farmers.

(3) Threshold values as basis for decision-making			
General IPM		**Actions necessary to bridge the**	**Crop specific IPM**

-obligatory-	gap between general and crop specific	-voluntary-
MS obliges professional user to apply crop and pest specific threshold values before a plant protection measure can be considered.	- MS have to elaborate information threshold values based on scientific knowledge or have to involve advisory services. - MS have to inform professional user on where to obtain information on threshold levels.	- action threshold values for CPB prior to a pesticide application. - action threshold values for CPB control are reached e.g. at 20% foliage loss or 20% of examined plants showing a high infestation which is 1 adult or 1 batch of eggs or 10 larvae.
(4) Non-chemical methods to be preferred		
General IPM -obligatory-	**Actions necessary to bridge the gap between general and crop specific**	**Crop specific IPM -voluntary-**
MS obliges professional user to prefer non chemical methods in case they provide satisfactory pest control.	- MS have to elaborate information on appropriate non chemical measures based on scientific knowledge or have to involve advisory services. - MS have to inform professional user on what satisfactory pest control means exactly. - MS have to inform professional user on where to obtain information on non chemical methods.	- information on recent research findings, field demonstrations, trainings and seminars - existing non-chemical methods to control the CPB are: • NOVODOR FC (B. thuringiensis ssp. tenebrionis), a form of Bt that is not genetically engineered and can be used. • NEEMAZAL-T/S (Neem seed-extracts). • SPRUZIT NEU (pyrethrum/rape oil). • Combined application of NEEMAZAL-T/S and 2 days later NOVODOR FC treatment is the best strategy for controlling defoliation through CPB parasitic nematodes; commercial formulations of Heterorhabditis species are available and have been shown to be more pathogenic, to the CPB than Steinernema species of nematodes, which are also commercially available. • Bt is effective only if ingested by the pest, and then only in the larval stage. Furthermore, Bt sprays are generally effective only against newly hatched CPB larvae. Applications should be made within one to two days. - essential for a successful control of CPB by using the listed bio- pesticides is the ideal timing of the treatment at the maximum occurrence of larvae (L3/L4).
(5) Target-specificity and minimization of side effects		
General IPM -obligatory-	**Actions necessary to bridge the gap between general and crop specific**	**Crop specific IPM -voluntary-**
MS obliges professional user to use the pesticide with the highest target	- MS have to elaborate information on target specificity and side	- comprehensive information on recent research findings regarding side effects

specificity and the least side effects on human health and on the environment.	effects of pesticides based on scientific knowledge or have to involve advisory services. - MS have to inform professional user on where to obtain information on target specificity and side effects.	on non-target organisms as well as on new developments in drift-minimizing spraying equipment. - guidance on the selection of a pesticide which shall be as protective for the environment as possible and meet economical requirements of the farmer as well. - drift of pesticide into other adjacent fields, public or private grounds or survey water while applied, is to be minimised - buffer zones close to the farmer's field and border strips to untreated field margins should be considered - certified and most precise spraying equipment should be used

(6) Reduction of use to necessary levels		
General IPM -obligatory-	**Actions necessary to bridge the gap between general and crop specific**	**Crop specific IPM -voluntary-**
MS obliges professional user to use the pesticide with the highest target specificity and the least side effects on human health and on the environment.	- MS have to elaborate information on target specificity and side effects of pesticides based on scientific knowledge or have to involve advisory services. - MS have to inform professional users on where to obtain information on target specificity and side effects.	- if the population distribution of CPB permits, the farmer should consider the option of partial or border strip-applications to reduce insect numbers - information on timely intervention at larval state L1-L2 which will enhance insecticide effectiveness and provide better pest suppression. Late season pesticide applications to reduce overwintering adults are not cost effective and contribute greatly to increasing insecticide resistance.

(7) Application of anti-resistance strategies		
General IPM -obligatory-	**Actions necessary to bridge the gap between general and crop specific**	**Crop specific IPM -voluntary-**
MS obliges professional user to consider anti resistance strategies.	- MS have to elaborate information on anti resistance strategies based on scientific knowledge or have to involve advisory services. - information on this subject should be obtained from the pesticide producing industry and evaluated independently - MS have to inform professional user on where to obtain information on anti resistance strategies.	- information on threatening pesticide resistance of CPB in region and strategies to prevent further resistance development. - the CPB has been steadily gaining resistance to the insecticides commonly employed to control this insect. To prevent further resistance development alternation between different classes of insecticides for the first and second larvae generation is strongly recommended. - a proper control strategy is based upon the different modes of action of the active substances included. - the reduction of application rate

		should not be permitted. - the major classes of available active substances are: pyrethroids, neonicotinoids and spymericines.
(8) Records, monitoring, documentation and check of success		
General IPM -obligatory-	**Actions necessary to bridge the gap between general and crop specific**	**Crop specific IPM -voluntary-**
MS obliges professional user to document monitoring results and use of plant protection measures. **MS obliges professional user to check the success of a plant protection measure.**	- MS have to elaborate documentation templates to be used. - MS have to elaborate information on how to check the success of a plant protection measure based on scientific knowledge or have to involve advisory services, - MS have to inform professional users on where to obtain information on documentation and checking of the success.	- documentation of all surveyed data on infestation level, occurrence of beneficial organisms, conduced treatments as well as results of pest control measures. - template (digital or print version) to enable the professional user to easily write down all collected data - to check the success of pesticide application, the farmer should monitor the infestation level promptly after the treatment. - this is particularly necessary in the case of threatening CPB resistance towards certain active substances or when biological control measures are applied, which often allow just a moderate control.

7.4 Criteria for evaluating crop specific principles

Within this chapter, the question should be discussed of how crop specific guidelines can be compared and evaluated by using specific performance indicators. As requested by Commission Services the SMART approach is used for this purpose. This means in particular, criteria are identified and checked against the following characteristics: specific, measureable, achievable, realistic and timely. Only if criteria fulfil the majority of the characteristics can they be regarded as appropriate.

Valuable input for this chapter could be found in the acceptance schemes of various organisations. One of the most important acceptance schemes is published by the IOBC and helps authorities and other organisations to check what has to be fulfilled, in order to comply with IOBC standards for Integrated Production. The document can be downloaded at http://www.iobc.ch/iobcadmisscrit.pdf. It is compiled in the form of a questionnaire and addresses the following two aspects:

- Conformity with overall concept and code of conduct
- Conformity with technical guidelines I/II

Although this questionnaire addresses mostly very general questions related to the IOBC system, some elements might be of interest for general performance indicators on crop specific elements. Such aspects are for example

- Are training courses addressed?
- Are measures requested to enhance biodiversity?

- Are control measures divided into specific categories – green for safe and yellow for critical?
- Is preference given to ecologically safer control methods?
- etc.

All these questions have to be answered simply with yes/no. For an in-depth analysis of the crop specific guidelines, additional questionnaires are used with a different ranking system. For viticulture for example, the following aspects are addressed:

- Definition of Integrated Production
- Professionally trained, environmentally and safety-conscious growers
- Conserving the vineyard environment
- Site, rootstock, cultivars and planting systems
- Soil management and nutrition
- Alleyways and weed-free strips
- Irrigation
- Canopy management
- Integrated plant protection
    - Preventive plant protection measures
    - Risk assessment and monitoring
    - Choice of plant protection measure including choice of pesticides
- Efficient and safe application methods

In each of these categories, several questions are listed, relevant answers are related to a points system. In cases where sufficient points are achieved, the crop specific IP guideline can be accepted as IOBC conforming.

Within the scope of this project, it is not recommendable to define such precise questions, since the currently available legislation provides only a general framework for MS to take into account in their national legislations. Therefore, it seems appropriate at this stage to identify general performance indicators, which are listed in the following table and are assessed according to the SMART approach.

Table 16 Evaluation of performance indicators

Performance indicator	Specific	Measurable	Achievable	Realistic	Timely
General prevention and support measures related to IPM addressed, having taking into account available scientific knowledge	✓	✓	✓	✓	✓
Application of monitoring system addressed, taking into account available scientific knowledge	✓	✓	✓	✓	✓
Application of decision making systems addressed with reference to information on threshold levels, taking into account available scientific knowledge	✓	✓	✓	✓	✓
Preference to non-chemical methods addressed	✓	✓	✓	✓	✓
Non-chemical methods described, having taken into account available scientific knowledge	✓	✓	✓	✓	✓
Recommendations on which pesticide should	✓	✓	✓	✓	✓

be used is available, having taken into account available scientific knowledge					
Recommendations on the necessary doses, having taken into account available scientific knowledge	✓	✓	✓	✓	✓
In cases where resistance risk is known, mentioning of anti resistance strategies having taken into account available scientific knowledge	✓	✓	✓	✓	✓
Need for documentation addressed as well as the check of success	✓	✓	✓	✓	✓

Again it should be mentioned that the principles are related to Integrated Pest Management – which is only one element in an Integrated Production scheme. Therefore, the identified performance indicators focus on the aspect that all eight general principles are addressed appropriately, having taken into consideration the available scientific knowledge. All these indicators fulfil the SMART criteria.

7.5 Monitoring of implementation

This issue is addressed particularly in the draft guidance document relating to the general IPM principles. For each of the principles an example of a decision tree is shown which makes it very clear why it is important that MS provide specific tools before professional user can implement the principles. It is clearly stated that for different crops, different information has to be provided. Even if crop specific guidelines are expected to be voluntary they are closely linked to the general IPM principles. Only if professional users apply the crop specific guidelines, compliance with the general IPM principles is ensured. Therefore, the monitoring activities are also closely linked.

8 Guidance document

The draft guidance document is prepared as a supplement to this report and is available in a separate document. It will be the basis for EC guidelines addressed to MS authorities dealing with the implementation of the Framework Directive.

Apart from a general introduction, it is explained what IPM means and what the differences are in relation to GPPP.

The main focus is given to the legal requirements relating to IPM. In this context, each of the eight principles is explained in detail and it is shown which tools MS authorities have to establish before professional users are in a position to apply the general principles adequately. Also, communication to professional users and compliance monitoring is addressed.

A separate chapter explains the differences of general to crop specific IPM principles.

Based on experiences, it was agreed not to exceed a page limit of about 30 pages for the main part of the guidance document.

In annexes, examples are provided, communication examples to professional users are given and recommendations for crop specific guidelines are included.

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10 Annex A – Questionnaire

	Catalogue of questions / aspects of interest relating to a European Commission project on the development of guidance for establishing Integrated Pest Management (IPM) principles	
	In order to facilitate an easy and efficient completion of the questionnaire we have used the following colours:	
	Blue: Key question / Key aspect of interest	
	Light blue: Aspects of interest related to the key question	
	Yellow: Explanations	
	Red: Fields for answers to questions/information needs	
0.0	Name of institution	
	Country	
	City	
	Postal code	
	Street	
	Competent contact person	
	e-mail	
	tel.	
	Remarks	
1.0	Does your country have national regulations, measures or guidelines on Integrated Pest Management?	
1.1	What is the legal status?	
1.2	Since when are those measures etc. in use?	
1.3	What are the key elements?	
1.4	Fields of implementation?	
1.5	How would you estimate the acceptance of professional users?	
1.6	Can you provide examples of successful or widely adopted IPM measures? If yes, please provide details	
1.7	Please provide information on experiences or lessons learned in your country?	
1.8	Are there specific deficits or incompleteness (in *implementation* and/or definition) as regard your national approach?	
1.9	If your country does not have regulation or measure etc. on IPM implemented – are regulations concerning the "Good Plant Production Practice" implemented?	
	In the Common Position of the EP and the Council (eight general principles for IPM are currently identified related to the following topics: (1) Measures for prevention and/or suppression of harmful organisms (2) Tools for monitoring (3) Threshold values as a basis for decision-making (4) Non-chemical methods to be preferred (5) Target-specificity and minimization of side effects (6) Reduction of use to necessary levels (7) Application of anti-resistance strategies (8) Records, monitoring, documentation and check of success For a download of the Common Position please use the following link: http://register.consilium.europa.eu/pdf/en/08/st06/st06124.en08.pdf In the following, we would like to ask you for feedback on specific aspects relating to each of these eight principles.	

2.0	**Principle 1:** The prevention and/or suppression of harmful organisms should be achieved or supported among other options especially by: – crop rotation, – use of adequate cultivation techniques (e.g. stale seedbed technique, sowing dates and densities, under-sowing, conservation tillage, pruning and direct sowing), – use, where appropriate, of resistant/tolerant cultivars and standard/certified seed and planting material, – use of balanced fertilisation, liming and irrigation/drainage practices, – preventing the spreading of harmful organisms by hygiene measures (e.g. by regular cleansing of machinery and equipment), – protection and enhancement of important beneficial organisms, e.g. by adequate plant protection measures or the utilisation of ecological infrastructures inside and outside production sites.
2.1	Is the indicated principle feasible (in the sense of efficient and reliable)?
2.2	Does the principle contribute to a reduced reliance on pesticides?
2.3	Is the approach based on the principle economically justifiable? – Is there a possibility that the principles reduce the profit of farmers? – If yes, should the principle be supported by incentives?
2.4	Do conditions/prerequisites with regard to training of farmers and advisory services exist to support the implementation of the principle?
2.5	Can the implementation of the principle be monitored?
2.6	Should the principle be slightly modified to ensure a better implementation and efficient control considering all questions above?
3.0	**Principle 2:** Harmful organisms must be monitored by adequate methods and tools, where available. Such adequate tools should include observations in the field as well as scientifically sound warning, forecasting and early diagnosis systems, where feasible, as well as the use of advice from professionally qualified advisors.
3.1	Is the indicated principle feasible (in the sense of efficient and reliable)?
3.2	Does the principle contribute to a reduced reliance on pesticides?
3.3	Is the approach based on the principle economically justifiable? – Is there a possibility that the principles reduce the profit of farmers? – If yes, should the principle be supported by incentives?
3.4	Do conditions/prerequisites with regard to the training of farmers and advisory services exist in your country to support the implementation of the principle?
3.5	Is there sufficient information available for professional users as regards monitoring tools?
3.6	Can the implementation of the principle be monitored?
3.7	Should the principle be slightly modified to ensure a better implementation and efficient control considering all questions above?
4.0	**Principle 3:** Based on the results of the monitoring, the professional user has to decide whether and when to apply plant protection measures. Robust and scientifically sound threshold values are essential components for decision making. For harmful organisms, threshold levels defined for the region, specific areas, crops and particular climatic conditions must be taken into account before treatments, where feasible.
4.1	Is the indicated principle feasible (in the sense of efficient and reliable)?
4.2	Does the principle contribute to a reduced reliance on pesticides?
4.3	Is the approach based on the principle economically justifiable? – Is there a possibility that the principles reduce the profit of farmers? – If yes, should the principle be supported by incentives?
4.4	Do conditions/prerequisites with regard to training of farmers and advisory services exist in your country to support the implementation of the principle?
4.5	Is there sufficient information available for professional users as regards decision support systems as well as threshold levels and classification and properties of pesticides?
4.6	Can the implementation of the principle be monitored?

4.7	Should the principle be slightly modified to ensure a better implementation and efficient control considering all questions above?
5.0	**Principle 4:** Sustainable biological, physical and other non-chemical methods must be preferred to chemical methods if they provide satisfactory pest control.
5.1	Is the indicated principle feasible (in the sense of efficient and reliable)?
5.2	Does the principle contribute to a reduced reliance on pesticides?
5.3	Is the approach based on the principle economically justifiable? – Is there a possibility that the principles reduce the profit of farmers? – If yes, should the principle be supported by incentives?
5.4	How would you estimate the acceptance of suitable biological, physical and other non-chemical methods?
5.5	Do conditions/prerequisites with regard to training of farmers and advisory services exist in your country to support the implementation of the principle?
5.6	Is there sufficient information available for professional users as regards biological and other non-chemical methods?
5.7	Can the implementation of the principle be monitored?
5.8	Should the principle be slightly modified to ensure a better implementation and efficient control considering all questions above?
6.0	**Principle 5:** The pesticides applied shall be as specific as possible for the target and shall have the least side effects on human health, non-target organisms and on the environment.
6.1	Is the indicated principle feasible (in the sense of efficient and reliable)?
6.2	Does the principle contribute to a reduced reliance on pesticides?
6.3	Is the approach based on the principle economically justifiable? – Is there a possibility that the principles reduce the profit of farmers? – If yes, should the principle be supported by incentives?
6.4	Do conditions/prerequisites with regard to training of farmers and advisory services exist in your country to support the implementation of the principle?
6.5	Is there sufficient information available for professional users as regards classification and properties of pesticides?
6.6	Can the implementation of the principle be monitored?
6.7	Should the principle be slightly modified to ensure a better implementation and efficient control considering all questions above?
7.0	**Principle 6:** The professional user should keep the use of pesticides and other forms of intervention to levels that are necessary, e.g. by reduced doses, reduced application frequency or partial applications, considering that the level of risk in vegetation is acceptable and they do not increase the risk for development of resistance in populations of harmful organisms.
7.1	Is the indicated principle feasible (in the sense of efficient and reliable)?
7.2	Does the principle contribute to a reduced reliance on pesticides?
7.3	Is the approach based on the principle economically justifiable? – Is there a possibility that the principles reduce the profit of farmers? – If yes, should the principle be supported by incentives?
7.4	Do conditions/prerequisites with regard to training of farmers and advisory services exist in your country to support the implementation of the principle?
7.5	Is there sufficient information available for professional users as regards necessary levels and their effects?
7.6	Can the implementation of the principle be monitored?
7.7	Should the principle be slightly modified to ensure a better implementation and efficient control considering all questions above?
8.0	**Principle 7:** Where the risk of resistance against a plant protection measure is known and where the level of harmful organisms requires repeated application of pesticides to the crops, available anti-resistance strategies should be applied to maintain the effectiveness of the products. This may include the use of multiple pesticides with different modes of action.
8.1	Is the indicated principle feasible (in the sense of efficient and reliable)?

8.2	Does the principle contribute to a reduced reliance on pesticides?
8.3	Is the approach based on the principle economically justifiable? – Is there a possibility that the principles reduce the profit of farmers? – If yes, should the principle be supported by incentives?
8.4	Do conditions/prerequisites with regard to training of farmers and advisory services exist in your country to support the implementation of the principle?
8.5	Is there enough awareness and information about pesticide resistance and strategies to solve them available?
8.6	Can the implementation of the principle be monitored?
8.7	Should the principle be slightly modified to ensure a better implementation and efficient control considering all questions above?
9.0	**Principle 8:** Based on the records on the use of pesticides and on the monitoring of harmful organisms the professional user should check the success of the applied plant protection measures.
9.1	Is the indicated principle feasible (in the sense of efficient and reliable)?
9.2	Does the principle contribute to a reduced reliance on pesticides?
9.3	Is the approach based on the principle economically justifiable? – Is there a possibility that the principles reduce the profit of farmers? – If yes, should the principle be supported by incentives?
9.4	Do conditions/prerequisites with regard to training of farmers and advisory services exist in your country to support the implementation of the principle?
9.7	Can the implementation of the principle be monitored?
9.8	Based on your national experience, which tool(s) would you propose to measure, based on the records, the success of the applied plant protection methods?
9.9	Should the principle be slightly modified to ensure a better implementation and efficient control considering all questions above?
10.0	Additional question:
10.1	Do you regard the description of the general principles of Integrated Pest Management as - too abstract or general - sufficiently specific - too detailed or particular

11 Annex B – Contents of draft legislation

12 July 2006

(14) The application of general standards of Integrated Pest Management by all farmers would result in a better targeted use of all available pest control measures, including pesticides. Therefore, it contributes to a further reduction of the risks to human health and to the environment. Member States should promote low pesticide-input farming, in particular Integrated Pest Management, and establish necessary conditions for implementation of Integrated Pest Management techniques. Additionally, Member States should encourage the use of crop-specific standards of Integrated Pest Management.

Article 13
Integrated Pest Management

1. Member States shall take all necessary measures to promote low pesticide-input farming, including integrated pest management, and to ensure that professional users of pesticides shift towards a more environmentally-friendly use of all available crop protection measures, giving priority to low-risk alternatives wherever possible, and otherwise to the products with minimum impact on human health and the environment among the ones available for the same pest problem.

2. Member States shall establish or support the establishment of all necessary conditions for implementation of integrated pest management.

3. In particular, Member States shall ensure that farmers have at their disposal systems, including training in accordance with Article 5, and tools for pest monitoring and decision making, as well as advisory services on integrated pest management.

4. By 30 June 2013, Member States will report to the Commission on the implementation of paragraphs 2 and 3, and in particular, whether the necessary conditions for implementation of integrated pest management are in place.

5. Member States shall ensure that, at the latest by 1 January 2014, all professional users of pesticides implement the general standards for Integrated Pest Management.

6. Member States shall establish all necessary incentives to encourage farmers to implement crop-specific standards of Integrated Pest Management.

7. The general standards for Integrated Pest Management referred to in paragraph 5 shall be developed in accordance with the procedure laid down in Article 52 of Regulation (EC) No […].

8. The crop-specific standards for Integrated Pest Management referred to in paragraph 6 may be developed in accordance with the procedure laid down in Article 6(3) of Directive 98/34/EC.

23 October 2007

(15) The application of general **and crop-specific** standards of Integrated Pest Management by all farmers would result in a better targeted use of all available pest control measures, including pesticides. Therefore, it would contribute to a further reduction of the risks to human health and the environment **and the reduction of pesticide use**. Member States should promote low pesticide-input farming, in particular **general and crop-specific standards of** Integrated Pest Management **and the increase of land under organic farming**, and establish necessary conditions for implementation of integrated pest management techniques. Additionally, Member States should **implement mandatory** crop-specific standards of Integrated Pest Management. **Member States should use economic instruments for the promotion of Integrated Pest Management to provide advice and training for farmers, and to reduce the risks of pesticide use. A levy on pesticide products should be considered as one of the measures to finance the implementation of general and crop-specific methods and practices of Integrated Pest Management and the increase of land under organic farming**.

Article 14
Integrated Pest Management

1. Member States shall take all necessary measures**, including the use of economic instruments,** to promote low pesticide-input farming, including integrated pest management **with the prioritisation of non-chemical methods of plant protection and pest and crop management**, and to ensure that professional users of pesticides **switch as quickly as possible to** a more environmentally-friendly use of all available crop protection measures, giving priority to low-risk alternatives wherever possible, and otherwise to the products with minimum impact on human health and the environment among the ones available for the same pest problem.

2. Member States shall encourage the use of low-risk plant protection products as defined in Article [50(1)] of Regulation (EC) No … [concerning the placing of plant protection products on the market].

3. Member States shall establish or support the establishment of all necessary conditions for implementation of integrated pest management **and non-chemical methods of plant protection and pest and crop management, and shall draw up descriptions of the best integrated crop protection practices, assigning priority to non-chemical crop protection**.

4. In particular, Member States shall ensure that farmers have at their disposal systems, including training in accordance with Article 5, and tools for pest monitoring and decision making, as well as advisory services on **non-chemical methods of plant protection and** pest **and crop** management.

5. By 30 June **2011**, Member States will report to the Commission on the implementation of paragraphs 3 and 4, and in particular, whether the necessary conditions for implementation of integrated pest management are in place.

6. Minimum requirements for the development of general standards of Integrated Pest Management are defined in Annex V.

7. Member States shall ensure that, at the latest by 1 January 2014, all professional users of pesticides implement the general standards for Integrated Pest Management.

8. Amendments to Annex V shall be adopted using the regulatory procedure with scrutiny referred to in Article 20(2).

9. Member States shall establish **appropriate** incentives**, training and financial measures** to **assist users** to implement crop-specific **or sector-specific guidelines for** Integrated Pest Management **which take account of the general criteria described in Annex V. In their national action plans pursuant to Article 4, Member States shall refer to the appropriate guidelines**.

10. The general standards for Integrated Pest Management ▌ shall be developed in accordance with the procedure referred to in Article [58] of Regulation (EC) No …[concerning the placing of plant protection products on the market], **with public participation of interested stakeholders**.

11. The crop-specific standards for Integrated Pest Management referred to in paragraph 9 may be developed in accordance with the procedure laid down in Article 6(3) of Directive 98/34/EC of the European Parliament and of the Council of 22 June 1998 laying down a procedure for the provision of information in the field of technical standards and regulations and of rules on Information Society services[14].

Annex V

Elements for general and crop-specific Integrated Pest Management criteria Integrated Pest Management as a minimum includes the following general criteria:

(a) The prevention and/or suppression of harmful organisms should be achieved or supported among other options especially by:

- **use of optimum crop rotation achieving a balanced population of soil organisms and maintenance of a healthy soil, in order to prevent outbreak of soil-bound pests and to eliminate use of soil fumigants and other soil chemicals;**
- **building a soil structure that can support a healthy crop, for instance by stimulating the percentage of organic matter, limiting depth of ploughing, preventing erosion, applying optimum crop sequence; use of adequate cultivation techniques, e.g. stale seedbed technique, sowing dates and densities, under-sowing, optimal plant distance, conservation tillage, hygiene measures, pruning;**
- **use of the best available resistant/tolerant cultivars and approved/certified seed and planting material;**
- **use of balanced fertilisation based on information concerning nutrients already present in the soil and the soil structure, liming and irrigation/drainage practices to reduce susceptibility to pests and diseases. Use of groundwater for irrigation should be avoided;**
- **preventing the spread of harmful organisms through machinery and equipment;**
- **protection and enhancement of important beneficial organisms, for instance by using ecological infrastructures inside and outside production sites, setting aside a minimum percentage of total field area, planting of plant species to attract natural enemies of pests.**

(b) Harmful organisms must be monitored with appropriate methods and tools. Such tools should include scientifically sound warning, forecasting and early diagnosis systems, where feasible, as well as professionally qualified advisers, such as those provided for by state and private extension services.

[14] *OJ L 204, 21.7.1998, p. 37. Directive as last amended by Council Directive 2006/96/EC (OJ L 363, 20.12.2006, p.81).*

(c) **Based on the results of the monitoring the professional user has to decide whether and when to apply plant protection measures. Robust and scientifically sound threshold values are essential components for decision making. For harmful organisms threshold levels defined for the region must be taken into account before treatment, where feasible.**

(d) **Biological, physical, mechanical and other non-chemical methods must be preferred to chemical methods whenever feasible. Against weeds, mechanical weeding or other non-chemical methods such as use of heat should be preferred. Exceptions should be allowed only in case of bad weather conditions during a prolonged period of time that makes mechanical weeding unfeasible.**

(e) **The pesticide applied shall be as specific as possible for the target and shall have the least side effects on human health and the environment, such as plant and tree extracts, mineral substances for prevention of fungal growth.**

(f) **The professional user should keep the use of pesticides and other forms of intervention to levels that are necessary, e.g. by reduced dosage, reduced application frequency or partial applications, bearing in mind that the level of risk in vegetation must remain acceptable and that they may not increase the risk for development of resistance in populations of harmful organisms.**

(g) **Where the risk of resistance against a plant protection measure is known and where the level of harmful organisms requires repeated application of pesticides to crops, available anti-resistance strategies should be applied to maintain the effectiveness of the products. This may include the use of multiple pesticides with different modes of action.**

(h) **Professional users should keep records of all pesticides used, by field. Based on the records on the use pesticides and on the monitoring of harmful organisms the professional user should check the success of the applied plant protection measures.**

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